

Syllabus for Ph.D. (Zoology) Entrance Exam 2021

1. Section A is compulsory for all students.
2. Section B is choice based, consisting of three different papers Cytogenetics, Physiology and Entomology. Students should attempt any one of these.

ZOOLOGY SYLLABUS

SECTION-A

RESEARCH METHODOLOGY

1. Principles and applications: Phase contrast microscopy, Fluorescence microscopy, Scanning electron microscopy (SEM) and Transmission electron microscopy (TEM).
2. Principles and applications: Paper Chromatography, Thin layer chromatography (TLC), Gas chromatography (GC), High pressure liquid chromatography (HPLC), Ion exchange and affinity chromatography.
3. Principles of biophysical methods for structural analysis of biopolymers: X-ray diffraction, fluorescence, Infrared, UV and circular dichroism (CD) spectroscopy NMR, ESR and atomic absorption and plasma emission spectroscopy, Flame photometry.
4. Principles and applications of tracer techniques: Radioactive isotopes and half life of isotopes, Autoradiography, Liquid scintillation spectrometry.
5. Molecular techniques: Polymerase chain reaction, Southern, Northern, Western Blotting. Principle of Electrophoresis: Polyacrylamide gel electrophoresis, (SDS-PAGE), Agarose gel electrophoresis, DNA sequencing.
6. Practice of statistical methods in biological research: Basic statistics-average, statistics of dispersion co-efficient of variations, Probability distribution- binominal, poisson and normal, Arithmetic, Geometric and Harmonic means; moments; matrices, simultaneous linear equations; tests of hypothesis and significance. Models of population growth and interactions – Lotka – Volterra model, Leslie's matrix model, point source stream pollution model, box model, Gaussian plume model. Tests of statistical significance – simple correlation of regression and analysis of variance.

SECTION-B
(CYTOGENETICS/ ENTOMOLOGY/ PHYSIOLOGY)

1. CYTOGENETICS

- 1 Membrane structure: The lipid bilayer, Membrane proteins, Human erythrocyte membrane. Membrane transport: Diffusion and facilitated diffusion, Na⁺ K⁺ transport system, calcium and proton pumps, Co-transport by symporter and antiporters. Membrane potentials: Ultrastructure of neuron, Conduction of nerve impulse, Synaptic transmission.
- 2 Cytoskeleton: Microtubules, Intermediate filaments, Microfilaments.
- 3 Cell signaling: Cell surface receptors, Second messenger systems, Neurotransmitters.
- 4 Cell adhesion and communication: Tight and gap junction, Connexins and desmosomes, Adhesive proteins.
- 5 Lysosomes: Enzymes of lysosomes, Heterophagy, Autophagy.
- 6 Intracellular protein trafficking: Protein synthesis on free and bound ribosomes, Targeting of proteins to ER, Membrane protein segregation and Golgi sorting.
- 7 Prokaryotic genome: Chemical composition of genome, Organization of genome into nucleoid. Extra chromosomal DNA: Bacterial plasmids and episomes, Transposable genetic element of bacteria.
- 8 Organization of eukaryotic genome: C-Value paradox, Reassociation kinetics, Sequence complexity. Packaging of eukaryotic genome into chromosomes: Chemical nature of eukaryotic chromatin, Packaging into nucleosome, solenoid and supersolenoid.
- 9 Organization of viral genomes: Genetic analysis of bacterial viruses and retroviruses.
- 10 Genomes sequestered in organelles: Mitochondrial genome, Chloroplast genome
- 11 Molecular analysis of genomes: chromosome walking, Simple sequence repeats (SSR's) Variable number of tandem repeats (VNTR's), Molecular markers and their applications.
- 12 Genomics and proteomics: Introduction to genomics and proteomics, Functional genomics, Pharmacogenomics.

- 13 Cell division in eukaryotes: Cell cycle, Measurement of cell cycle period, Spindle organization, Chromosome movements, Synchronization of cell division, Regulation of cell division
- 14 Differentiation: Genetic determinants of development, Genetic Control of cell lineages, Genetic basis of pattern formation, Homeo-box, significance in differentiation, Cellular senescence.
- 15 Cancer: Macroscopic and Microscopic features of tumors, Mechanism of invasion and metastasis, Etiology and pathogenesis of neoplasia. Molecular Genetics of cancer: Oncogenes, Tumor suppressor genes, Mutator genes, Tumor markers.
- 16 Cell and environment: Effects of radiations on cells, Effects of Mutagens and drug on cells. Apoptosis- mechanism and Significance.
- 17 Organization of human genome: Techniques in human chromosome analysis, Human karyotype and nomenclature, Morphological characteristics of human somatic chromosomes, Morphological variability of human chromosomes: satellite variability, acrocentric chromosomes and secondary constriction.
- 18 Sex determination and sex linked diseases: X chromosomes and X linked diseases, Y chromosomes and Y linked diseases, Dosage compensation.
- 19 Chromosome banding and mapping: C, G, Q and R banding, Chromosome painting, Somatic cell hybridization and in situ hybridization, Restriction maps and construction, Physical map of human genome.
- 20 Numerical abnormalities of human chromosomes: Non disjunction and aneuploidy, Patau syndrome, Edward syndrome, Down syndrome, Turner syndrome and Klinefelter syndrome, Mosaics and chimeras.
- 21 Structural abnormalities of human chromosomes: Deletions and robertsonian translocations, Cri-du-Chat syndrome, Pader-Willi syndrome, Williams syndrome and Wolf-Hirschhorn syndrome, Genomic imprinting.
- 22 Genetic screening and prenatal diagnosis: Prenatal, neonatal and adult screening, Pedigree analysis and genetic counselling, Pre-implantation diagnosis and genetic imprinting, ELSI.
- 23 Gene therapy: Criteria for effective gene therapy, Therapy of recessive and dominant disorders, Current gene therapy and its future.

2. ENTOMOLOGY

- 1 Morphology of head, thorax and Abdomen: Head: Morphology of facial sutures, Morphology of facial region, the types of antennae and legs in Insects, Morphology of generalized & specialized mouth parts. Thorax: The neck region in Insects, Topography of typical tergum, sternum and pleuron, Generalized structure of wing and wing modifications. Abdomen: Insect abdomen generalized structure, Generalized structure of external male and female genitalia.
- 2 Integument and Metamorphosis, General introduction to insect orders: Origin and evolution of Insects
- 3 Insect general body systems: Digestive system, Excretory system, Circulatory system, Respiratory system, Reproductive system, Nervous System, Sense Organs and Endocrine glands.
- 4 Biological control and Procedure: Parasites, Predators, Micro organisms
- 5 Introduction to IPM: Resistance to Insecticides, Introduction to transgenic crops.
- 6 Toxicology: Mode of action of various insecticides, Brief idea about antidotes, Route and sites of toxicity.
- 7 Basic Principles of insect pest control: Quarantine, Mechanical control, Physical methods of control, Synthetic organic insecticides (Organochlorines), Natural organic insecticides, Inorganic insecticides.
- 8 Insect pests: Emergence of pests and pest resurgence, Life history, mode of damage and control of insect pests of cotton, wheat, sugarcane, rice, pulses, oil seeds, vegetables, Stored grain pests, their biology and control, Biology and control of locust, Household pests.
- 9 Arthropods as vectors of human diseases, Systematics, biology and control of major insect vectors belonging to Diptera, Mode of transmission, control of vectors and epidemiology of Malaria, Filariasis, Dengue and Plague

3. PHYSIOLOGY

- 1 Histology of the adult mammalian testis: Structure and function of the Leydig cells, Endocrine function of the sertoli cells, Spermatogenesis and its hormonal control, Abnormal spermatogenesis and male fertility, Function of the male accessory reproductive organs-epididymis, seminal vesicles, prostate gland, Structure of spermatozoa, Biochemistry of semen, Capacitation of spermatozoa.
- 2 Structure of adult mammalian ovary: Folliculogenesis and ovogenesis, Hormonal factors in ovulation, Corpus luteum and its function, Reproductive cycles and their hormonal

regulation, Functions of placenta, Regulation of parturition , Structure, development, differentiation, and hormonal regulation of mammary glands, Factors regulating the initiation and maintenance of lactation.

- 3 Basic concepts of environmental stress and Thermal stress: Rate effects, Acclimation and acclimatization, Endothermy in invertebrates, Nature of chilling and freezing injuries, mechanisms of cold tolerance and resistance, Molecular mechanisms of thermal acclimation in poikilotherms- homeokinetic and homeoviscous adaptations.
- 4 Water, osmotic and ionic stress: Preservation of intracellular solvent capacity and associated metabolic adaptation, Ionic regulation in Micro-organisms. Regulation of intracellular osmolarity; role of glutamate dehydrogenase; coupling of water transport to active transport of solutes, Sodium pump and Na, +K, + ATPase in relation to salinity adaptation in freshwater and sea water fishes, Ion transport in avian salt gland and its neuroendocrine regulation.
- 5 Pressure stress: Rate effects, Enzymatic adaptations to hyperbaric stress with special reference to deep sea fish, Adaptations to depth problems; concept of buoyancy in marine organisms, Physiology of aviation and space: Effects of centrifugal and linear acceleratory force on the body, Weight lessness in space.
- 6 Oxygen deficient stress: Oxygen debt in vertebrate muscle and its anoxia adaptations , Anoxia adaptation in anaerobic vertebrates, Biochemical adaptations to high altitude in man. Respiratory Adaptations in parasitic habitats, Hypoxic & hyperoxic adaptations in organisms inhabiting shore lines and estuaries.
- 7 Physiology of digestion: The basic pattern and innervations of the gut wall, Digestion and absorption of carbohydrates, proteins and lipids. Role of liver and pancreas in digestion, Neural regulation of gastrointestinal movements. General disorders of the gastrointestinal tract: Vomiting, Gastritis, Peptic ulcer, Gastrointestinal obstruction.
- 8 Physiology of respiration: Air conducting passages and respiratory surfaces, Mechanism of breathing, Volume and capacities of lungs, Alveolar ventilation and dead space, Transport of O₂ and CO₂ in the blood, Chemical control of respiration. Pulmonary abnormalities: Emphysema, Pneumonia, Atelectasis, Asthma, Hypoxia.
- 9 Physiology of excretion: The functional anatomy of mammalian kidney and its renal unit, The role of ultrafiltration, re-absorption and secretion as transport mechanisms involved in the formation of urine, Control of urinary concentration of sugar, urea, sodium, potassium and pH, Functions of aldosterone. Antidiuretic hormone and rennin angiotensin system in renal physiology, Regulation of acid-base balance.
- 10 Physiology of blood circulation: Pacemaker system and the specialized conducting fibres, Cardiac action potentials, Cardiac cycle, Cardiac output, Blood pressure and its regulation, Lymphatic system.

- 11 Physiology of Muscle contraction: The biochemistry of contraction with special reference to the physiology of skeletal muscle fiber : Ultra structure and the structural proteins of muscle cells, The sliding filament theory of muscle contraction and the source of energy for contraction, Excitation of muscle contraction and the mechanism of coupling between the electrical and chemical events, Work and heat relations in muscle contraction, Physiological types of muscles (skeletal, cardiac and smooth) and their functional specialization, Mechanism of contraction in non-muscular cells.
- 12 Applications of the laws of thermodynamics to the cell :The First law of thermodynamics : The law of conservation of energy, Entropy and second law of thermodynamics, The Law of conservation of matter and life , Cellular enzymes: Hydrolytic enzymes, Enzymes involved in cellular oxidation – reduction, Release of energy in cells: Pathway of oxidation reduction reactions of the cell, Determination of redox potentials in living cells.
- 13 The functional significance of cell membranes: The chemical composition of cell membrane, The models of membranous structure, Cell to cell contact and communications, Biological transport processes: Osmotic flow, Facilitated diffusion, Active transport, Bulk transport (endocytosis, phagocytosis, pinocytosis, exocytosis etc.)Membrane bioelectrics: Action potentials in excitable plant cells, Sensory fiber action potentials, Synaptic transmission of action potentials.