



# Gyanveer University Sagar (M.P.)



## Ph.D Entrance Test Syllabus Session: 2024-25 Zoology

### Part A : Research Methodology

### Part B : Zoology

#### Part-A Research Methodology

**Unit – I :** Motivation and objectives of research - Research methods /vs Methodology. Types of research - Descriptive vs. Analytical, Applied vs. Fundamental, Quantitative vs. Qualitative, Conceptual vs. Empirical.

- Research Formulation: Defining and formulating the research problem, selecting the problem, necessity of defining the problem, importance of literature review in defining a problem, development of working hypothesis. Primary and secondary sources - reviews, treatise, monographs, patents.

**Unit – II:** Research design and methods: Basic Principles, need of research design, features of good design, important concepts relating to research design. Developing a research plan exploration, description, diagnosis, experimentation.

- Data collection and analysis: Execution of the research, observation, collection of data, methods of data collection, modeling, tabulation of data, processing and analysis of data. Sampling techniques - random and stratified sampling - primary and secondary data.
- Collection, classification & diagrammatic representation of statistical data, frequency and frequency distribution, measures of central tendency: mean, median and mode.

**Unit – III :** Measures of dispersion: range, mean deviation, variance, standard deviation, standard error, skewness, kurtosis, regression & correlation, chi-square test, student's t-test, Parametric and non-parametric test, ANOVA and other statistical computer packages.

- Molecular Biology and Recombinant DNA methods: Isolation and purification of RNA, DNA (genomic and plasmid) and proteins, different separation methods. Analysis of RNA, DNA and proteins by one- and two-dimensional gel electrophoresis, Isoelectric focusing gels. Expression of recombinant proteins using bacterial, animal vectors. Isolation of specific nucleic acid sequences.



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**Unit – IV :** Isolation, separation and analysis of carbohydrate and lipid molecules RFLP, RAPD and AFLP techniques.

- Histochemical and Immuno techniques Antibody generation, Detection of molecules using ELISA, RIA, western blot, immunoprecipitation, flowcytometry and immunofluorescence microscopy, detection of molecules in living cells.

**Unit - V :** Molecular analysis using UV/visible, fluorescence, circular dichroism, NMR Spectroscopy Molecular structure determination using X-ray diffraction.

- Microscopic techniques: Visualization of cells and subcellular components by light microscopy, resolving powers of different microscopes, microscopy of living cells, scanning and transmission microscopes.

## Part-B

### Zoology

#### Unit – I: Biochemistry

- Composition, structure and function of biomolecules (carbohydrates, lipids, proteins, nucleic acids and vitamins).
- Bioenergetics, glycolysis, oxidative phosphorylation, coupled reaction, group transfer, biological energy transducers.
- Enzyme kinetics, enzyme regulation, mechanism of enzyme catalysis, isozymes

#### Unit – II: Cell Biology

- Membrane structure and function (Structure of model membrane, lipid bilayer and membrane protein diffusion, osmosis, ion channels, active transport, membrane pumps, mechanism of sorting and regulation of intracellular transport, electrical properties of membranes).
- Structural organization and function of intracellular organelles (Cell wall, nucleus, mitochondria, Golgi bodies, lysosomes, endoplasmic reticulum, peroxisomes, plastids, vacuoles, chloroplast, structure & function of cytoskeleton and its role in motility).
- Cell division and cell cycle (Mitosis and meiosis, their regulation, steps in cell cycle, regulation and control of cell cycle).
- DNA replication, repair and recombination (Unit of replication, enzymes involved, replication origin and replication fork, fidelity of replication, extrachromosomal replicons, DNA damage and repair mechanisms, homologous and site-specific recombination).
- RNA synthesis and processing (transcription factors and machinery, formation of initiation complex, transcription activator and repressor, RNA polymerases, capping,



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elongation, and termination, RNA processing, RNA editing, splicing, and polyadenylation, structure and function of different types of RNA, RNA transport).

- Protein synthesis and processing (Ribosome, formation of initiation complex, initiation factors and their regulation, elongation and elongation factors, termination, genetic code, aminoacylation of tRNA, tRNA-identity, aminoacyl tRNA synthetase, and translational proof-reading, translational inhibitors, post-translational modification of proteins).
- Control of gene expression at transcription and translation level (regulating the expression of phages, viruses, prokaryotic and eukaryotic genes, role of chromatin in gene expression and gene silencing).
- Genetic rearrangements in progenitor cells, oncogenes, tumor suppressor genes, cancer and the cell cycle, virus-induced cancer, metastasis, interaction of cancer cells with normal cells, apoptosis, therapeutic interventions of uncontrolled cell growth.

### Unit – III: Immunology

- Innate and adaptive immune system Cells and molecules involved in innate and adaptive immunity, antigens, antigenicity and immunogenicity. B and T cell epitopes, structure and function of antibody molecules. generation of antibody diversity, monoclonal antibodies, antibody engineering, antigen-antibody interactions, MHC molecules, antigen processing and presentation, activation and differentiation of B and T cells, B and T cell receptors, humoral and cell-mediated immune responses, primary and secondary immune modulation, the complement system, Toll-like receptors, cell-mediated effector functions, inflammation, hypersensitivity and autoimmunity, immune response during bacterial (tuberculosis), parasitic (malaria) and viral (HIV) infections, congenital and acquired immune deficiencies, vaccines.

### Unit – IV: Developmental Biology

- Basic concepts of development: Potency, commitment, specification, induction, competence, determination and differentiation; morphogenetic gradients; cell fate and cell lineages; stem cells; genomic equivalence and the cytoplasmic determinants; imprinting; mutants and transgenics in analysis of development.
- Gametogenesis, fertilization and early development: Production of gametes, cell surface molecules in sperm-egg recognition in animals; zygote formation, cleavage, blastula formation, embryonic fields, gastrulation and formation of germ layers in animals; embryogenesis.
- Morphogenesis and organogenesis in animals: limb development and regeneration in vertebrates; differentiation of neurons, post embryonic development- larval formation, metamorphosis; environmental regulation of normal development; sex determination.
- Programmed cell death, aging and senescence.



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### Unit – V: Animal Physiology

- Digestive system - Digestion, absorption, energy balance, BMR
- Blood and circulation - Blood corpuscles, haemopoiesis and formed elements, plasma function, blood volume, blood volume regulation, blood groups, haemoglobin, immunity, haemostasis.
- Cardiovascular System: Comparative anatomy of heart structure, myogenic heart, specialized tissue, ECG – its principle and significance, cardiac cycle, heart as a pump, blood pressure, neural and chemical regulation of all above.
- Respiratory system - Comparison of respiration in different species, anatomical considerations, transport of gases, exchange of gases, waste elimination, neural and chemical regulation of respiration.
- Nervous system - Neurons, action potential, gross neuroanatomy of the brain and spinal cord, central and peripheral nervous system, neural control of muscle tone and posture.
- Excretory system - Comparative physiology of excretion, kidney, urine formation, urine concentration, waste elimination, micturition, regulation of water balance, blood volume, blood pressure, electrolyte balance, acid-base balance.
- Thermoregulation - Comfort zone, body temperature – physical, chemical, neural regulation, acclimatization.
- Stress and adaptation
- Endocrinology and reproduction - Endocrine glands, basic mechanism of hormone action, hormones and diseases; reproductive processes, gametogenesis, ovulation, neuroendocrine regulation.

### Unit – VI: Genetics

- Mendelian principles: Dominance, segregation, independent assortment.
- Concept of gene: Allele, multiple alleles, pseudo allele, complementation tests.
- Extensions of Mendelian principles: Codominance, incomplete dominance, gene interactions, pleiotropy, genomic imprinting, penetrance and expressivity, phenocopy, linkage and crossing over, sex linkage, sex limited and sex influenced characters.
- Gene mapping methods: Linkage maps, tetrad analysis, mapping with molecular markers, mapping by using somatic cell hybrids.
- Extra chromosomal inheritance: Inheritance of Mitochondrial and chloroplast genes, maternal inheritance.
- Microbial genetics: Methods of genetic transfers – transformation, conjugation, transduction and sex-duction, mapping genes by interrupted mating, fine structure analysis of genes.
- Human genetics: Pedigree analysis, lod score for linkage testing, karyotypes, genetic disorders.



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- Mutation: Types, causes and detection, mutant types – lethal, conditional, biochemical, loss of function, gain of function, germinal versus somatic mutants, insertional mutagenesis.
- Structural and numerical alterations of chromosomes: Deletion, duplication, inversion, translocation, ploidy and their genetic implications.
- Recombination: Homologous and non-homologous recombination including transposition.

### Unit – VII: Taxonomy

- Principles & methods of taxonomy: Concepts of species and hierarchical taxa, biological nomenclature, classical & quantitative methods of taxonomy of animals and microorganisms.
- Outline classification animals & microorganisms: Important criteria used for classification in each taxon. Classification of animals and microorganisms. Evolutionary relationships among taxa.

### Unit – VIII: Ecology

- Species Interactions: Types of interactions, interspecific competition, herbivory, carnivory, pollination, symbiosis.
- Community Ecology: Nature of communities; community structure and attributes; levels of species diversity and its measurement; edges and ecotones.
- Ecological Succession: Types; mechanisms; changes involved in succession; concept of climax.
- Ecosystem Ecology: Ecosystem structure; ecosystem function; energy flow and mineral cycling (C,N,P); primary production and decomposition; structure and function of some Indian ecosystems: terrestrial (forest, grassland) and aquatic (fresh water, marine, eustarine).

### Unit – IX: Evolution

- Lamarck; Darwin–concepts of variation, adaptation, struggle, fitness and natural selection; Mendelism; Spontaneity of mutations; The evolutionary synthesis.
- Concepts of neutral evolution, molecular divergence and molecular clocks; Molecular tools in phylogeny, classification and identification; Protein and nucleotide sequence analysis; origin of new genes and proteins; Gene duplication and divergence.