



SYLLABUS FOR SCREENING TEST FOR THE POST OF ASSISTANT PROFESSOR

Subject : ZOOLOGY

Note: There shall be 100 questions with multiple Choices carrying 100 marks to be completed in 3 hrs duration.

1. MOLECULES AND THEIR INTERACTION RELAVENT TO BIOLOGY

- A. Structure of atoms, molecules and chemical bonds.
- B. Composition, structure and function of biomolecules (carbohydrates, lipids, proteins, nucleic acids and vitamins).
- C. Stablizing interactions (Van der Waals, electrostatic, hydrogen bonding, hydrophobic interaction, etc.).
- D. Bioenergetics, glycolysis, oxidative phosphorylation, coupled reaction, group transfer, biological energy transducers.
- E .Principles of catalysis, enzymes and enzyme kinetics, enzyme regulation, mechanism of enzyme catalysis, isozymes
- F. Conformation of proteins (Ramachandran plot, secondary structure, domains, motif and folds).
- G. Conformation of nucleic acids (helix (A, B, Z), t-RNA, micro-RNA).
- H. Metabolism of carbohydrates, lipids, amino acids nucleotides and vitamins.

2. CELLULAR ORGANIZATION

- A.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.
- B.Structural organization and function of intracellular organelles:**Cell membrane, nucleus, mitochondria, Golgi bodies, lysosomes, endoplasmic reticulum, peroxisomes, structure & function of cytoskeleton and its role in motility.
- C.Organizatiion of genes and chromosomes:** Operon, unique and repetitive DNA, interrupted genes, gene families, structure of chromatin and chromosomes, heterochromatin, euchromatin, transposons.
- D.Cell division and cell cycle** Mitosis and meiosis, their regulation, steps in cell cycle, regulation and control of cell cycle.

3. FUNDAMENTAL PROCESSES

- A.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.

B. RNA synthesis and processing. Transcription factors and machinery, formation of initiation complex, transcription activator and repressor, RNA polymerases, capping, elongation, and termination, RNA processing, RNA editing, splicing, and polyadenylation, structure and function of different types of RNA, RNA transport.

C. 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.

4. CELL COMMUNICATION AND CELL SIGNALING

A. Cell signaling: Hormones and their receptors, cell surface receptor, signaling through G-protein coupled receptors, signal transduction pathways, second messengers, regulation of signaling pathways.

B. Cellular communication: Regulation of hematopoiesis, general principles of cell communication, cell adhesion and roles of different adhesion molecules, gap junctions, extracellular matrix, integrins, neurotransmission and its regulation.

C. Cancer: 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.

5. 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, vaccines.

6. DEVELOPMENTAL BIOLOGY

A. 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

B. Gametogenesis, fertilization and early development: Gametogenesis, Types of eggs, cell surface molecules in sperm-egg recognition in animals; zygote formation, cleavage, blastula formation, gastrulation and formation of germ layers in animals; embryogenesis.

C. Morphogenesis and organogenesis in animals : Amphibia and chick; organogenesis – vulva formation in *Caenorhabditis elegans*, eye lens induction, limb development and regeneration in vertebrates; differentiation of neurons, post embryonic development- larval formation, metamorphosis; environmental regulation of normal development; sex determination.

7. ANIMAL SYSTEM PHYSIOLOGY

A. Blood and circulation - Blood corpuscles, haemopoiesis and formed elements, plasma function, blood volume, blood volume regulation, blood groups, haemoglobin, haemostasis.

B.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.

C.Respiratory system - Comparison of respiration in different species, anatomical considerations, transport of gases, exchange of gases, waste elimination, neural and chemical regulation of respiration.

D.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.

E.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.

F.Thermoregulation - Comfort zone, body temperature – physical, chemical, neural regulation, acclimatization.

G.Digestive system - Digestion, absorption, energy balance, BMR.

H.Endocrinology and reproduction - Endocrine glands, basic mechanism of hormone action, hormones and diseases; reproductive processes, gametogenesis, ovulation, neuroendocrine regulation.

8. INHERITANCE BIOLOGY

A)Mendelian principles : Dominance, segregation, independent assortment.

B)Concept of gene : Allele, multiple alleles, pseudoallele, complementation tests

C)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.

D)Extra chromosomal inheritance :Inheritance of Mitochondrial and chloroplast genes,maternal inheritance.

E)Human genetics : Pedigree analysis, lod score for linkage testing, karyotypes, genetic disorders.

F)Mutation : Types, causes and detection, mutant types – lethal, conditional, biochemical, loss of function, gain of function, germinal verses somatic mutants, insertional mutagenesis.

G)Structural and numerical alterations of chromosomes : Deletion, duplication, inversion, translocation, ploidy and their genetic implications.

9. DIVERSITY OF LIFE FORMS:

A. Principles and methods of Taxonomy-

Principles and basis of classification.

Binomial system of nomenclature.

B. Outline Classification of animals-

General survey of animal kingdom,classification upto order and inter-relationship of the various phyla.

Evolutionary relationship among Taxa.

C. Levels of structural organization-

Structure and functions of the invertebrates from Protozoa to Echinodermata.

Levels of structural organizations-Unicellular, colonial and multicellular forms. coelom,segmentation and metamerism.

Locomotory organs and their mechanisms.

Food,feeding and digestion.

Respiration

Excretory and osmoregulatory organs.

Primitive and advanced nervous systems.

Reproduction:Asexual,sexual and parthenogenesis.

Larval forms.

D.Structural organization of thefollowing chordate types-

Protochordates, Herdamani,Branchiostoma.

Chordates-Structure, classification and organization of vertebrates.

Comparative anatomy of the integument,digestive,respiratory,

Circulatory & urinogenital of vertebrates.

Adaptation in vertebrates; Adaptations in fishes, amphibians,reptiles,birds and mammals.

Economic importance of non-chordates and chordates.

10. ECOLOGICAL PRINCIPLES

A.The Environment: Physical environment; biotic environment; biotic and abiotic interactions.

B.Population Ecology: Characteristics of a population; population growth curves; population regulation; life history strategies (*r* and *K* selection); concept of metapopulation – demes and dispersal, interdemic extinctions, age structured populations.

C.Community Ecology: Nature of communities; community structure and attributes; levels of species diversity and its measurement; edges and ecotones.

D.Ecological Succession: Types; mechanisms; changes involved in succession; concept of climax.

E.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).

11.APPLIED BIOLOGY

A.Applied Ecology; Environmental pollution; global environmental change; biodiversity: status, monitoring and documentation; major drivers of biodiversity change; biodiversity management approaches.Bioremediation and phytoremediation.

B.Conservation Biology: Principles of conservation, major approaches to management Indian case studies on conservation/management strategy(Project Tiger, Biosphere reserves).

Biodiversity concepts, Different types of biodiversity, Rare, endangered species.

C.Natural history of Indian subcontinent: Major habitat types of the subcontinent,geographic origins and migrations of species.Comman Indian mammals,birds. Seasonal and phenology of the subcontinent.

D.Organisms of health & agricultural importance: Common parasites and pathogens of humans, domestic animals and crops.

E. Bioremediation, phytoremediation

12. EVOLUTION AND BEHAVIOUR

A. Emergence of evolutionary thoughts :Lamarck; Darwin–concepts of variation, adaptation, struggle, fitness and natural selection; Mendelism; Spontaneity of mutations; The evolutionary synthesis.

B. Origin of cells and unicellular evolution: Origin of basic biological molecules; Abiotic synthesis of organic monomers and polymers; Concept of Oparin and Haldane; Experiment of Miller (1953); The first cell; Evolution of prokaryotes; Origin of eukaryotic cells; Evolution of unicellular eukaryotes; Anaerobic metabolism, photosynthesis and aerobic metabolism.

C. Paleontology and Evolutionary History: The evolutionary time scale; Eras, periods and epoch; Major events in the evolutionary time scale; Origins of unicellular and multi cellular organisms; Major groups of animals; Stages in primate evolution including *Homo sapiens*.

D. The Mechanisms: Population genetics – Populations, Gene pool, Gene frequency; Hardy-Weinberg Law; concepts and rate of change in gene frequency through natural selection, migration and random genetic drift; Adaptive radiation; Isolating mechanisms; Speciation; Allopatricity and Sympatricity; Convergent evolution; Sexual selection; Co-evolution.

E. Brain, Behavior and Evolution: Approaches and methods in study of behavior; Proximate and ultimate causation; altruism and evolution-Group selection, kin selection, reciprocal altruism; Neural basis of learning, memory, cognition, sleep and arousal; Biological clocks; Development of behavior; Social communication; Social dominance; Parental investment Parental care, Mating systems. Migration, orientation and navigation;

13. METHODS IN BIOLOGY

A. Molecular Biology and Recombinant DNA methods:

Isolation and purification of RNA , DNA (genomic and plasmid) and proteins, separation methods.

Molecular cloning of DNA or RNA fragments in bacterial and eukaryotic systems.

Expression of recombinant proteins using bacterial and animal vectors. Isolation of specific nucleic acid sequences.

Generation of genomic and cDNA libraries in plasmid, phage, cosmid, BAC and YAC vectors.

B. Histochemical and Immunotechniques

Antibody generation, Detection of molecules using ELISA, RIA, western blot, immunoprecipitation, fluocytometry and immunofluorescence microscopy.

C. Statistitcal Methods:

Mean, median, mode, students''t''test, chi-square test, standard deviation. Correlation and regression, variance and analysis of variance.

D. Microscopic techniques: Microscopic techniques: Compound, Florescence, Phase contrast, Confocal, Eelectron (scanning and transmission)and Atomic force microscopes, Electron microscopy.