Far Western University
Service Commission

Syllabus 2081

Special Internal Competition for the Post of Lecturer

Subject: Zoology **Full Marks 50**

Paper: II **Time: 2 hrs**

This paper will include questions to assess the subject-specific or content knowledge of the candidates. Questions will be asked from the following content areas that are covered in the curricula of the Bachelor's and Master's degree programs.The distribution of questions will be as follows:

1) Long Answer Questions – 3 questions x 10 Marks = 30 Marks
2) Short Answer Questions – 2 Questions x 10 Marks = 20 Marks (Each short answer question will have 2 questions with 5 marks each)

S.N.	Themes	Sub Themes
1	Biosystematics and evolution	• Current advancements in taxonomy, Importance of taxonomy, taxonomic characters, taxonomic mistakes and bad practices, International Codes of Zoological Nomenclature (ICZN. • Evolutionary interrelationships among protostome, pseudocoelomate, coelomate, and deuterostome phyla. • Major geological timescales, mass extinction and its consequences.
2	Cell and developmental biology	• Cell membrane transport and metabolism, cytoskeleton and cell cycle regulation and signaling • Early embryonic developments, organogenesis and post embryonic development
3	Animal Anatomy & physiology	• Integument structure and its derivatives • Principles of digestion and absorption, ruminant and non-ruminant digestive patterns, • Respiratory pigments, transportation of gases, • Circulations in invertebrates and vertebrates, • Excretion and osmoregulation in animals • Hormonal control mechanisms in animal reproduction
4	Biochemistry & Immunology	• Structure and functions of amino acids, protein, carbohydrate and lipids • Basic concept of immune system, nature of antigen and antibodies, disorder of immune responses.
5	Animal Behaviour	• Principles, mechanism of animal behavior, learning and memories, animal migration, feeding behavior of animals, defensive mechanisms in animals, parental cares, territoriality.

6	Non-chordata	• Characteristic features of non-chordate phyla, structure, life cycle and pathogenicity of some non-chordate parasites (e.g. *Entamoeba, Leishmania, Schistosoma, Fasciola, Ascaris, Ancylostoma)* • Social life of honeybees, vector insects and diseases, metamorphosis in insects • Shell and foot in Mollusca, torsion in molluscs and economic importance of terrestrial and aquatic molluscs
7	Chordata	• Origin, evolution and adaptive radiations of fishes and reptiles • Parental cares in fish and amphibian • Poisonous and non-poisonous snakes and their biting mechanism, snake venom, symptoms and first aid treatment of snake bite • Bird migration and perching mechanisms • Endemic vertebrate species of Nepal • Mammalian dentition
8	Entomology & parasitology	• Insect diversity and importance, insect body plan and appendages (head, thorax, abdomen), insect wings and venation, feeding behavior of insects, insect pests, integrated pest management (IPM), potentiality of entomology based industries such as beekeeping, sericulture and lac culture in Nepal • Host parasite relations, vector and vector born diseases and their control, epidemiology of common zoonotic diseases.
9	Ecology and fisheries	• Concept and principles of ecology, Biotic and abiotic factors, ecosystem dynamics and energy flow, population dynamics and interactions, community ecology. • Limnological parameters of fish habitats, capture and culture fisheries, Fish breeding and production management and marketing,
10	Animal toxicology, wildlife conservation and bioinformatics	• Overview of toxicology, toxic substances of public health, mechanisms of toxicity, • Protected Area concept, principles and techniques of wildlife management, Threatened animals species and their status. Threats to biodiversity, *In-situ* and *ex-situ* conservation, Conservation policies and legislations.

Model Questions

Far Western University

Service Commission

Subject: Zoology **Full Marks 50**

Post: Lecturer **Time 2hrs**

Paper: II

Attempt all questions

Long Answer Questions: 3 x 10 Marks = 30 Marks)

1. Discuss modern trends and practice in animal taxonomy. Why taxonomy is important in context to Nepal?
2. Describe the mechanism of digestion and absorptions in animals. What factors play a key role in regulating digestion and absorptions?
3. Explain the principles of animal behavour. How migration occurs in animals? Explain

Short Answer Questions: 2 x 10 Marks = 20 Marks (5 Marsk each)

4 a. Write structure, life cycle and pathogenicity of *Leishmania*.

b. Explain differentiation among mammalian dentitions of different feeding habits.

5 a. Write different type of mouthparts in insects. What association of insect mouthparts found with vector species? Explain

b. What toxic substances make our environment unhealthy? Also write their implications in wildlife conservation?

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Syllabus 2081

Special Internal Competition for the Post of Lecturer

Subject: Environmental Science **Full Marks 50**

Paper: II **Time: 2 hrs**

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1) Long Answer Questions – 3 questions x 10 Marks = 30 Marks
2) Short Answer Questions – 2 Questions x 10 Marks = 20 Marks (Each short answer question will have 2 questions with 5 marks each)

S.No.	Themes	Sub Themes
1.	**Ecology and Environmental Science**	• Principles of ecology and philosophical foundations • Environmental movements and ethics • Energy flow and nutrient cycling in ecosystems • Population and community characteristics, community interactions, and eco physiological adaptations • Ecosystem succession, diversity, stability and applications • Biogeography, biomes, and ecological regions of Nepal • Forest ecology and sustainable management of natural resources • Evolutionary ecology: adaptation, speciation, extinction, and ecological niches • Measurement of diversity: indices, ordination, and clustering methods • Social responsibility and gender perspectives in ecology
2.	**Environmental Earth Science and Disaster Risk Management**	• Fundamentals of geomorphology and concepts of landform development • Continental landscape dynamics: plate tectonics, continental drift, and global topography • Geomorphic processes: weathering, erosion, fluvial, glacial, wind and aeolian actions • Hydrological processes: precipitation, evaporation, runoff, soil-water dynamics, and groundwater recharge • Hydrology of urban and agricultural systems • Geological materials: minerals, igneous, sedimentary, and metamorphic rocks, and field identification protocols • Geological structures and plate tectonics • Geological surface processes: soil horizons, erosion cycles, landslides, and fluvial environments • Disaster risk reduction and management: preparedness, response, recovery, resilience building, and community-based approaches
3.	**Environmental Pollution and Quality Management**	• Point and non-point sources of pollutants • Environmental pollution (air, water, noise): Causes, impacts and control measures • Impact of pollution on human health and ecosystems • Emission, transport, receptors of pollutants, criteria pollutants • Pollution measurement and estimates: Methods of analysis, dispersion models

		• Principles of air pollution management: criteria, standards and control strategies • Transboundary pollution and Nepal's air quality framework • Water pollution management: surface and groundwater monitoring, purification processes, water and wastewater treatment • Land degradation and desertification: causes, impacts, prevention, and remedial measures • Soil pollution and chemistry: contaminants, plastics, biodegradation, and ecological health impacts • Environmental toxicology: sources, transport, effects, testing methods, and ecological risk assessment • Occupational health and safety: hazards, risk assessment, and certification systems
4.	**Climate Change Science and Resilience**	• Climate change science and theories, natural vs. anthropogenic drivers, variability, and greenhouse effect • Climate feedback mechanisms and role of black carbon in the earth–atmosphere system • Paleoclimatology: glacial–interglacial cycles, dating methods • Climate modelling: general circulation, regional models and PRECIS • Climate projections: emission scenarios, RCPs, uncertainties, and GHG inventory methods • Climate data analysis: downscaling techniques, software tools, and climatic indices • Vulnerability, mitigation, and adaptation strategies: community-based, ecosystem-based, and sectoral approaches • IPCC reports, observed changes and impacts of climate change on different sectors • IPCC reports, observed changes and impacts of climate change on different sectors • Indigenous knowledge, national legal frameworks, NDCs of Nepal, and resilience frameworks in practice • International climate policies: UNFCCC, Kyoto, Paris Agreement, and institutional mechanisms
5.	**Biodiversity Conservation and Management**	• Global and national biodiversity status, global distribution patterns of biodiversity (latitude, altitude, hotspots), biogeography and regulating processes • Concepts of biodiversity assessment, sampling strategies, diversity indices, and methods for sampling plants, invertebrates, vertebrates and habitats • Habitat degradation and fragmentation, overexploitation, invasive species, climate change, pollution, disease, extinction dynamics, and fragmented landscapes • Protected areas (design, IUCN categories, adaptive management) and conservation beyond protected areas in Nepal, community-based approaches and invasive species control • National and international efforts, conservation priorities, community roles, livelihoods, adaptive management, and financing mechanisms (carbon finance, PES, ecotourism, compensation, bioprospecting, trust funds) • Concepts, values, threats, and management of wildlife • Niche concepts, behavior (territoriality, resource selection), population dynamics, predator-prey systems, genetic issues, and wildlife diseases • Habitat quality evaluation, abundance estimation, behavioral studies,

		and risk-sensitive habitat use • Demographic and genetic issues in biodiversity conservation, effective population size, carrying capacity • Protected area management, ex-situ conservation (captive breeding, reintroduction, translocation), population and species management, ecosystem and landscape approaches, and Nepal-specific practices with legal frameworks
6.	**Research and Applied Statistics**	• Design of field and laboratory experiments, data types • Management of raw data, detect outliers/errors/missing values, data transformations • Use of tables, histograms, box plots, kernel density, dispersion measures • Mean, standard deviation, standard error; descriptive and inferential analysis, test assumptions of parametric methods • t-tests, z-test, ANOVA and correlation tests; statistical power • Chi-square, Kruskal-Wallis, Mann-Whitney, Wilcoxon for categorical/non-normal data • Linear, logistic, additive and mixed models • Unconstrained (PCA, CA, DCA), constrained (CCA, RDA) and clustering methods • Manipulative/natural experiments, research designs (experimental, survey, case-study, meta-analysis), replication, randomization, independence • Research ethics
7.	**Energy, Environment, and Society**	• Classification (renewable and non-renewable energy sources), demand/consumption of energy types in Nepal, environmental concerns of energy use • Fuel characteristics and efficiency, GHGs, pollution and human well-being • Potentials, challenges, micro vs mega projects, environmental impacts, and Nepal's hydro development • Waste-to-energy, biogas, biofuels, biomass conversion, briquettes/pellets, and environmental considerations • Fossil fuels: deposits, exploration, imports, and environmental concerns; nuclear energy • Demand-side management, conservation, smart grids, battery storage, and climate resilience • National and international institutions and policies related to energy development, use, supply and subsidies
8.	**Solid and Hazardous Waste Management**	• Sources, types and composition of solid waste • Elements of solid waste management • Data collection, analysis and projection of baseline conditions of waste, municipal solid waste (existing status and management) • Integrated approach of solid waste management to address growing urban waste issues • Categorization of e-waste, hazardous and health care waste; Solid waste management approaches • Siting, design, construction, operation, monitoring, emission control, gas extraction, leachate control, and environmental monitoring • Material recovery, reuse recycle, pyrolysis, refuse-derived fuel, gasification, aerobic/anaerobic methods, and environmental implications • Treatment and disposal of medical, industrial, and chemical wastes; environmental and health safeguards

		• Current practices of solid waste technologies in Nepal, including municipal waste management systems and challenges • Legal, institutional, and technical reforms to strengthen solid and hazardous waste management in Nepal
9.	**Integrated Water Resources Management**	• Nepal's surface and groundwater resources • Current scenario, development and planning issues, top-down vs bottom-up approaches, and sectoral/cross-sectoral integration • Interlinkages among sectors, importance of integrated approaches, and IWRM principles in the context of climate change • Precipitation analysis, runoff and discharge estimation in gauged/ungauged watersheds • Parameterization, efficiency, validation, uncertainty, variability of runoff, and management tools, Darcy's Law, and well hydraulics • Exploitable resources, sustained use, flow estimation, recharge methods, aquifer sustainability, and groundwater modelling • Observed/projected changes in rainfall, surface and groundwater, and cryosphere dynamics • Glacier retreat, GLOFs/LDOFs, adaptation/mitigation practices, water demand projections • Water-efficient technologies, smart and resilient communities, integrated water resource management • Global commitments/treaties, riparian rights, national and international watercourse laws, national policies and transboundary governance frameworks
10.	**Environmental Assessment, Governance and Legal Framework**	• Concepts, principles, and understanding of environmental policy in theory and practice (Constitution of Nepal 2015; National Environmental Policy 2019, 16th Periodic Plan 2024-2029) • Environmental policies of Nepal, plans, and strategies with evaluation of their effectiveness (Environment Protection Act 2019, Environment Protection Rules 2020, Forest Act 2019, National Climate Change Policy 2019, DRRM Act 2017) and other relevant policies • International environmental policies, plans, strategies, and commitments addressing global challenges, legally binding and non-binding instruments • Environmental assessment provisions and steps in Nepal: Screening, ToR, scoping and final report preparation and approval of EA studies • Status, implementation, compliance of environmental standards in Nepal • Policies and cooperative frameworks for environmental protection across borders (Mahakali Treaty 1996-Nepal-India water sharing; SAARC Action Plan on Climate Change, BIMSTEC environmental cooperation initiatives) • Roles and responsibilities of international and national environmental institutions; governance structures in Nepal • Good governance for environmental management and sustainable development.

Model Questions

Far Western University

Service Commission

Subject: Environmental Science **Full Marks 50**

Post: Lecturer **Time 2hrs**

Paper: II

Attempt all questions

Long Answer Questions: 3 x 10 Marks = 30 Marks

1. Discuss how climate change impacts water resource management and food security in Nepal. Propose integrated strategies that balance water resource development and ecosystem resilience in the Himalayas under climate change scenarios.

2. Evaluate the role of biodiversity in sustaining ecosystem services. Design a conservation framework that integrates traditional knowledge with modern science for forest resource management in the Himalayas.

3. Critically assess the effectiveness of Environmental Impact Assessment (EIA) in ensuring sustainability of large infrastructure projects in Nepal. Recommend improvements in the existing EIA processes that enhance transparency, stakeholder participation, and long-term monitoring.

Short Answer Questions: 2 x 10 Marks = 20 Marks (5 Marsk each)

4. a) Discuss the drivers of air pollution in Nepal. Elaborate the disproportionate impacts of air pollution on vulnerable populations.

b) Develop a multi-sectoral action plan for disaster management that integrates policy, technology, and community participation.

5. a) Why is data management important? Explain the methods of detecting outliers and errors in the environmental data.

b) How the concepts of Clements and Gleason theories differ in explaining the organization and boundaries of ecological communities? Explain.

Far Western University
Service Commission

Syllabus 2081

Special Internal Competition for the Post of Lecturer

Subject: Computer Science Faculty of Science **Full Marks 50**

Paper: II **Time: 2 hrs**

This paper will include questions to assess the subject-specific or content knowledge of the candidates. Questions will be asked from the following content areas that are covered in the curricula of the Bachelor's and Master's degree programs.The distribution of questions will be as follows:

1) Long Answer Questions – 3 questions x 10 Marks = 30 Marks
2) Short Answer Questions – 2 Questions x 10 Marks = 20 Marks (Each short answer question will have 2 questions with 5 marks each)

S.No.	Themes	Sub Themes
1.	**Procedural and Object-Oriented Programming**	Procedural Programming, Data Types, Operators, Control Statements, Functions, Arrays, Object-Oriented Programming, Objects and Classes, Inheritance, Polymorphism, Abstraction, Function Overloading, Function Overriding, Compile Time and Run Time Polymorphism
2.	**Data Structure and Algorithms**	Time and Space Complexity, Abstract Data Types, Linked List, Stack, Queue, Sorting, Searching and Hashing, Tree and Graph
3.	**Database Management System**	Database and Database Management System, RDBMS, Three-Schema Architecture, ER Diagram, Relational Algebra, SQL, Normalization, Transaction Management, Concurrency Control, Database Recovery
4.	**Operating System**	Functions and Types of Operating System, Process Management, Process Synchronization, Memory Management, Storage and File Management, I/O Management
5.	**System Analysis and Design**	System Development Life Cycle, Waterfall Model, Prototyping, Spiral and Agile Development, SDLC Phases: Planning, Analysis, Design, Implementation, and

		Maintenance
6	**Software Engineering**	Importance of Software Engineering, Software Project Management, Requirements Engineering, System Modeling, Software Design, Software Testing, Software Quality Assurance, Software Configuration Management
7.	**Cybersecurity**	Overview, Threats and Vulnerability, CIA Triad, Security Policy, Security Standards, Network Security, OS and Application Security, VAPT
8.	**Principles of Programming Languages**	Language Design Issues, Syntax vs. Semantics, Compilation vs. Interpretation, Programming Paradigms, Virtual Machines, Steps in Program Translation, Bindings, Data Types, Sequence and Subprogram Control, Exception and Event Handling, Abstract Data Types, Memory Management
9.	**Web Intelligence**	Web Search, Web Information Retrieval, Link Analysis, Collaborative Filtering Recommendation, Content Based Recommendation, Semantic Web
10.	**Machine Learning**	Data Preprocessing, Classification, Clustering, Neural Networks, Deep Learning

Model Questions

Far Western University

Service Commission

Subject: Computer Science/ Faculty of Science **Full Marks 50**

Post Lecturer **Time 2hrs**

Paper II

Attempt all questions

Long Answer Questions: 3 x 10 Marks = 30 Marks

1. Compare procedural programming with object-oriented programming. Explain different principles of object-oriented programming. (3 + 7)
2. Compare linked list with array. How do you insert and remove nodes in a singly linked list? (2 + 8)
3. Explain different memory management techniques in programming languages. (10)

Short Answer Questions: 2 x 10 Marks = 20 Marks (5 Marsk each)

4 a) Explain three-schema architecture of databases. (5)

b) What do you mean by prototyping approach in information system development? (5)

5a) Explain collaborative filtering recommendation in brief. (5)

b) What is deep learning? Why does deep learning require large dataset? (2 + 3)

Far Western University
Service Commission

Syllabus 2081

Special Internal Competition for the Post of Lecturer

Subject: Physics **Full Marks 50**

Paper: II **Time: 2 hrs**

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1) Long Answer Questions – 3 questions x 10 Marks = 30 Marks
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S. N.	Themes	Sub Themes
1.	**Classical Mechanics**	Inertial reference frames, Newton's laws of motion, Rectilinear motion, Circular motion, Conservative and non-conservative forces, Work and energy, Conservation of energy, Linear momentum and its conservation, Angular momentum and its conservation, Collisions in one and two dimensions, Centre of mass motion, Relative motion, Two-particle system and reduced mass, Central forces, Central force problem, Classification of orbits, Virial theorem, Differential equation of orbit, Power-law potentials, Closed orbits (Bertrand's theorem), Kepler's problem, Inverse-square law, Time motion in Kepler's problem, Scattering in central force field, Laboratory transformation of scattering, Simple harmonic motion, Complex notation, Damped oscillations, Forced oscillations, Resonance, Spring–mass system, Simple pendulum, Compound pendulum, Torsional pendulum, Helmholtz resonator, Coupled oscillators
2.	**Heat and Thermodynamics**	Probability and thermodynamic probability, Equal a priori probability principle, Accessible and inaccessible states, μ-space representation, Energy surfaces and phase cells, Harmonic oscillator, Free particles, Thermal equilibrium, Microscopic–macroscopic bridge, Entropy and probability, Boltzmann entropy relation, Second law (statistical interpretation), Canonical distribution, Maxwell–Boltzmann distribution, Speed and velocity distribution, Mean, RMS and most probable speeds, Doppler broadening, Bose–Einstein statistics, Fermi–Dirac statistics, Black body radiation, Planck's law, Ideal Bose gas, Weakly degenerate Bose gas, Strongly degenerate Bose gas, Bose–Einstein condensation, Liquid helium-4, Ultra-cold atomic gases, Phonons, Specific heat of solids, Free electron gas, Fermi energy, Weakly and strongly degenerate Fermi gas, Relativistic Fermi gas
3.	**Electrodynamics**	Scalars and vectors, Polar and axial vectors, Fields and point functions, Gradient, Divergence, Curl, Physical interpretation of vector operators, Gauss's theorem, Stoke's theorem, Green's theorem, Laplacian

		operator, Laplace equation, Poisson equation, Maxwell's equations (general and free space), Energy of charged particle, Poynting vector, Electromagnetic wave equation, Plane electromagnetic waves, Polarization, Stokes parameters, Dispersion in dielectrics, Dispersion in conductors, Dispersion in plasmas, Ionospheric propagation, Lorentz transformations, Velocity addition, Proper time, Time dilation, Matrix formulation, Infinitesimal generators
4.	**Optics**	Free oscillations of systems with one degree of freedom, sinearity and superposition principle, free oscillations of systems with two degrees of freedom, free oscillations of systems with many degrees of freedom, transverse modes of continuous string, general motion of continuous string and Fourier analysis, damped driven one-dimensional harmonic oscillator, resonances in system with two degrees of freedom, phase velocity and group velocity. Lasers: population inversion, the Ruby laser, the He-Ne laser, holography
5.	**Electronics**	Transistors: NPN and PNP characteristics, transistor biasing: CB, CC and CE configurations, DC load line, Q point, stability factor, DC and AC equivalent circuits. Amplifiers: CB, CE and CC amplifiers, classification of amplifiers: class A, B and C amplifiers, RC-coupled amplifiers. Oscillators: Berkhausen criterion, Hartley, Colpitts, phase shift and Wien bridge oscillators, multivibrators: astable, monostable and bistable. Review of Op-amp and its applications: control Sources, definition and basic concepts of frequency response, series capacitance and low frequency response, shunt capacitance and high frequency response, low and high frequency response of BJT and FET amplifiers
6.	**Atomic and Nuclear Physics**	Atomic Structure: the Bohr's atom, energy level diagram and spectra of hydrogen atom, limitations of Bohr's model, the Sommerfeld atom. Many Electrons Atom: Electron spin, Pauli's exclusion principle, shells and subshells of electrons, vector atom model, LS coupling and s, p, d, f notation. Atomic Spectra: fine structures of H, Na, He and Hg, Paschen-Back effect, normal and anomalous Zeeman effect. Nuclear Structure: proton-electron and proton-neutron hypothesis, nuclear composition and its properties (mass, charge, density, magnetic and electric properties), nuclear stability and binding energy, Meson theory of nuclear forces. Nuclear Transformations: law of successive radioactive disintegration, half-life, mean life, natural radioactive series, alpha, beta and gamma ray spectra, absorption of α particles, its range and stopping power, theory of α decay, neutrino hypothesis of β-decay.
7.	**Particle Physics**	Elementary Particles: Conservation laws: lepton number, baryon number, parity, charge conjugation, Isospin, Strangeness and Hypercharge, Parity violation: examples and explanation, quark and lepton: generations and properties, Baryon and Meson: properties and examples, Interaction of quarks and leptons, Standard Model of particle physics: matter sector. Leptons: Lepton multiplets and lepton numbers, Neutrinos, Neutrino mixing and oscillations, Neutrino masses, Universal lepton interactions – the number of neutrinos
8.	**Quantum Mechanics**	Introductory Wave Mechanics: Inadequacy of classical mechanics, de Broglie waves, group and phase velocity, Uncertainty principle and its application. Quantum Mechanical Wave Propagation: time dependent

		and time independent Schrödinger equation, wave function: explanation, normalization of wave function, expectation values of dynamical quantities, general solution of Schrodinger equation, time-independent Schrodinger equation in spherical polar coordinates. Operator Formalism in Quantum Mechanics: commuting and non-commuting operators, linear operator, Hermitian operator, orthogonal functions and orthogonality, parity operator, projection operator, position and momentum operators, angular momentum operators, Hamiltonian operator, commutation relations between position, momentum, angular momentum and Hamiltonian operators: physical interpretation, angular momentum operators in spherical polar coordinates.
9.	**Solid State Physics**	Crystal Structure: Periodic array of atoms: lattice translation vectors, basis and the crystal structures, primitive lattice cell, fundamental types of lattices: two- & three-dimensional lattice types, index systems for crystal planes, simple crystal structure: sodium chloride, hexagonal closed-packed & diamond structure, direct imaging of atomic structure. Free electrons in metals: energy levels in one dimension, effect of temperature on the Fermi-Dirac distribution, free electron gas in 3 dimensions, the Hall effect
10.	**Mathematical Physics**	Fourier series and transforms: Fourier series representation, even and odd functions, Fourier series expansion of square, triangular, saw-tooth waves and output of full wave rectifier, complex representation of Fourier series, Dirac delta function, Parseval relation, Fourier transform and convolution theorem, Laplace transform, Laplace transform of derivatives and integrals, use of Fourier and Laplace transform in solving partial differential equations. Differential equations: series solutions of Bessels's, Legendre's, Hermite's, Laguerre's differential equations, Rodrigue's formula, Recurrence relations. Partial differential equations: Wave equations, Laplace, Poisson and diffusion equations, boundary value problems, Method of separation of variables.

Model Questions

Far Western University

Service Commission

Subject: Physics **Full Marks 50**

Post: Lecturer **Time 2hrs**

Paper: II

Attempt all questions

Long Answer Questions: 3 x 10 Marks = 30 Marks)

1. What do you understand by a frame of reference? Show that all frames of reference moving with a constant velocity with respect to an inertial frame are also inertial frame of reference.
2. Point out the difference between real gas and ideal gas in the light of kinetic theory of gases. Describe how statistical mechanical approach can be used to study the thermodynamics of the mono-atomic ideal gas.
3. Show that Fourier expansion of an oscillating function gives all modes of oscillations. Also write down its application in physical problems.

Short Answer Questions: 2 x 10 Marks = 20 Marks (5 Marsk each)

4. a) Give an account of how electric and magnetic phenomena are unified through Maxwell's equation.

   b) What are the properties of metal which do not change in superconductivity transition from metal?

5. a) Explain the concept of quantum number associated with vector atom model.

   b) Discuss the physical significance of normalization and probability density. Are these concepts related to each other. Explain

Far Western University
Service Commission

Syllabus 2081

Special Internal Competition for the Post of Lecturer

Subject: Chemistry **Full Marks 50**

Paper: II **Time: 2 hrs**

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S. N	Themes	Sub Themes
1.	Theories of Chemical Bonding and Periodic Properties of Elements	Types of chemical bonds (ionic, covalent, metallic) Valence bond theory and molecular orbital theory Hybridization and molecular shape Periodic trends (atomic size, ionization energy, electronegativity) Relationship between electronic configuration and properties
2.	Radioactivity, Electrochemistry, Thermodynamics, Chemical Kinetics and Photo-chemistry	Types of radioactive decay and nuclear reactions Electrochemical cells and electrode potentials Laws of thermodynamics and energy changes Rate of chemical reactions and factors affecting rate Light-induced chemical reactions (photochemical reactions)
3.	Chemical Equilibrium and Colligative Properties of Solutions	Dynamic nature of chemical equilibrium Equilibrium constant and Le Chatelier's principle Acids, bases, and buffer solutions Concentration, boiling point elevation, and freezing point depression Osmotic pressure and its applications
4.	Coordination Compounds, Inert Gas Compounds, Organometallic Compounds and Their Uses	Structure and nomenclature of coordination compounds Bonding theories in coordination chemistry Properties and applications of noble gas compounds Organometallic compounds and metal–carbon bonds Industrial and biological applications of these compounds
5.	Reaction Mechanisms, Reaction	Types of organic reactions Reaction mechanisms (stepwise processes)

	Intermediates, Stereochemistry and Configuration of Compounds	Reaction intermediates (carbocations, carbanions, free radicals) Stereoisomerism and optical activity Configuration and conformation of molecules
6.	Hydrocarbons, Heterocyclic Compounds, Carbohydrates, Proteins, Biomolecules and Metabolic Pathways	Classification and reactions of hydrocarbons Structure and importance of heterocyclic compounds Carbohydrates: types and functions Proteins: structure and biological role Basic metabolic pathways and enzymes
7.	Environmental Pollution, Principles of Green Chemistry and Nanotechnology	Types and sources of environmental pollution Chemical pollutants and their effects Principles of green chemistry Sustainable and eco-friendly chemical processes Basics and applications of nanotechnology
8.	Natural Products, Polymers, Fertilizers, Industrial Products and their Uses	Natural products and their chemical nature Types and properties of polymers Fertilizers and soil chemistry Important industrial chemicals Applications in daily life and industry
9.	Transition Metal Compounds, Catalysis, Corrosion and Passivity	Properties of transition metals Coordination behavior of transition metal compounds Types of catalysts and catalytic processes Causes and prevention of corrosion Passivity and protective oxide layers
10.	Spectroscopic Techniques, Chromatographic Techniques and Advanced Surface Characterisation Techniques	Basics of spectroscopy (UV, IR, NMR, MS) Chromatographic methods (TLC, column, ion exchange, GC, HPLC) Principle of electron microscopy (SEM, TEM) Surface analysis using AFM and XPS Applications in material and chemical analysis

Model questions:

Far Western University
Service Commission

Subject: Chemistry **Full Marks: 50**
Post: Lecturer
Paper: II **Time: 2.00 Hrs.**

Attempt all Questions

Long Answer Questions: 3 x 10 Marks = 30 Marks

1) Explain molecular orbital theory in favour of chemical bonding.

2) What are radioactive radiations? Explain with examples.

3) Explain applications of organometallic compounds in synthesis.

Short Answer Questions: 2 x 10 Marks = 20 Marks (5 Marks each)

4. A.) What are the principles of green chemistry? Explain.

B) What is corrosion? Explain various measures for the prevention of corrosion.

5. A) How can NMR spectroscopy be used for the identification of new compounds? Explain with examples.

B) Shed light on advantages of nanotechnology in our daily lives.