

# **VARDHMAN MAHAVEER OPEN UNIVERSITY, KOTA**

## **SYLLABUS of M.Sc. ZOOLOGY ENTRANCE EXAMINATION Admission Session July 2021**

### **Taxonomy; Structure, Functions and Biology of Chordates & Non-Chordates**

Classification of Protozoa, Porifera, Coelenterata, Platyhelminthes and Nematoda up to class with examples. Fundamentals of body organization emphasizing symmetry, metamerism, coelome and levels of structural organization.

Protozoa: - Study of structural organization and life history of paramecium. Study of locomotion, osmoregulation, nutrition and reproduction in protozoa. Parasitism, pathogenecity and control in protozoans with special reference to Entamoeba and Plasmodium.

Porifera: - Habit, habitat, structure and function of Sycon. Types of canal system.

Coelenterata: - Habit, habitat, structure, function and life history of Aurelia. Polymorphism in coelenterata, coral reef. Ctenophora - Structural organization and affinities.

Platyhelminthes: - Structural organization and life history of Fasciola. Parasitic adaptation in Helminthes. Aschehelminthes: - Study of structure and life history of Ascaris Nematode parasites and human diseases.

Classification of Annelida (up to subclass); metamerism and coelom in Annelida General account of Annelida structural organization, Physiology & life history of Hirudinaria, Trochophore larva.

Arthropoda 1. General characters and classification of phylum - Arthropoda up to subclass.

2. Habit, habitat, external features, appendages, digestive, respiratory, circulatory, excretory, reproductive and nervous system and sense organs of prawn (Palaemon).

3. Larval forms of Crustacea.

4. Metamorphosis in Insects.

5. Apiculture, sericulture, lac culture

Mollusca 1. General characters and classification phylum - Mollusca upto subclass. 2. Habit, habitat, external features, coelom, general anatomy, digestive, respiratory, circulatory, excretory, reproductive systems, of snail (Pila) . 3. Torsion in Gastropoda. 4. Larval forms of Mollusca. 5. Pearl culture

Echinodermata 1. General characters and classification of phylum- Echinodermata upto subclass. 2. Habit, habitat, symmetry, external features, coelom, general anatomy, digestive, respiratory, circulatory, excretory, water vascular, reproductive, nervous system and sense organs of star fish (Asterias). 3. Larval forms of Echinodermata. 4. Autotomy and regeneration in Echinoderms.

Chordata : Primary chordate characters, invertebrate chordates (Protochordata), concept of invertebrate and nonchordates.

Hemichordata : 1. General characters and classification of Hemichordata. 2. Habit, habitat, external features, coelom, body wall, digestive, skeletal, respiratory, circulatory, excretory, nervous and reproductive system and sense organs of Balanoglossus. 3. Tornaria larva. 4. Affinities of Hemichordata.

Urochordata and 1. General characters and classification upto class level. 2. Habit, habitat, general anatomy and various systems, including sense organs of Herdmania. Ascidian tadpole and its metamorphosis; affinities of Urochordata.

Cephalochordata: 3. Habit, habitat, general anatomy and various systems, including sense organs of Branchiostoma (Amphioxus). 4. Affinities of Cephalochordata.

1. Classification of Vertebrates. 2. Cyclostomata: Classification and characters with suitable examples. Petromyzon: General morphology and Ammocoete larva. 3. Pisces-I: Classification and characters with suitable examples; differences between cartilagenous and bony fishes; Dipnoans. 4. Pisces-II: General morphology of Scoliodon ; types of scales and caudal fin; electric

organs; aquatic adaptations in fishes. 5. Pisciculture: Introductory knowledge of Pisciculture;

Tetrapoda 1. Amphibia: Classification and characters with suitable examples, adaptations for amphibious life. 2. Reptilia: Classification and characters with suitable examples, difference between lizards and snakes, identification of poisonous and non-poisonous snakes, biting mechanism in snakes, snake venom. 3. Aves: General classification and characters with important examples; difference between Ratitae and Carinatae; flight muscles, flight mechanism, flight adaptations, Archaeopteryx as a connecting link. 4. Mammalia-I: Classification and characters with suitable examples; 5. Mammalia-II: Dentition.

Comparative Anatomy of Vertebrates-I Comparative anatomy of the following organ systems of Scoliodon, Rana, Uromastix / Varanus, Collumba and Oryctolagus: 1. Integument and integumentary derivatives. 2. Alimentary canal and accessory digestive glands. 3. Respiratory organs. 4. Heart, aortic arches and their evolution.

Comparative Anatomy of Vertebrates-II Comparative anatomy of the organ systems of Scoliodon, Rana, Uromastix / Varanus, Collumba and Oryctolagus and miscellaneous: 1. Comparative structure of urinogenital system (pro, meso and metanephric kidney and genital ducts in males and females). 2. Brain and cranial nerves. 3. Comparative anatomy of eye and ear. 4. Parental care in vertebrates.

## **INHERITANCE BIOLOGY**

Mendel's laws of inheritance. Monohybrid and dihybrid cross. Dominance. Incomplete dominance. Current status of Mendelism. Genetic variation: Variation in chromosome number (Euploidy and Aneuploidy). Unit-VII Genetic disorders in Human beings (Down's, Turner's, Klinefelter's and Edward's syndrome) Types of chromosomal mutations. Molecular basis of gene mutation, mutagens, crossing over and linkage.

Sex-determination XX-XY. XO-XY and WZ mechanisms. Sex-linked inheritance (X-and Y-linked) Color blindness. Haemophilia. Gene interactions. Supplementary, complementary, epistasis and inhibitory. Multiple allele-ABO, Rh and MN blood groups and their inheritance, polymorphic genes. Unit-IX Gene structure (Recon. muton, cistron) and regulation of gene (lac operon: inducible and repressible system). Bacterial genetic transformation, Transduction and conjugation. Lytic and lysogenic cycle. Elementary idea about eugenics. Elementary idea about genetic engineering. Gene cloning and recombinant DNA technology (Vectors for gene transfers. Plasmids and phages). Restriction enzymes.

## **BIOTECHNOLOGY AND MICROBIOLOGY**

Introduction. Historical prospective of animal cell hybridoma, major areas and future prospects of biotechnology. Medicines and Biotechnology: Microbes in medicine, antibiotics, vaccine, antibodies, antigens. Environmental Biotechnology: use of micro organisms in metal and petroleum recovery pest control. Waste treatment, Processing of industrial waste. Degradation of Xenophobic compounds including pesticides and surfactants. Surfactants, Surfactants and oil pollutants, Food and drink biotechnology, Ferment food dairy products. Food preservation microbial spoilage, alcoholic beverages, Vinegar. Monoclonal antibodies and their applications.

Brief Introduction to the History of Microbiology. The Prokaryota :Structural Organization.

Genetic Material of Prokaryotes, Reproduction in Prokaryotes, Microbial Nutrition.

## **CELL BIOLOGY AND BIOCHEMISTRY**

(a) Introduction, Discovery of cell, cell theory, golden period of cytology, prokaryotic and eukaryotic cell characteristics of animal cell. (b) Protoplasm-: History, physical characters, colloidal

property, chemical composition and Biological characters of protoplasm. (c) Cell organelles: - Structure chemical composition and functions of plasma membrane, endoplasmic reticulum, Golgi apparatus, lysosome ribosome, mitochondria, nucleus and nucleolus. Nucleic Acid: - Chemistry, Molecular model, Duplication, properties and functions of DNA, Types of RNA, Nucleic Acid as Genetic material. (b)Mitosis: - cell cycle, mitotic apparatus, centriole aster, and significance. (c)Meiosis: - Introduction, meiotic cycle, synapses of chromosomes, crossing over mechanism, Initiation and control of meiosis, significance. (a)Nucleic Acid synthesis: - Synthesised DNA, RNA biosynthesis of DNA and RNA. Genetic code, transcription and translation. (b)Protein synthesis: - Genetic code, transcription, translation, Role of RNA, Mechanism of protein-synthesis, Regulation of protein synthesis. (a)Cell chemistry: - Nomenclature, classification, Action theory and specificity of Enzyme, enzyme activator, inhibitor, regulation and control of enzyme activity. (b) Cell metabolism: - Anabolic and catabolic process, metabolism of protein, carbohydrates and fats, ketone bodies. Microscopy: - Structure and functioning of compound and electron microscope. Principle, Uses and Limitations.

## **ANIMAL PHYSIOLOGY and IMMUNOLOGY**

Digestion: a. Nutrients: Carbohydrates, lipids, proteins, vitamins. b. Digestive enzymes and hormones of GIT. c. Digestive mechanism: Mechanical and chemical digestion.

d. Absorption and assimilation of end products of digestion. e. Balanced diet, malnutrition (PEM), obesity; endoscopy.

Respiration: a. Aerobic and anaerobic respiration. b. Structure of respiratory organs. c. Mechanism and regulation of breathing. d. Transport of O<sub>2</sub> and CO<sub>2</sub>. e. Respiratory disorders: Emphysema, asthma, occupational disorders, spirometry.

Circulation: a. Circulatory fluids: Blood, lymph; blood cells; structure of haemoglobin. b. Blood circulation through heart,

arteries, arterioles, capillaries, venules and veins. c. Cardiac cycle and its regulation. d. Blood clotting mechanism, blood pressure. e. Cardiac disorders, ECG, heart transplantation (an introductory idea).

Excretion: a. Excretory products:  $\text{NH}_3$ , urea, uric acids, amino acids. b. Structure of kidney, nephron; mechanism of urine formation; micturition. c. Autoregulation, counter-current mechanism, renin-angiotensin system. d. Accessory excretory organs: Skin, liver, lungs etc. e. Excretory disorders, dialysis, Kidney transplant.

Muscle and Neural Physiology: a. Structure of smooth, skeletal and cardiac muscles; myofibrils. b. Isotonic and isometric contraction of muscles, sliding-filament theory of muscle contraction; relaxation of muscle fibres; Properties of muscles (muscle twitch, fatigue, summation, treppe, tetanus, rigor mortis), myopathy. c. Kinds of neuron, structure of myelinated and nonmyelinated nerve fibres. d. Origin and propagation of nerve impulse through different types of neurons and synapse. e. Reflex action, types.

Sensory Physiology: a. Tactile receptors, pain receptors, thermo receptors, chemoreceptors. b. Structure of human eye; image formation and colour vision. c. Eye disorders, lenses used in eye care. d. Structure of human ear, mechanism of hearing, kinds of deafness. e. EEG, MRI, CT-scan, mental health (epilepsy, neurosis, psychosis).

Immunology .

Basics of Immunity: a. Types of immunity: Active, passive, innate and acquired immunity. b. Antigens and antibodies. c. Types of antibodies and their structure. d. Interferons, cytokines (haptens ). e. Mechanism of reactions: Precipitation, agglutination, neutralization, opsonisation. 8. Cells and Organs in Immunity: a. Humoral and cell-mediated immunity. b. B and T cells. c. Lymphocytes: Helper, killer, memory and suppressor cells. d. Complement system, secondary lymphoid organs; tonsils,

adenoids, thymus, bone marrow, bursa fabricus, macrophages. e. Antigen - antibody reaction.

Immune disorders and techniques: a. Basic idea of immune disorders. b. Auto-immune diseases c. AIDS, mechanism of HIV infection. d. Monoclonal antibodies and their production. e. Applications of monoclonal antibodies; ELISA. 10. Vaccines and Transplants: a. Vaccination and immunization. b. Surface antigens; vaccines; hepatitis vaccine, attenuation (oral polio vaccine). c. Antivenoms. d. Organ transplants: Various types of transplant ( allograft, xenograft, autograft). e. Major histocompatibility complex.

Endocrinology:-

Introduction, basics and functions 1. Glands : Exocrine and endocrine; Secretions : Autocrine and paracrine.

2. Hormones : Chemical nature and properties, role in homeostasis.

3. Structure and functions of major endocrine glands : Pituitary, thyroid, parathyroid, adrenal gland, pancreas; their hormones, role and abnormalities due to hyposecretion and hypersecretion.

4. Structure and functions of minor endocrine glands : Thymus, pineal, GIT, kidney , heart; endocrine glands in insects; their hormones and role.

Control and regulation of secretion and molecular mechanism

1. Regulation of hormone secretion; positive and negative feedback control mechanism.

2. Extra cellular and intracellular receptors.

3. Second messengers: Cyclic AMP, PIP<sub>2</sub>, IP<sub>3</sub>, DG, G-protein, protein kinase and role of Ca<sup>++</sup> as messenger; cell signalling; amplification of signal.

4. Molecular mechanism of insulin action.

Role in reproduction

1. Hormones from testis, ovary and placenta, their structure and functions.

2. Importance of hormones in sexual differentiation in embryo.

3. Hormonal control of menstrual cycle, implantation, pregnancy, parturition and lactation.
4. Different types of contraceptives, their composition and effects.

## **ETHOLOGY , ECOLOGY AND EVOLUTION**

Introduction and basics 1. Introduction and history of behaviour, approaches and study of animal behaviour (ecological, physiological, evolutionary and neural methods) MRI and CAT scan.

2. Genetic basic of animal behaviour and evolution of ethology.
3. Biological clock; circadian and circannual rhythms.
4. Learning and imprinting, instinct behaviour.

Areas of behaviour 1. Searching of food : Honey bee , rhesus monkey and langoor.

2. Social behaviour and organization: Honey bee, termite, mammals (black-buck and monkeys).

3. Communication, fights and alarm call : Vocal, visual, tactile, olfactory and acoustic; honey bee language; pheromonal and hormonal basis of aggression, brain hormone relation in sexual behaviour.

4. Migration in fishes and birds. Orientation : Taxes and kinesis.

'Ecology' as a science, its meaning and history. Modern concept, scope, components of ecosystem, abiotic physical factors : temperature, light, water, soil and soil profile, current, pressure, gravity, biotic factors, intraspecific and interspecific relation, concept of limiting factors; Liebig's law of minimum, Shelford's law of tolerance, modern concept, importance.

Population ecology : Determination of population density, factors affecting population density, demography, community ecology, characteristics of bio-community, interdependence for reproduction and protection , ecosystem homeostasis, ecosystem and productivity concept, its types and methods, energy flow, food chain and food web in ecosystem, ecological pyramids, ecological niche.

Aquatic ecology, fresh water lotic and lentic fresh water habitat, fresh water biota, marine habitat, zonation, marine water biota, ecology and biota of deep sea zone, estuarine habitat and biota, terrestrial habitat, forest and desert ecosystem and biomes, ecology and human future, growth rate, role of man in modification of natural communities.

Natural resources, renewable resources (forest/wild life), non-renewable resources (water, mineral resources), aquaculture and Mariculture, conservation, management of natural resources - renewable resources, non-renewable resources, environmental pollution, types (water, air, soil, pollution by insecticides, noise). Basic concepts of bioaccumulation, biomagnification, and biodegradation of pollutants, impact of urbanization, characteristics of urbanization in India, urban problems.

Functions and importance of biostatistics, frequency - distribution, presentation of data, mean, mode, median, deviation, error, probability-distribution, correlation, significance-tests, biostatistical analysis of gene distribution in populations.

Evolution 1. Basics and origin of life: Definition, pre-darwinian theories of evolution; Oparin- Haldane concept of origin of life; Miller- Urey experiment; molecular evolution of RNA, proteins and DNA;

2. Micro-evolution: Work and theories of Lamarck, Weisman and Darwin; theory of natural selection of Darwin and Wallace, neo-darwinism.

3. Evidences of evolution: Various evidences favouring evolution: Homology, analogy, vestigial organs; palaeontological, embryological, biogeographical and biochemical evidences; adaptive radiations, mimicry.

4. Genetic basis of evolution and speciation : Hardy-Weinberg law, gene frequency, genetic drift, factors affecting Hardy-Weinberg law, Founder effect, bottle neck effect, Sewall -Wright effect; speciation; role of various isolating mechanisms in speciation.

5. Macro-evolution: Geological time scale and imperfection of geological record, continental drift, human evolution.

## **DEVELOPMENTAL BIOLOGY**

- a. Historical perspective and scope of developmental biology.
- b. General idea of asexual reproduction (fission, budding, gemmule formation, metagenesis, polyembryony etc.).
- c. An introduction to animal development in sexually reproducing animals.
- d. Neuroendocrine regulation of reproductive organs; estrous and menstrual cycles.

Gametogenesis and fertilization

- a. Gametogenesis: Definition; structure of gametes (sperm and egg).

- b. Spermatogenesis and oogenesis.
- c. Types of eggs; detailed structure of amphibian, avian and mammalian egg.
- d. Fertilization: Events of fertilization, polyspermy and preventing mechanism.
- e. Significance of fertilization; parthenogenesis; evolution of viviparity.

Cleavage and Gastrulation

- a. Cleavage, creating multicellularity; definition of embryonic cleavage, morula; blastula, patterns and planes of cleavage; blastulation, types of blastula.

- b. Types of gastrulation mechanisms.
- c. Fate maps (with suitable examples); cell lineage.
- d. Reorganization of embryonic cells, gastrulation in amphibians, birds and mammals.
- e. Morphogenetic cell movements and their significance in gastrulation.

Induction, Differentiation, Organogenesis and Regeneration

- a. Embryonic induction, organizers, competence.
- b. Mechanism of cellular differentiation; sex determination during development. Government rules against sex determination during pregnancy.

- c. Neurula formation, growth and organogenesis.
  - d. Regeneration: types and mechanism. Senescence and ageing.
- Embryonic adaptation
- a. Salient features of development of frog/toad; amphibian metamorphosis and its endocrine regulation.
  - b. Extraembryonic membranes in chick, salient features of development of chick upto 72 hours of incubation.
  - c. Placentation in mammals: Definition, types; classification on the basis of morphology and histology; functions of placenta.

## **APPLIED ZOOLOGY AND BIOSTATISTICS**

Principles and Practices of the following:

1. Vermiculture
2. Sericulture
3. Lac culture
4. Apiculture
5. Aquaculture
6. Poultry keeping

Economic Importance of the following

1. Protozoa
2. Coral and coral reefs
3. Helminthes
4. Arthropoda: Insects and their management
5. Mollusca: Outline idea of pearl culture

Biostatistics

1. Introduction, Scope and Application of Biostatistics.
2. Understanding the concepts of descriptive and inferential statistics
3. Frequency distribution
4. Graphical and tabular presentation of data
5. Mean, Median, mode and their significance
6. Standard deviation, standard error and Significance
7. Hypothesis: Null and Alternative; Student's t-test