वीर बहादुर सिंह पूर्वाञ्चल विश्वविद्यालय,जौनपुर–222003

(उत्तर प्रदेश राज्य विश्वविद्यालय अधिनियम 1973 द्वारा स्थापित)

(NAAC A^{+} accredited University)



पत्रांक : 1358 / प्रवेश सेल / 2026

दिनांक : 12 जून .2026

पी.यू.कैट–2026

प्रवेश परीक्षा हेतु विषय सामग्री (Syllabus) के सम्बन्ध में

विश्वविद्यालय परिसर में संचालित विषयों में सत्र 2026–27 में प्रवेश हेतु प्रवेश परीक्षा–2026 हेतु M.Sc (Chemistry) एवं M.Sc (Zoology) की विषय सामग्री (Syllabus) इस पत्र के साथ संलग्न है। अन्य विषयों जिसमें प्रवेश परीक्षा होनी है, उन विषयों का Syllabus पूर्व से ही विश्वविद्यालय की वेबसाईट पर उपलब्ध है।

उक्त से सम्बन्धित अन्य महत्वपूर्ण तिथियों, आवेदन शुल्क संचालित विषयों का विवरण एवं उपलब्ध सीटों की **विस्तृत जानकारी विश्वविद्यालय की वेबसाईट www.vbspu.ac.in पर उपलब्ध है।**

12/06/26

समन्वयक

पी.यू.कैट–2026

प्रतिलिपिः निम्नलिखित को सूचनार्थ एवं आवश्यक कार्यवाही हेतु प्रेषित–

1. अध्यक्ष, पी.यू.कैट–2026 विश्वविद्यालय परिसर।
2. संकायाध्यक्ष / विभागाध्यक्ष / प्रभारी, विश्वविद्यालय परिसर संचालित पाठ्यक्रम।
3. निजी सचिव–कुलपति, कुलपति जी के संज्ञानार्थ।
4. वरिष्ठ आशुलिपक–वित्त अधिकारी, वित्त अधिकारी जी को सूचनार्थ।
5. प्रभारी–विश्वविद्यालय वेबसाईट, को इस आशय से प्रेषित कि उक्त सूचना को विश्वविद्यालय की वेबसाईट पर प्रदर्शित कराने का कष्ट करें।

समन्वयक

पी.यू.कैट–2026

SYLLABUS FOR PUCAT-2026

Master of Science (M. Sc.) Chemistry
For Admission to: Master of Science (M. Sc.) Chemistry

Question Paper Pattern	**Time: 02 Hours**	**Chemistry**
	Total: 100 MCQs	**100**

Syllabus

Chemistry

Molecular polarity and Weak Chemical Forces :

Resonance and resonance energy, formal charge, Van der Waals forces, ion-dipole forces, dipole-dipole interactions, induced dipole interaction, dipole moment and molecular Structure (Diatomic and polyatomic molecules), Percentage ionic character from dipole moment, polarizing power and polarizability. Fajan's rules and consequences of polarization. Hydrogen bonding, van der Waals forces, ion-dipole forces, dipole-dipole interactions, induced dipole interaction.

Simple Bonding theories of Molecules

Atomic orbitals, Aufbau principle, multiple bonding (σ and π bond approach) and bond lengths, the valence bond theory (VBT), Concept of hybridization, hybrid orbitals and molecular geometry, Bent's rule, Valence shell electron pair repulsion theory (VSEPR), shapes of the following simple molecules and ions containing lone pairs and bond pairs of electrons: H_2O, NH_3, PCl_5, SF_6, SF_4, ClF_3, I_3^-, and H_3O^+ . Molecular orbital theory (MOT). Molecular orbital diagrams bond orders of homonuclear and heteronuclear diatomic molecules and ions (N_2, O_2, C_2, B_2, F_2, CO, NO, and their ions).

Periodic properties of Atoms (with reference to s & p-block):

Brief discussion, factors affecting and variation trends of following properties in groups and periods. Effective nuclear charge, shielding or screening effect, Slater rules, Atomic and ionic radii, Electronegativity, Pauling's/ Allred Rochow's scales, Ionization enthalpy, Electron gain enthalpy.

Recapitulation of basics of Organic Chemistry: Hybridization, bond lengths and bond angles, bond energy, localized and delocalized chemical bonding, Van der Waals interactions, inclusion compounds, Clatherates, Charge transfer complexes, hyperconjugation, Dipole moment; Electronic Displacements: Inductive, electromeric, resonance mesomeric effects and their applications

Mechanism of Organic Reactions: Curved arrow notation, drawing electron movements with

allows, half-headed and double-headed arrows, homolytic and heterolytic bond fission, Types of reagents – electrophiles and nucleophiles, Types of organic reactions, Energy considerations. Reactive intermediates – Carbocations, carbanions, free radicals, carbenes, arynes and nitrenes (with examples).

Stereochemistry-Concept of isomerism, Types of isomerism; Optical isomerism – elements of symmetry, molecular chirality, enantiomers, stereogenic center, optical activity, properties of enantiomers, chiral and achiral molecules with two stereogenic centers, disasteromers, threo and erythro diastereomers, meso compounds, resolution of enantionmer, inversion, retention and recemization. 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 isomerism in oximes and alicyclic compounds. Conformational isomerism – conformational analysis of ethane and n-butane; conformations of cyclohexane, axial

Basic Computer system (in brief)-Hardware and Software; Input devices, Storage devices, Output devices, Central Processing Unit (Control Unit and Arithmetic Logic Unit); Number system (Binary, Octal and Hexadecimal Operating System); Computer Codes (BCD and ASCII)**;** Numeric/String constants and variables. Operating Systems (DOS, WINDOWS, and Linux); Introduction of Software languages: Low level and High Level languages (Machine language, Assembly language; QBASIC, FORTRAN) Software Products (Office, chemsketch, scilab, matlab, hyperchem, etc.), internet application.

Mathematical Concepts for Chemistry

Logarithmic relations, curve sketching, linear graphs and calculation of slopes, differentiation of functions like Kx, e^x, X^n , sin x, log x; maxima and minima, partial differentiation and reciprocity relations, Integration of some useful/relevant functions; permutations and combinations, Factorials, Probability.

Chemistry of Carbohydrates: Classification of carbohydrates, reducing and non-reducing sugars, General Properties of Glucose and Fructose, their open chain structure. Epimers, mutarotation and anomers. Mechanism of mutarotation Determination of configuration of Glucose (Fischer's proof). Cyclic structure of glucose. Haworth projections. Cyclic structure of fructose. Inter conversions of sugars (ascending and descending of sugar series, conversion of aldoses to ketoses). Lobry de Bruyn-van Ekenstein rearrangement; stepping–up (Kiliani- Fischer method) and stepping–down (Ruff's &Wohl's methods) of aldoses; end-group- interchange of aldoses Linkage between monosachharides, structure of disacharrides (sucrose, maltose, lactose.)

Chemistry of Proteins: Classification *of amino acids,* zwitter ion structure and Isoelectric point. Overview of primary, secondary, tertiary and quaternary structure of proteins.

Determination of primary structure of peptides, determination of N-terminal amino acid (by DNFB and Edman method) and C–terminal amino acid (by thiohydantoin and with carboxypeptidase enzyme). Synthesis of simple peptides (upto dipeptides) by N-protection & C-activating groups and Merrifield solid phase synthesis. Protein denaturation/ renaturation Mechanism of enzyme action, factors affecting enzyme action, Coenzymes and cofactors and their role in biological reactions).

Chemistry of Nucleic Acids: Constituents of Nucleic acids: Adenine, guanine, thymine and Cytosine (Structure only), Nucleosides and nucleotides **(nomenclature**), Synthesis of nucleic acids, Structure of polynucleotides; Structure of DNA (Watson-Crick model) and RNA (**types of RNA**), Genetic Code, Biological roles of DNA and RNA: Replication, Transcription and Translation.

Introductory Medicinal Chemistry: Drug discovery, design and development; Basic Retrosynthetic approach. Drug action-receptor theory. Structure –activity relationships of drug molecules, binding role of –OH group,-NH_2 group, double bond and aromatic ring. Mechanism of action of the representative drugs of the following classes: analgesics agents, antipyretic agents, anti-inflammatory agents (Aspirin, paracetamol); antibiotics (Chloramphenicol); antibacterial and antifungal agents (Sulphonamides; Sulphanethoxazol, Sulphacetamide); antiviral agents (Acyclovir), Central Nervous System agents (Phenobarbital, Diazepam),Cardiovascular (Glyceryl trinitrate), HIV-AIDS related drugs (AZT- Zidovudine

Solid State:

Definition of space lattice, unit cell. Laws of crystallography – (i) Law of constancy of interfacial angles, (ii) Law of rationality of indices and iii) Symmetry elements in crystals and law of symmetry .X-ray diffraction by crystals. Derivation of Bragg equation. Determination of crystal structure of NaCl, KCl and CsCl (powder method).

Introduction to Polymer:

Monomers, Oligomers, Polymers and their characteristics, Classification of polymers : Natural synthetic, linear, cross linked and network; plastics, elastomers, fibres, Homopolymers and Co-polymers, Bonding in polymers : Primary and secondary bond forces in polymers ; cohesive energy, and decomposition of polymers. Determination of Molecular mass of polymers: Number Average molecular mass (Mn) and Weight average molecular mass (Mw) of polymers and determination by (i) Viscosity (ii) Light scattering method (iii) Gel permeation chromatography (iv) Osmometry and Ultracentrifuging.

Silicones and Phosphazenes:

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

Kinetics and Mechanism of Polymerization:

Polymerization techniques, Mechanism and kinetics of copolymerization,Addition or 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.

Synthetic Dyes:

Colour and constitution (electronic Concept), Classification of dyes,Chemistry and synthesis of Methyl orange, Congo red, Malachite green, crystal violet, phenolphthalein, fluorescein, Alizarin and Indigo.

Chemical Kinetics: Rate of a reaction, molecularity and order of reaction, concentration dependence of rates, mathematical characteristic 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, half-life method and isolation method.

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 (no derivation).

Chemical Equilibrium : Equilibrium constant and free energy, thermodynamic derivation of law of mass action. Le-Chatelier's principle. reaction isotherm and reaction isochore – Clapeyron-Clausius equation and its applications.

Phase Equilibrium : 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 systems. Phase equilibria of two component systems – Solid - liquid equilibria , simple eutectic – Bi-Cd, Pb-Ag systems.

Kinetic theories of gases:

Gaseous State: Postulates of kinetic theory of gases, deviation from ideal behavior, 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 constants, the law of corresponding states, reduced equation of state.

Molecular Velocities: Qualitative discussion of the Maxwell's distribution of molecular velocities, collision number, means free path and collision diameter.

Liquid State: 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, structure of nematic and cholesterol phases.

Liquids in solids (gels): Classification, preparation and properties, inhibition, general application

Coordination Chemistry

Werner's theory of coordination complexes, classification of ligands, ambidentate ligands, chelates, coordination numbers, IUPAC nomenclature of coordination complexes (up to two metal centers), Isomerism in coordination compounds, constitutional and stereo isomerism, geometrical and optical isomerism in square planar and octahedral complexes.

Theories of Coordination Chemistry

I. Metal- ligand bonding in transition metal complexes, limitations of valance bond theory, an elementary idea of crystal field theory, crystal field splitting in octahedral, tetrahedral and square planner complexes, John teller effect, factors affecting the crystal-field parameters.

II. Thermodynamic and kinetic aspects of metal complexes: A brief outline of thermodynamic stability of metal complexes and factors affecting the stability, stability constants of complexes and their determination, substitution reactions of square planar complexes.

Theories of Coordination Chemistry

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II. Thermodynamic and kinetic aspects of metal complexes: A brief outline of thermodynamic stability of metal complexes and factors affecting the stability, stability constants of complexes and their determination, substitution reactions of square planar complexes.

Inorganic Spectroscopy and Magnetism

I)Electronic spectra of Transition Metal Complexes

Types of electronic transitions, selection rules for d-d transitions, spectroscopic ground states, spectrochemical series, Orgel-energy level diagram for d1 and d9 states, discussion of the electronic spectrum of $[Ti(H_2O)6]^{3+}$ complex ion.

II) Magnetic properties of transition metal complexes, types of magnetic behaviour, methods of determining magnetic susceptibility, spin-only formula, L-S coupling, correlation of μs and μ eff. values, orbital contribution to magnetic moments, application of magnetic moment data for 3d-metal complexes.

Atomic Structure: Idea of de-Broglie matter waves, Heisenberg uncertainty principle, atomic orbitals, Schrödinger 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 exclusion principles, Hund's multiplicity rule.

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. Heisenberg uncertainty principle. Hamiltonian Operator. Schrödinger wave equation (time dependent and time independent) and its importance, physical interpretation of the wave function, postulates of quantum mechanics, particle in a one dimensional box. Schrödinger 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 functions. Molecular orbital theory, basic ideas – Criteria for forming MO from AO, construction of MO by LCAO – H_2^+ ion, calculation of energy levels from wave functions, physical picture of bonding and anti-bonding wave functions, concept of σ, σ^*, π, π^* orbitals and their characteristics.

Molecular Spectroscopy: 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.

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: Concept of polarizability , pure rotational and pure vibrational, Raman spectra of diatomic molecules, selection rules. Electronic Spectrum: Concept of potential energy curves for bonding and antibonding molecular orbitals, qualitative description of selection rules.

UV-Visible Spectroscopy :

Origin of spectra, interaction of radiation with matter, fundamental laws of spectroscopy and selection rules. Types of electronic transitions, λmax, chromophores and auxochromes, Bathochromic and Hypsochromic shifts, Intensity of absorption; application of Woodward Rules for calculation of λmax for the conjugated dienes: alicyclic, homoannular and heteroannular; extended conjugated systems distinction between cis and trans isomers (Cis and trans stilbene).

Infrared Spectroscopy:

IR Spectroscopy: Fundamental and non-fundamental molecular vibrations; Hooke's law selection rule, IR absorption positions of various functional groups (C=O, OH, NH, COOH and nitile) , Effect of H-bonding, conjugation, resonance and ring size of cyclic ketones and lactones on IR

absorptions; Fingerprint region and its significance; application in functional group analysis and interpretation of I.R. spectra of simple organic compounds.

^{1}H-NMR Spectroscopy (PMR):

NMR Spectroscopy: introduction; nuclear spin; NMR active molecules; basic principles of Proton Magnetic Resonance; choice of solvent and internal standard; equivalent and non-equivalent protons; chemical shift and factors influencing it; ring current effect; significance of the terms: up-/downfield, shielded and deshielded protons; spin coupling and coupling constant (1st order spectra); relative intensities of first-order multiplets: Pascal's triangle; chemical and magnetic equivalence in NMR ; anisotropic effects in alkene, alkyne, aldehydes and aromatics; NMR peak area, integration; relative peak positions with coupling patterns of common organic compounds; interpretation of NMR spectra of simple compounds. Applications of IR, UV and NMR spectroscopy for identification of simple organic molecules such as Ethanol, Ethyl acetate, acetone, acetaldehyde, dimethylformamide, Cis and trans 1,2-dimethyl cycloprpanone, propene, vinyl chloride, acetophenone, benzaldehyde, phenol, Toluene and ethyl benzene.

Introduction to Mass Spectrometry: Principle of mass spectrometry, the mass spectrum, mass spectrometry diagram, molecular ion, metastable ion, fragmentation process, McLafferty rearrangement.

Separation Techniques:

Solvent extraction: Classification, principle and efficiency of the technique. Mechanism of extraction: extraction by solvation and chelation. Technique of extraction: batch, continuous and counter current extractions. Qualitative and quantitative aspects of solvent extraction: extraction of metal ions from aqueous solution, extraction of organic species from the aqueous and non-aqueous media.

Chromatography: Classification, principle and efficiency of the technique. Mechanism of Separation, adsorption, partition & ion exchange. Development of chromatograms: frontal, elution and displacement methods.

Chemistry of Alkanes and Cycloalkanes

A) Alkanes :Classification of carbon atom in alkanes, General methods of preparation, physical and chemical properties of alkanes: Wurtz Reaction, Wurtz-Fittig Reactions, Free radical substitutions: Halogenation -relative reactivity and selectivity

B) Cycloalkanes: Nomenclature, methods of formation, chemical reactions, Baeyer's strain theory and its limitations. Chair, Boat and Twist boat forms of cyclohexane with energy diagrams ring strain in small rings, theory of strain less rings. The case of cyclopropane ring, banana bonds.

Chemistry of Alkenes

Methods of formation of alkenes, Addition to **C=C:** mechanism (with evidence wherever

applicable), reactivity, regioselectivity (Markownikoff and anti-Markownikoff additions) and stereoselectivity; reactions: hydrogenation, halogenation, hydrohalogenation, hydration, oxymercuration demercuration, hydroboration-oxidation, epoxidation, *syn* and *anti*-hydroxylation, ozonolysis, addition of singlet and triplet carbenes; Simmons-Smith cyclopropanation reaction; electrophilic addition to diene (conjugated dienes and allene); radical addition: HBr addition; mechanism of allylic and benzylic bromination in competition with brominations across C=C; use of NBS; interconversion of *E*- and *Z*- alkenes.

Chemistry of Alkynes

Methods of formation of alkynes, Addition to C≡C, mechanism, reactivity, regioselectivity and stereoselectivity; reactions: hydrogenation, halogenations, hydrohalogenation, hydration, oxymercuration demercuration, hydroboration-oxidation, dissolving metal reduction of alkynes (Birch); reactions of terminal alkynes by exploring its acidity; inter conversion of terminal and non- terminal alkynes.

Aromaticity and Chemistry of Arenes

Nomenclature of benzene derivatives, MO picture of benzene, Aromaticity: Hückel's rule, aromatic character of arenes, cyclic carbocations/carbanions. Electrophilic aromatic substitution: halogenation, nitration, sulphonation and Friedel-Craft's alkylation/acylation with their Mechanism. Directing effects of the groups. Birch reduction, Methods of formation and chemical reactions of alkylbenzenes, alkynylbenzenes and biphenyl, naphthalene and anthracene.

Chemistry of Alcohols

Classification and nomenclature, Monohydric alcohols – 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 [Pb(OAc)4 and HIO4] and pinacol pinacolone rearrangement. Trihydric alcohols - nomenclature, methods of formation, chemical reactions of glycerol.

Chemistry of Phenols : Nomenclature, structure and bonding, preparation of phenols, physical properties and acidic character, Comparative acidic strengths of alcohols and phenols, resonance stabilization of phenoxide ion. Reactions of phenols – electrophilic aromatic substitution, acylation and carboxylation. Mechanisms of Fries rearrangement, Claisen rearrangement, Gatterman syntheis, Hauben Hoesch reaction, Lederer-Manasse reaction and Reimer-Tiemann reaction.

Chemistry of Ethers and Epoxides: Nomenclature of ethers and methods of their formation, physical properties, Chemical reactions – cleavage and autoxidation, Ziesel's method. Synthesis of epoxides, Acid and base-catalyzed ring opening of epoxides, orientation of epoxide ring

opening, reactions of Grignard and organolithium reagents with epoxides.

Chemistry of Organic Halides

Nomenclature and classes of alkyl halides, methods of formation, chemical reactions, Mechanisms of nucleophilic substitution reactions of alkyl halides, SN^2 and SN^1 reactions with energy profile diagrams; Polyhalogen compounds : Chloroform, carbon tetrachloride; Methods of formation of aryl halides, nuclear and side chain reactions; The addition-elimination and the elimination-addition mechanisms of nucleophilic aromatic substitution reactions; Relative reactivities of alkyl halides vs allyl, vinyl and aryl halides, Synthesis and uses of DDT and BHC.

Rearrangements:

A detailed study of the following rearrangements: Pinacol-pinacolone, Demjanov, BenzilBensilic acid, Favorskii, Hofman, Curtius, Schmidt, Baeyer-Villiger and Fries rearrangement

Catalysis:

General principles and properties of catalysts, homogenous catalysis (catalytic steps and examples) and heterogenous catalysis (catalytic steps and examples) and their industrial applications, Deactivation or regeneration of catalysts. Phase transfer catalysts, application of zeolites as catalysts. Enzyme catalysis; Michaelis-Menten equation, turn-over number.

Chemistry of Main Group Elements: Block Elements: Comparative study, diagonal relationship, salient features of hydrides, solvation and complexation tendencies including their function in biosystems, an introduction to alkyls and aryls.

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

Chemistry of Noble Gasses: Chemical properties of the noble gases, chemistry of xenon, structure and bonding in xenon compounds.

Chemistry of Transition Elements

Chemistry of Elements of First Transition Series -Characteristic properties of d-block elements. Binary compounds (hydrides, carbides and oxides) of the elements of the first transition series and complexes with respect to relative stability of their oxidation states, coordination number and geometry.

Chemistry of Elements of Second and Third Transition Series- General characteristics, comparative treatment of Zr/Hf, Nb/Ta, Mo/W in respect of ionic radii, oxidation states, magnetic behavior, spectral properties and stereochemistry.

Chemistry of Lanthanides:

Electronic structure, oxidation states and ionic radii and lanthanide contraction, complex formation,

occurrence and isolation, ceric ammonium sulphate and its analytical uses.

Chemistry of Actinides

Electronic configuration, oxidation states and magnetic properties, chemistry of separation of Np, Pu and Am from U.

Metal carbonyls: 18-electron rule, preparation, structure and nature of bonding in the mononuclear and binuclear carbonyls.

Bioinorganic Chemistry

Essential and trace elements in biological processes, metalloporphyrins with special reference to heamoglobin and myoglobin. Biological role of alkali and alkaline earth metal ions with special reference to Ca^{2+}. Nitrogen fixation

Reagents in Organic Synthesis:

A detailed study of the following reagents in organic transformations oxidation with DDQ, CAN and SeO_2, mCPBA, Jones Oxidation, PCC, PDC, PFC, Collin's reagent and ruthenium tetraoxide. Reduction with $NaBH_4$, $LiAlH_4$, Meerwein-Ponndorf-Verley (MPV) reduction, Wilkinson's catalyst, Birch reduction, DIBAL-H

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

Organic Compounds of Nitrogen- Preparation of nitroalkanes and nitroarenes, Chemical reactions of nitroalkanes. Mechanisms of nucleophilic substitution in nitroarenes and their reductions in acidic, neutral and alkaline media, Picric acid. Halonitroarenes: reactivity, Structure and nomenclature of amines, physical properties, Stereochemistry of amines, Separation of a mixture 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, nitrities), reductive amination of aldehydic and ketonic compounds, Gabriel-phthalimide reaction, Hofmann bromamide reaction. Reactions of amines, electrophilic aromatic substituton in aryl amines, reactions of amines with nitrous acid. Synthetic transformations of aryl diazonium salts, azo coupling.

Heterocyclic Chemistry

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

Mechanism of electrophilc substitution reactions of indole, quinoline and isoquinoline.

Natural Products

Alkaloids & Terpenes: Natural occurrence, General structural features, their physiological action, Hoffmann's exhaustive methylation, Emde's modification;. Medicinal importance of Nicotine, Hygrine, Quinine, Morphine, Cocaine, and Reserpine. Natural Occurrence and classification of terpenes, isoprene rule.

Thermodynamics-1 :

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.

Thermochemistry: 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 thermo-chemical data, temperature dependence of enthalpy. Kirchhoff's equation.

Thermodynamics II: 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 gases. Gibbs and Helmholtz Functions Gibbs function (G) and Helmhotz function (A) as thermodynamic quantities. A & G as criteria for thermodynamic equilibrium and spontaneity, their advantage over entropy change, Variation of G and A with P, V and T.

Third Law of Thermodynamics; Nernst heat theorem , statement and concept of residual entropy. Nernst distribution law – Thermodynamic derivation, applications.

Electrochemistry: Electrical transport:- Conduction in metals and in electrolyte solutions, specific conductance molar and equivalent conductance, measurement of equivalent conductance, variation of molar, equivalent and specific conductances with dilution. Migration of ions and Kohlrausch law, Arrhenius theory of electrolyte dissociation and its limitations. Weak and strong electrolytes. Ostwald's dilution law, its uses and limitations. Debye-Huckel-Onsager equation for strong electrolytes (elementary treatment only). Transport number, definition and determination by Hittorf method and moving boundary method.

Ionic Equilibrium: Electrode reactions, Nernst equation, derivation of cell EMF and single electrode potential, standard hydrogen electrode-reference electrodes and their applications, standard electrode potential, sign conventions, Electrolytic and Galvanic cells–Reversible and

irreversible cells, conventional representation of electrochemical cells. EMF of a cell and its measurement. 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, application of buffer solution. Hydrolysis of salts.

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

Colligative Properties-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, 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, Van't Hoff factor, Colligative properties of degree of dissociation and association of solutes.

Surface Chemistry:

Adsorption: Physical and chemical adsorption; Freundlich and Langmuir adsorption isotherms; multilayer adsorption and BET isotherm (no derivation required); Gibbs adsorption isotherm and surface excess; Heterogenous catalysis (single reactant);

Colloids: Lyophobic and lyophilic sols, Origin of charge and stability of lyophobic colloids,Coagulation and Schultz-Hardy rule, Zeta potential and Stern double layer (qualitative idea), Tyndall effect; Electrokinetic phenomena (qualitative idea only); Stability of colloids and zetapotential; Micelle formation.

Radiochemistry: Natural and induced radioactivity; radioactive decay-a-decay, b-decay, g-decay; neutron emission, positrom emission, electron capture; unit of radioactivity (Curie); half-life period; Geiger-Nuttall rule, radioactive displacement law, radioactive series. Measurement of radioactivity: ionization chamber, Geiger counters scintillation counters. Applications: energy tapping, dating of objects, neutron activation analysis, isotopic labelling studies, nuclear medicine-99mTc radiopharmaceutical

Master of Science (M. Sc.) Zoology		
For Admission to: Master of Science (M. Sc.) Zoology		
Question Paper Pattern	**Time: 02 Hours**	**Zoology**
	Total: 100 MCQs	**100**

Syllabus

1. **Animal Diversity (Systematics and Classification):**

Principles of classification, binomial nomenclature, hierarchical categories

Protozoa to chordates: general characteristics, modes of life, life cycles, economic/medical importance

Major phyla: Porifera, Coelenterata, Platyhelminthes, Nematoda, Annelida, Arthropoda, Mollusca, Echinodermata, Hemichordata, Urochordata, Cephalochordata, vertebrate classes (fish, amphibians, reptiles, birds, mammals) — salient features and examples

2. **Comparative Anatomy and Functional Morphology:**

Integument, skeletal systems (endoskeleton/ exoskeleton), muscular systems

Digestive, respiratory, circulatory, excretory, nervous, endocrine, reproductive systems—comparative aspects across taxa Locomotion and support structures

3. **Cell Biology and Histology:**

Cell structure and organelles, membrane transport, cell cycle, mitosis, meiosis

Cell signaling, cell junctions, cytoskeleton

Tissues: epithelial, connective, muscle, nervous — histological identification and functions

4. **Genetics and Evolution:**

Mendelian inheritance, linkage, crossing over, gene interactions, sex determination

Population genetics: Hardy–Weinberg equilibrium, genetic drift, migration, selection

Molecular basis of heredity: DNA, RNA, replication, transcription, translation, gene expression regulation

Concepts of evolution: speciation, adaptive radiation, evolutionary mechanisms, phylogenetics, evidence for evolution

5. **Developmental Biology and Embryology:**

Gametogenesis, fertilization, types of eggs, cleavage patterns

Gastrulation, organogenesis, embryonic membranes

Model organisms in development, basic developmental genes and morphogens

6. **Physiology (Animal Physiology):**

Neurophysiology: nerve impulse, synapses, sensory systems

Muscle physiology and contractile mechanisms

Endocrinology: hormone types, mechanisms, major endocrine glands and functions, Homeostasis, osmoregulation, excretion (nephron structure/function)

Cardiovascular and respiratory physiology, digestion and metabolism

7. **Biochemistry and Molecular Biology:**

Structure and function of biomolecules: proteins, carbohydrates, lipids, nucleic acids

Enzymes: kinetics, regulation

Metabolic pathways: glycolysis, TCA cycle, oxidative phosphorylation, photosynthesis basics if included

8. **Immunology and Microbiology (applied aspects relevant to zoology):**

Basics of immune system: innate and adaptive immunity, antibodies, antigen–antibody interactions, Pathogens relevant to animals (bacteria, viruses, parasites), Host–pathogen interactions, zoonoses

9. **Ecology & Environmental Biology:**

Ecosystem structure and function, energy flow, food chains/webs, biogeochemical cycles, Population ecology, community ecology, succession

Biodiversity: measurement, conservation biology, endangered species concepts

Pollution and environmental impact assessment basics

10. **Applied Zoology & Economic Zoology:**

Animal husbandry basics, aquaculture, sericulture, apiculture Pest management, biological control agents, Wildlife biology, conservation strategies, protected area management