

## Syllabus for Entrance Test M Sc Zoology and Aquaculture

### Basic Concepts of Zoology

Role of Zoology in Amelioration of Human problems (Vector, Parasite and Pest Control) 2. Application of Zoology in Everyday life: Domestication of Livestock, Poultry, Fisheries, Prawn Culture, Pearl culture Apiculture, Sericulture, Vermiculture, Origin of Life on Earth, Products of evolutionary process. Origin of life on Earth: Arrival of simple form from primordial chemicals, Multicellularity: from simple collections of poorly differentiated cells to complex body plans.. Biological diversity, Systematics and taxonomy, Species concept. Nomenclature and utility of scientific names. Classification: morphological and evolutionary (molecular). Phylogenetic Relationship of taxa, Structural and Functional Unit of Life . Cell Theory. Macromolecules in Cell. Flow of energy and Information in Cell 4. Concept of continuity of life . Concept of Inheritance: Phenotype, Genotype, Genes, Alleles and Linkage, Interaction between Environment and Human population 1. Flow of energy- Trapping Solar energy, Energy pathway, Food Chain, Food Web . Biogeochemical Cycles. Natural Resources and their Conservation. Anthropogenic Effects- Acid rain, Global Warming, Ozone Depletion.

### Study of non-chordates:

Protozoa to Coelenterate • Protozoa - Euglena, Monocystis and Paramecium • Porifera – Sycon • Coelenterata - Obelia and Aurelia, Ctenophora to Nematelminthes • Ctenophora - Salient features • Platyhelminthes - Fasciola (Liver fluke) and Taenia (Tape worm) Nematelminthes - Ancylostoma (Hook worm), Annelida to Arthropoda • Annelida - Nereis and Hirudinaria (Leech) • Arthropoda - Palaemon (Prawn) and Schistocerca (Locust) , Mollusca to Hemichordata • Mollusca - Lamellidens (Fresh water mussel) and Pila • Echinodermata -Pentaceros (excluding development)

Origin of Chordates & Hemichordata • Origin of Chordates. • Classification of Phylum Chordata up to the Order. • Hemichordata: General characteristics, classification and detailed study of Balanoglossus (Habit and Habitat, Morphology, Anatomy, Physiology and Development). Cephalochordata and Urochordata • Cephalochordata : General characteristics, classification and detailed study of Branchiostoma (Amphioxus) (Habit and Habitat, Morphology, Anatomy, Physiology). • Urochordata : General characteristics, classification and detailed study of Herdmania (Habit and Habitat, Morphology Anatomy, Physiology and Post Embryonic Development). Classification and General Characteristics of Vertebrates • General characters and Classification of different classes of Pisces and Amphibia up to the order with examples. • Neoteny and Paedogenesis

Vertebrates, General characters and Classification of different classes of Reptilia, Aves and Mammalia up to the order with examples. Poisonous and Non Poisonous Snakes, Biting mechanism of snakes. • Flight Adaptations in Birds • Adaptive Radiations in Eutheria,



Integumentary System • Structure, functions and derivatives of integument Skeletal System • Overview of axial and appendicular skeleton, Jaw suspensorium Visceral arches , Digestive System • Alimentary canal and associated glands Respiratory System • Skin, gills, lungs and air sacs; Accessory respiratory organs, Circulatory System • General plan of circulation, evolution of heart and aortic arches Urinogenital System • Succession of kidney, Evolution of urinogenital ducts, Types of mammalian uteri, Nervous System • Comparative account of brain Autonomic nervous system, Spinal cord, Cranial nerves in mammals Sense Organs • Classification of receptors Brief account of visual and auditory receptors in man

### Evolutionary Biology:

Theories of Evolution • Origin of Life • Historical review of evolutionary concept: Lamarckism, Darwinism (Natural, Sexual and Artificial selection) • Modern synthetic theory of evolution • Patterns of evolution (Divergence, Convergence Parallel, Co-evolution) ,Population Genetics • Microevolution and Macroevolution: allele frequencies, genotype frequencies, • Hardy Weinberg equilibrium and conditions for its maintenance • Forces of evolution: mutation, selection, genetic drift, Direct Evidences of Evolution • Types of fossils, Incompleteness of fossil record, • Dating of fossils, Phylogeny of horse, Species Concept and Extinction • Biological species concept (Advantages and Limitations); • Modes of speciation(Allopatric, Sympatric) • Mass extinction (Causes, Names of five major extinctions).

### Animal Development

Gamete Fertilization and Early Development • Gametogenesis, Fertilization • Cleavage pattern • Gastrulation, fate maps • Developmental mechanics of cell specification • Morphogenesis and cell adhesion. Developmental Genes • Genes and development • Molecular basis of development • Differential gene expression , Early Vertebrate Development • Early development of vertebrates (fish, birds & mammals) • Metamorphosis, regeneration and stem cells • Environmental regulation of development . Late Developmental Processes • The dynamics of organ development • Development of eye, kidney, limb • Metamorphosis: the hormonal reactivation of development in amphibians, insects • Regeneration: salamander limbs, mammalian liver, Hydras • Aging: the biology of senescence

### Biochemistry:

Structure and Function of Biomolecules • Structure and Biological importance of carbohydrates (Monosaccharides, Disaccharides, Polysaccharides and Glycoconjugates) • Lipids (saturated and unsaturated fatty acids, Tri-acylglycerols, Phospholipids, Glycolipids, Steroids) • Structure, Classification and General properties of  $\alpha$ -amino acids; Essential and non-essential  $\alpha$ -amino acids, • Levels of organization in proteins; Simple and conjugate proteins. Enzyme Action and Regulation • Nomenclature and classification of enzymes; Cofactors; Specificity of enzyme action; • Isozymes; Mechanism of enzyme action; • Enzyme kinetics; Factors affecting rate of enzyme-catalyzed reactions; Derivation of Michaelis-Menten equation, Concept of  $K_m$  and  $V_{max}$ , Lineweaver-Burk plot; Enzyme inhibition; • Allosteric enzymes and their kinetics;

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Regulation of enzyme action, Metabolism of Carbohydrates and Lipids • Metabolism of Carbohydrates: glycolysis, citric acid cycle, gluconeogenesis, phosphate pentose pathway Glycogenolysis and Glycogenesis Lipids --- Biosynthesis of palmitic acid; Ketogenesis,  $\beta$ -oxidation and omega -oxidation of saturated fatty acids with even and odd number of carbon atoms, Metabolism of Proteins and Nucleotides • Catabolism of amino acids: Transamination, Deamination, Urea cycle • Nucleotides and vitamins • Review of mitochondrial respiratory chain, Oxidative phosphorylation, and its regulation.

## Physiology

Digestion and Respiration • Structural organization and functions of gastrointestinal tract and associated glands • Mechanical and chemical digestion of food; Absorptions of carbohydrates, lipids, proteins, water, minerals and vitamins; • Histology of trachea and lung, • Mechanism of respiration, Pulmonary ventilation; Respiratory volumes and capacities; Transport of oxygen and carbon dioxide in blood, Respiratory pigments, Dissociation curves and the factors influencing it; Control of respiration, Circulation and Excretion • Components of blood and their functions • Haemostasis: Blood clotting system, • Blood groups: Rh factor, ABO and MN • Structure of mammalian heart, Cardiac cycle; Cardiac output and its regulation, Electrocardiogram, Blood pressure and its regulation Structure of kidney and its functional unit; Mechanism of urine formation, Nervous System and Endocrinology • Structure of neuron, resting membrane potential • Origin of action potential and its propagation across the myelinated and unmyelinated nerve fibers • Types of synapse • Endocrine glands - pineal, pituitary, thyroid, parathyroid, pancreas, adrenal; hormones secreted by the Classification of hormones; Mechanism of Hormone action, Muscular System • Histology of different types of muscle, • Ultra structure of skeletal muscle; • Molecular and chemical basis of muscle contraction; • Characteristics of muscle twitch; Motor unit, summation and tetanus.

## Cell Biology:

Structure and Function of Cell Organelles I • Plasma membrane: chemical structure—lipids and proteins Endomembrane system: protein targeting and sorting, endocytosis, exocytosis Introduction to all national Biologists (Zoologists) who have contributed/contributing to Zoological and Life Sciences as a mark of tribute to ancient and modern biology will be included as part of the Continuous Internal Evaluation (CIE),

Structure and Function of Cell Organelles • Cytoskeleton: microtubules, microfilaments, intermediate filaments • Mitochondria: Structure, oxidative phosphorylation • Peroxisome and ribosome: structure and function

Nucleus and Chromatin Structure • Structure and function of nucleus in eukaryotes • Chemical structure and base composition of DNA and RNA • DNA supercoiling, chromatin organization, structure of chromosomes • Types of DNA and RNA IV Cell cycle, Cell Division and Cell Signaling • Cell division: mitosis and meiosis • Cell cycle and its regulation, apoptosis, Signal transduction: intracellular signaling and cell surface receptors via G-protein linked receptors, JAKSTAT pathway

Mendelism and Sex Determination • Basic principles of heredity: Mendel's laws, monohybrid

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and dihybrid crosses • Complete and Incomplete Dominance, • Penetrance and expressivity, • Genic Sex-Determining Systems, Environmental Sex Determination, Sex Determination in *Drosophila*, Sex Determination in Humans, • Sex-linked characteristics and Dosage compensation

Extensions of Mendelism, Genes and Environment • Extensions of Mendelism: Multiple Alleles, Gene Interaction, • Cytoplasmic Inheritance, Genetic Maternal Effects, • Genomic Imprinting, Anticipation, • Interaction Between Genes and Environment: Environmental Effects on Gene Expression, Inheritance of Continuous Characteristics

Human Chromosomes and Patterns of Inheritance • Human karyotype, Chromosomal anomalies: Structural and numerical aberrations with examples, • Pedigree analysis

### **Molecular Biology and Gene technology**

Process of Transcription • Fine structure of gene • RNA polymerases • Transcription factors and machinery • Formation of initiation complex • Initiation, elongation and termination of transcription in prokaryotes and eukaryotes, Process of Translation • The Genetic code •

Ribosome • Factors involved in translation • Aminoacylation of tRNA, tRNA-identity, aminoacyl Trna synthetase • Initiation, elongation and termination of translation in prokaryotes and eukaryotes,

Regulation of Gene Expression I • Regulation of gene expression in prokaryotes: lac and trp operons in *E. coli* • Regulation of gene expression in eukaryotes: Role of chromatin in gene expression • Regulation at transcriptional level, Post-transcriptional modifications: Capping, Splicing, Polyadenylation, RNA editing.

Regulation of Gene Expression • Regulation of gene expression in eukaryotes: • Regulation at translational level, Post- translational modifications: protein folding etc. • Intracellular protein degradation • Gene silencing, RNA interference (RNAi)

**Principles of Gene Manipulation** • Recombinant DNA Technology • Restriction Enzymes, DNA modifying enzymes, Cloning Vectors, Ligation • Gene transfer techniques, Gene therapy • Selection and identification of recombinant cells

Applications of Genetic Engineering • Single cell proteins, • Biosensors, Biochips, • Crop and live stock, Improvement, Development of transgenic organisms, • Development of DNA drugs and, vaccines. Enzyme Technology • Microbial culture, • Methods of enzyme production, •

Immobilization of enzymes, • Applications IV DNA Diagnostics • Genetic analysis of human diseases, detection of known and unknown mutations • DNA fingerprinting •

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Concept of pharmacogenomics and pharmacogenetics • Personalized medicine—optimizing drug therapy

**Biostatistics:** Calculations of mean, median, mode, variance, standard • Deviation, • Concepts of coefficient of variation, Skewness, Kurtosis • Elementary idea of probability and application  
Data summarizing: frequency distribution, graphical presentation—bar, pie diagram, histogram,  
• Tests of significance: one and two sample tests, t-test and Chi-square test.

**Basics of Computers** • Basics (CPU, I/O units) and operating systems, • Concept of homepages and websites, World Wide Web, URLs, using search engines VIII Bioinformatics • Databases: nucleic acids, genomes, protein sequences, and structures, Bibliography, • Sequence analysis (homology): pairwise and multiple, sequence alignments BLAST, CLUSTALW, • Phylogenetic analysis

### **Immunobiology**

Immune System and its Components • Historical perspective of Immunology, Innate and Adaptive Immunity, Structure and functions of different classes of immunoglobulins, Hypersensitivity, • Immune system: innate and adaptive immunity, clonal selection, complement system, • Humoral immunity and cell mediated immunity, • Immunoglobulin and T-cell receptor genes: organization of Ig gene loci, molecular mechanism of generation of antibody diversity  
HLA complex: organization, class I and II HLA molecules, expression of HLA genes.

### **Tools and techniques used in biological studies**

Principle and Types of Microscopes • Principle of Microscopy and Applications • Types of Microscopes: light microscopy, dark field microscopy, phase-contrast microscopy, • Fluorescence microscopy, confocal microscopy, electron microscopy VI Centrifugation and Chromatography • Principle of Centrifugation: • Types of Centrifuges: high speed and ultracentrifuge • Types of rotors: Vertical, Swing-out, Fixed-angle etc. • Principle and Types of Chromatography: paper, thin layer, column—ionexchange, gel filtration, HPLC, affinity VII Spectrophotometry and Biochemical Techniques • Colorimetry and spectrophotometry: Beer-lambert law, absorption spectrum • Biochemical techniques: Measurement of pH, • Preparation of buffers and solutions • Measurement, applications and safety measures of radio-tracer techniques VIII Molecular Techniques • Nucleic acid fractionation, detection by electrophoresis, DNA sequencing, Polymerase Chain Reaction (PCR), primer designing, DNA fingerprinting, site directed mutagenesis, RFLP • Molecular cloning, genomic libraries, Gene transfer techniques: electroporation, microinjection • Detection of proteins, PAGE, ELISA, Western blotting, • Hybridoma technology

### **Parasitology:**

Parasitology, Structure, life cycle, pathogenicity, including diseases, causes symptoms and

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control of the following parasites of domestic animals and humans: Trypanosoma, Giardia and Wuchereria. Vectors and pests, Life cycle and their control of following pests: Gundhi bug, Sugarcane leafhopper, Rodents, Termites and Mosquitoes and their control.

**Economic Zoology-** Beneficial and harmful insects, Animal breeding and culture: Aquaculture, Pisciculture, Poultry VIII Economic Zoology- 2, Sericulture, Apiculture, Lac-culture, Vermiculture

**Ecology and Environment:** Levels of organization, Laws of limiting factors Study of physical factors, Population: Density, natality, mortality, life tables, fecundity tables, survivorship curves, age ratio, sex ratio, dispersal and dispersion, Exponential and logistic growth, Types of ecosystems with one example in detail, Food chain: Detritus and grazing food chains, Food web, Energy flow through the ecosystem • Ecological pyramids and Ecological efficiencies, Nutrient and biogeochemical cycle with one example of Carbon cycle

Community characteristics: species richness, dominance diversity, abundance, Ecological succession with one example

Sources of Environmental hazards, Climate changes, Greenhouse gases and global warming, Acid rain, Ozone layer destruction

Effect of climate change on public health, sources of waste, types and characteristics Sewage disposal and its management, Solid waste disposal, Biomedical waste handling and disposal, Nuclear waste handling and disposal, Waste from thermal power plants, Case histories on Bhopal gas tragedy, Chernobyl disaster, Seveso disaster and Three Mile Island accident and their aftermath.

**Behavioural Ecology and Chronobiology** • Origin and history of Ethology, Instinct vs. Learnt Behaviour • Associative learning, classical and operant conditioning, Habituation, Imprinting • Circadian rhythms; Tidal rhythms and Lunar rhythms • Chronomedicine

**Wild Life:** Values of wild life - positive and negative; • Conservation ethics; • Importance of conservation; • Causes of depletion; • World conservation strategies.

Protected areas • National parks & sanctuaries, • Community reserve; • Important features of protected areas in India; • Tiger conservation - Tiger reserves in India; • Management challenges in Tiger reserve.

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