

## **DETAILED SYLLABUS FOR THE POST OF BIOLOGIST**

### **(MUSEUMS AND ZOOS)**

**(CAT.NO. : 460/2021)**

**(Total Marks - 100)**

#### **PART I : VETERINARY SCIENCE & ANIMAL HUSBANDRY (50 Marks)**

##### **GENERAL ANATOMY**

**(5 Marks)**

Study of properties and structure of bone. Classification of skeletons, classification of bones with suitable examples. Introduction to arthrology, classification of joints, different diarthrodial joints, the structure of diarthrodial joints and movements permitted. Introduction to myology, classification of muscles, etymology of muscles. Description of tendon, ligaments, aponeurosis, synovial bursa and synovial sheath. Structure of heart. General plan of systemic and pulmonary circulations, lymphatic and venous systems. Introduction to neurology and parts of the central, peripheral and autonomic nervous system and sense organs. Structure of meninges, brain, spinal cord. Microscopy and micrometry. Comparison of light and electron microscopy. Histological techniques, processing of tissues for paraffin sectioning and haematoxylin and eosin staining. Microscopic examination of epithelium, connective tissue, muscular tissue, nervous tissue and blood.

##### **GENERAL BIOCHEMISTRY & PHYSIOLOGY**

**(5 Marks)**

Chemistry of the animal cell, applications of biochemistry of biomolecules, enzymes, metabolism, biochemical basis of disease in animals, reproductive biochemistry, physiology of digestion, cardiovascular physiology, renal physiology, haematology, reproductive physiology, neuromuscular physiology, neuro-endocrinology, physiology of behaviour and stress. Liver function tests - Classification - Biochemical tests for differential diagnosis. Biochemical tests of renal function - Urine analysis - Role of BUN, Uric acid and Creatinine in diagnosis. Disturbance in acid base balance and its diagnosis. Biochemistry of digestive disorders. Biochemistry of oxidative stress and shock. Biochemical basis of fluid therapy

##### **ZOO ANIMALS' PRODUCTION & MANAGEMENT**

**(15 Marks)**

Taxonomy of important wild zoo animals. Status and conservation practices of wildlife in India. Basic principles of habitat and housing of various classes of wild zoo animals. Size and space requirement (dimension) of cubicles, enclosures of important wild zoo animals. Management of livestock in fringe areas, in and surrounding the breeding areas. Restraining, capture, handling, and physical examination of captive animals. Classification of zoos, management of sanctuaries, national parks etc. Acts and Rules related to captive animals. National and international organization and institutions interlinked to captive animals' role and functioning. Body conformation and identification. Transportation of livestock and wild or zoo animals.

Breeding of zoo and wild animals: Population dynamics and effective population size of wild animals in captivity or zoo or natural habitats. Planned breeding of wild animals. Controlled breeding and assisted reproduction. Breeding for conservation of wild animals.

Acts and Rules related to Zoo and wild animals. National and international organizations and institutions interlinked to wild and zoo animals – role and functioning.

### **NUTRITION OF ZOO ANIMALS**

**(10 Marks)**

History of animal nutrition. Importance of nutrients in animal production and health. Composition of animal body and plants. Nutritional terms and their definitions. Nutritional aspect of carbohydrates, protein and fats. Role and requirement of water, metabolic water. Importance of minerals (major and trace elements) and vitamins in health and production, their requirements and supplementation in feed. Common feeds and fodders, their classification. Measures of food energy and their applications - gross energy, digestible energy, metabolizable energy, net energy, total digestible nutrients, starch equivalent, food units, physiological fuel value. Direct and indirect calorimetry, carbon and nitrogen balance studies. Protein evaluation of feeds - Measures of protein quality in ruminants and non-ruminants, biological value of protein, protein efficiency ratio, protein equivalent, digestible crude protein. Calorie protein ratio. Nutritive ratio.

Food and feeding habits of free ranging and captive wild animals, nutritional requirement of various species of wild animals, ration formulation of captive animals, artificial feeding, feeding during emergencies, nutritional characteristics and adequacy of forage plants for wild animals, special diets used in captivity, hand-raising of orphan animals, nutritional deficiencies in free ranging and captive wild animals, clinical and geriatric nutrition of captive wild animals.

### **HEALTH CARE OF ZOO ANIMALS**

**(15 Marks)**

Principles of zoo hygiene, public health problems arising from zoos. Prevention, control and treatment of infectious, parasitic, nutritional and metabolic diseases in zoo and wild animals including exotic birds: viral, bacterial, protozoan, fungal and parasitic diseases of Indian wild mammals, birds, amphibians and reptiles. Nutritional diseases, poisoning, stress, shock, capture myopathy, physical trauma. Assessment of condition, health and nutritional status in free-ranging populations.

Definition, history and socio-economic impact of zoonotic diseases. Classification of zoonoses and approaches to their management. Multisectoral approach for zoonoses prevention and control. Emerging, re-emerging and occupational zoonoses. Role of wild, animals and birds in the transmission of zoonoses. Zoonotic pathogens as agents of bioterrorism.

Gross and microscopic pathology of important diseases of wild animals. Surgical sterilization, various methods of sterilization (Heat, chemical and radiations etc.), disinfections. Sutures: Definitions, suturing, factors influencing suturing, characteristics of ideal suture material, types of suture material, surgical knots, and various suture patterns. Treatment of acute and chronic inflammation: Use of anti-inflammatory drugs and proteolytic enzymes. Definitions, classification, diagnosis and treatment of abscess, tumour, cyst, hernia, haematoma, necrosis, gangrene, burn and scald, frost bite and surgical affections of muscles, artery and vein, sinus and fistula. Wounds: Definition, classification, examination and diagnosis, general principles for the treatment of aseptic, contaminated and septic wounds, healing and factors affecting wound healing, complications of wounds and their remedies. Surgical infection; their prevention and management: Classification of infection, management of surgical shock. Principles of fluid therapy in surgical patients. General considerations of anaesthesia: Avian, wild, zoo, and exotics animals. Anaesthetic emergencies and management, Toxicity, antidote and reversal agents, Wild or zoo animal surgery.

## **PART II : ZOOLOGY AND WILD LIFE (50 Marks)**

### **Module I: Taxonomic principles and tools (2marks)**

Systematics, Taxonomy, Chemotaxonomy, Serotaxonomy, Cytotaxonomy, Evolutionary taxonomy, Molecular systematics, DNA barcoding, Nomenclature: Binomial and Trinomial nomenclature; International Code of Zoological Nomenclature (ICZN), Five Kingdom Classification.

### **Module II: Animal Diversity (3 marks)**

Basis for Animal kingdom classification [Levels of organization, Symmetry, Coelom],

Kingdom Protista: Characteristic features and classification of Kingdom Protista.

Kingdom Animalia: [Salient features of the Major Phyla of animals and their diversity, classification of each phylum down to classes and examples: Mesozoa, Parazoa: Porifera, Metazoa: Cnidaria, Ctenophora. Acoelomata: Platyhelminthes. Pseudocoelomata: Aschelminthes: Nematoda.

Coelomata: Annelida, Onychophora, Arthropoda, Mollusca, Echinodermata, Hemichordata.

Chordates: Urochordates and Cephalochordates. Vertebrates: Agnatha, Gnathostomata: Pisces, Tetrapoda: Amphibia, Reptilia. Aves: Archaeornithes, Neornithes. Mammalia (Classification of class Mammalia down to the orders): Prototheria, Metatheria, Eutheria.

### **Module III Ethology (4 marks)**

Physiological, Neural and hormonal mechanisms of behavior. Darwinian fitness and inclusive fitness concepts, fitness in natural environment and evolution of adaptive strategies. Movement and migration; types of migration, factors governing migration, advantages and disadvantages of migration, dispersal and orientation. Biological clock.

Types of behaviours – innate and learnt. Types of learning with examples, Neural mechanisms in behaviour. Patterns of behaviours– types or rhythms, navigation, homing instinct, hibernation, aestivation; pheromones- types and their effect on behavior, hormones and their action on behavior (aggressive and parental behavior).

Types of social organizations solitary, monogamy, harem forming, territorial male, multimale/multifemale theories. Benefit of living in social group, kinship determinants of social behavior: Mating strategies and breeding biology, intolerance, group mobility, ecological factors, affection bonds, fecundity, longevity & gregariousness. Social life in insects and mammals.

Group living: costs, benefits and optimal group size. Selfishness and altruism. Competition for resources: ideal free distributions and resource defence. Sexual selection; parental care and mating systems. Cooperation and helping in mammals, birds and fishes. Behavioral patterns in captivity and animal welfare issues.

### **Module IV: Evolution (3 marks)**

Ideas of evolution during Pre-Darwinian, Darwinian and Post-Darwinian periods, Biogenesis, Chemical evolution- Haldane and Oparin theory, Miller-Urey experiment, origin of mitochondria and chloroplast. Origin of prokaryotes and eukaryotes.

Direct evidences of evolution – Recapitulation Theory of Haeckel, Geological time scale, Fossilization, Kinds of fossils, fossil dating, Homologous organs and analogous organs.

Lamarckism and its Criticism, Weismann's Germplasm theory, Darwinism and its Criticism, Neo-Darwinism, Theory of De Vries.

Population genetics and evolution: Hardy-Weinberg Equilibrium, gene pool, gene frequency. Factors that upset Hardy-Weinberg Equilibrium, Effects of genetic drift on population:

Bottleneck effect and founder effect. Genetic drift and natural selection, importance of genetic drift in evolution; theory of punctuated equilibrium and its relevance. RNA world. Isolating mechanisms and speciation. Microevolution, Macroevolution (Adaptive radiation -Darwin finches).

Evolution of Man and Vertebrates: Organic evolution of human, Evolution of vertebrate groups - Fishes, amphibians, reptiles, birds and mammals.

#### **Module V: Biogeography (2 marks)**

Classical biogeography concepts: Continental drift, dispersal, bio-geographical realms and provinces, ecology of dispersal and faunal exchange, barriers, concept of Island Biogeography, mode of dispersal, corridors their importance; threats and solution

#### **Module VI: Biology of Indian Wildlife (5 marks)**

Role of non-chordates in nature, economic importance, threats and conservation of non-chordates. Honey bee, Termites, Ants. Preliminary knowledge about Butterflies, Moths, Dragonflies, Scorpions, Spiders.

Classification and evolution of major groups of fishes in India. Ichthyogeography and diversity of freshwater fishes of India.. Threatened fishes of India.

Taxonomy of amphibians, their role in nature, threats to their existence and conservation measures.

Taxonomy of reptilian (Fresh water and marine turtles, lizards, snakes and crocodilians). Thermoregulation, its role, aestivation, Hibernation and other eco-physiological adaptations.. Identification of venomous and non venomous snakes. Snake bites, Venom, Anti-venom, First Aid and Management of snake bite cases.

Avian classification and distribution with special reference to Indian birds morphological adaptations in bills and claws. Flight adaptations, diurnal and nocturnal adaptations.

Bird Migration, Impact of migrants on resident species of birds. Threats faced by the avian community, causes of decline of common birds and their control measures.

Mammalian characteristics and origin of mammals. Morphological and physiological adaptations in mammals. Hibernation, Aestivation, locomotion and water regulation. Body size variation in mammals and its influence on life history, metabolic rate, weight constraints. Digestive system of herbivores and carnivores.

#### **Module VII: Biostatistics (2 marks)**

Definition; scope; role of statistics in life sciences; Sample & Sampling techniques, Collection of data, classification of data, Presentation of data, Measures of Central Tendency, Measures of dispersion, Correlation, Test of Hypothesis and Test of Significance. Interpretation of data.

#### **Module VIII: Bioinformatics (2marks)**

Biological databases: features of a good database. Classification format of biological databases.

Sequence analysis and alignment. Genomics and Proteomics. Molecular visualization software. Human Genome Project.

#### **Module IX: Biophysics & Instrumentation (2marks)**

Microscopy: Light microscope, Phase contrast microscope, fluorescent microscope, Electron microscope. Micrometry, Camera Lucida, pH meter.

Separation techniques: Chromatography, centrifugation, Electrophoresis.  
Radioactive techniques: Autoradiography, X-ray diffraction and crystallography,  
Spectrophotometer: Colorimeter, UV spectrophotometer.

### **Module X: Biochemistry ( 3 marks)**

Basic structure, biological importance and classification of Carbohydrates, Proteins & Lipids.  
Vitamins and minerals: biological importance, fat soluble and fat-soluble vitamins, Important minerals and trace elements required for living organisms.

Enzymes: Chemical nature of enzymes, enzyme activation, enzyme inhibition, allosteric enzymes, isoenzymes, co-enzymes.

Metabolism of carbohydrates, proteins and lipids: Glycolysis, Krebs cycle, glycogenesis, glycogenolysis, gluconeogenesis and HMP pathway, electron transport chain, oxidative phosphorylation, proton gradient and chemiosmotic synthesis of ATP.

### **Module XI: Physiology ( 4 marks)**

Nutrition: Regulation of digestive activity: Nervous and hormonal control, Nutritional requirements – carbohydrates, proteins, lipids, Balanced diet. Malnutrition (PEM, Obesity). Digestion of carbohydrate, protein & lipids– role of salivary glands, liver, pancreas and intestinal glands in digestion.

Respiration: Phases of respiration, Respiratory pigments, Transport of respiratory gases. Control of respiration. Respiratory disturbances. Physiological effect of smoking.

Circulation: Blood: functions and composition; Clinical analysis of blood, Blood transfusion and agglutination. Types of heart, Human heart ECG; Common cardio-vascular problems.

Osmoregulation and Excretion: Water conservation in desert forms; Osmotic and ionic regulation in terrestrial, fresh water and marine animals; Types of excretion, urea cycle.

Human kidney: Urine formation, Mechanism of concentration of urine, hormonal regulation of kidney function, renal disorders.

Muscle Physiology: Structure of vertebrate skeletal muscle: EM structure of Myofibrils and Myofilaments, contractile proteins; Mechanism of muscle contraction: Ultra structural changes (sliding filament theory); physiology, biochemistry and energetics of muscle contraction; energy sources, role of creatine phosphate, Cori cycle.

Nerve physiology: Ultra structure of neuron. Nerve impulse production (resting membrane potential, action potential), transmission of impulse along the nerve fiber, interneuron (synaptic) transmission, neuromuscular junction and transmission of impulses. Neurotransmitters (acetyl choline, adrenalin, dopamine).

Environmental Physiology: Concept of homeostasis, regulators and conformers. Tolerance, resistance, acclimation and acclimatization. Overview of thermal homeostasis in homeotherms, CNS regulation of body temperature maintenance. Temperature compensation in poikilotherms. Osmoregulation in aquatic and terrestrial animals.

### **Module XII: Cell Biology (2 marks)**

Histological techniques, Cell structure and functions: Protoplasm, Plasma membrane, Endoplasmic reticulum, Ribosomes, Golgi bodies, Lysosomes, Mitochondria, Cytoskeleton,

Microbodies, Interphase nucleus, Chromosomes, Giant chromosomes. Cell signalling, Membrane transport. Cell cycle & Cell division, Cancer & Apoptosis.

**Module XIII: Molecular biology ( 3 marks)**

Modern concepts of gene, Prokaryotic genome, Eukaryotic genome. Watson – Crick model of DNA, Different forms of DNA, Types of RNA, secondary and tertiary structure of tRNA. Sequencing of DNA by Sanger’s method. DNA Replication, DNA repair, Gene and genetic code, Transcription, Translation, Regulation of gene expression and organization of genome.

**Module XIV: Genetics (3 marks)**

Mendelian Genetics, Allelic & Non-Allelic interaction of genes. Multiple alleles, Sex determination, Recombination and Linkage, Sex Linked inheritance, Mutation. Extrachromosomal inheritance.

Human genetics: Karyotyping, Normal Human chromosome Complement, Pedigree analysis, Aneuploidy and Non- disjunction. Autosomal abnormalities, Sex chromosomal abnormalities, Single gene disorder, Autosomal single gene disorder, Inborn errors of metabolism. Multifactorial traits – polygenic disorder.

**Module XV: Ecology / Environmental biology (5 marks)**

Ecosystem: Components (Abiotic and Biotic), Functions, limiting factors, Biogeochemical cycles, Renewable and Non-renewable resources.

Population ecology: Properties of Population – Density, Natality, mortality, age distribution, biotic potential, environmental resistance, energy carrying capacity. Population growth forms (J and S curves). Emigration, immigration, migration and population fluctuation.

Community ecology: Definition and characters. Community Structure, stratification, Ecotone and Edge effect, Ecological indicators. Community periodicity. Ecological succession- Basic types of succession. Process in succession. Population interactions.

Biodiversity: Types, concept and importance. Global environmental issues. National environmental issues. Toxic products and disaster. Local environmental issues. Threats to water resources of Kerala. Ecological tools and techniques: Commonly used techniques for study of animal populations.

Pollution: Types, Global warming, green house effects, ozone layer depletion, acid rain, impact and control measures, environmental monitoring; concept of sustainable development, control and prevention of air, water and noise pollution.

**Module XVI: Conservation (5 marks)**

Components of biodiversity, diversity indices, Levels of diversity in community and ecosystem diversity: Alpha, beta and gamma diversities. Keystone species, umbrella species, flagship species, indicator species, Indigenous and introduced / exotic species. Hot spots of biodiversity. Hotspots in Indian region. Biodiversity of Western Ghats.

Threats to biodiversity, Threatened fauna- IUCN categories. Biological consequences of habitat fragmentation, covering barriers and isolation, crowding effect, local and regional extinctions, edge effects, changes in species composition and community; ecosystem level conservation. Control of invasive species. Significance of ecological restoration in conservation. Conservation of biodiversity and wildlife: conservation measures. Biodiversity conservation strategies: Ex- situ conservation & In situ conservation. Man-animal conflict. Water conservation. Global strategy for conservation. Environmental laws. Important conservation projects undertaken in India: Project Tiger, Project Elephant, Rhino-reintroduction and Tiger-reintroduction Program.

Forest Protection and Legislation: Role of afforestation and forest regeneration in absorption of CO<sub>2</sub>, concept of carbon sequestration. Indian Forest Policy, 1988 of People's involvement, Joint Forest Management, Forest laws, necessity; general principles, Indian Forest Act 1927; Forest Conservation Act, 1980; Wildlife Protection Act 1972 and their amendments; Application of Indian Penal Code to Forestry.

**NOTE: - It may be noted that apart from the topics detailed above, questions from other topics prescribed for the educational qualification of the post may also appear in the question paper. There is no undertaking that all the topics above may be covered in the question paper**