

Syllabus for Ph.D Entrance Test

UNIT-1: ECOLOGY AND ENVIRONMENTAL BIOLOGY Concept of eco-system: Ecological habitat, niche, Ecological equivalents, Hydrological cycle, Energy flow in an ecosystem, Mineral cycling: Carbon, Nitrogen, Phosphorus; Primary & Secondary productivity and their methods of determination Limiting factors: Law of minimum, Law of tolerance, Biotic community concept Intra-community classification, Patterns in communities, Ecological dominance, Species diversity, Ecotones, Edge effect, Succession: Types, Mechanism, Concept of climax, Soil subsystem, Characteristics of Population: Size & density, Dispersal, Dispersion, Age structure, Natality, Mortality, Life tables, Isolation, territoriality, Biological Invasions, Species interaction: Competition, Predation, Parasitism, Commensalism, Mutualism, Sources and Uses of Non-conventional energy, Bio-indicators, Bio-remediation, Sustainable development, natural resources management in changing environment, Biodiversity: Definition, Assessment and Management, Natural resources, Wild life and its management, Aquatic resources: Freshwater, Marine and Estuarine, Conservation Biology, Principles, Keystone species, *in-situ* & *ex-situ* conservation, Acts & International Conventions, Estimation of CO₂, D.O, Ca²⁺, CO₃²⁻, HCO₃⁻, Mg²⁺, Primary productivity, SOM, BOD, dissolved organic matter

UNIT-2: FUNDAMENTALS OF GENETICS Structure of chromatin: heterochromatin, euchromatin, Nucleosome model, Chromosome structure, Lampbrush & Polytene chromosomes, Mitochondrial Genome, Numerical and structural chromosomal variations in humans, Structure of DNA: nucleotides and various models, Types of DNA, Repetitive DNA, Mutation: Types, causes and detection, Insertional mutagenesis, DNA Repair and mechanisms, Transposons in prokaryotes & eukaryotes, DNA replication and Recombination, Origin of replication, enzymes involved and replication fork, DNA replication in eukaryotes and prokaryotes, RNA synthesis and processing, Transcription factors, Transcription in Prokaryotes and Eukaryotes, RNA processing: RNA splicing, polyadenylation, RNA editing, Types of RNA, Protein Synthesis and processing, Genetic Code, Translational inhibitors, Post translation modifications, Regulation of gene expression in prokaryotes & eukaryotes, Role of chromatin in gene expression and gene silencing, general principles and BSL guidelines for working in molecular genetics lab, preparation of temporary mount of salivary gland of *Chironomus* larva and study the polytene chromosome structure, procedure of blood sample collection and storage from different individuals, DNA extraction from the stored blood samples by using organic method, Qualitative and quantitative analysis of extracted DNA samples, agarose gel electrophoresis of DNA sample.

UNIT-3: ICHTHYOLOGY AND ENTOMOLOGY Morphological characteristics of fishes, Body form and its diversity, Fins, Outline classification of fishes, Scales: types, structure and functions of scales, Coloration: chromatophores, pigments and biological significance of coloration in fishes, Bioluminescence in fishes and its significance, Electric organs: their structure and use in fishes, Venomous and poisonous fishes, Sense organs in fishes, Feeding and Respiration in fishes, Reproductive organs and Accessory sex organs, Secondary sexual characters, Types of eggs, Hatching, Metamorphosis, Deep sea fishes, Hill stream fishes, Cave dwelling fishes, Arctic and Antarctic fishes, Migration & Osmoregulation in fishes, Insects: General Organization and Classification, Morphology of insects, Types of Antennae in insects, Compound eye, Leg modifications in insects, Chemoreceptor and Mechanoreceptor, Metamorphosis: its types and regulation, Diapause & Stridulation, Defence mechanism in insects, Mouth parts of various insects : Cockroaches, grasshoppers, mosquito, butterfly, bug, housefly, honeybee, different types of larva and pupae

UNIT-4: IMMUNOLOGY, CELLULAR ORGANIZATION, CELL SIGNALLING 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, Toll-like receptors, cell-mediated effector functions, inflammation, hypersensitivity and autoimmunity, Immunological Techniques-ELISA, Immunoprecipitation, Immuno blotting, Total Leukocytes Count (TLC), Differential Leukocytes Count (DLC) of the given sample, Cell division and cell cycle, Cell signaling Hormones and their receptors, cell surface receptor, signaling through G-protein coupled receptors, signal transduction pathways, second messengers, regulation of signaling pathways, Membrane structure and function, diffusion, osmosis, ion channels, active transport, membrane pumps, mechanism of sorting and regulation of intracellular transport, electrical properties of membranes, Nucleus, mitochondria, Golgi bodies, lysosomes, endoplasmic reticulum, apoptosis, cell death in *C.elegans* and *Drosophila*

UNIT-5: RESEARCH INSTRUMENTATION & BIOTECHNOLOGY Electrophoretic techniques, Chromatography, Centrifugation: principles and types, Bright Field Microscopy, Dark Field Microscopy, Electron microscopy: Transmission Electron microscopy and Scanning Electron microscopy, Fluorescence Microscopy (Principle and Types), Polymerase Chain Reaction, DNA sequencing Techniques: Sanger Sequencing, Chemical Degradation method, Southern Blotting, Western Blotting, Northern Blotting, Slot Blots and Dot Blots, Isolation and purification of RNA, DNA, Proteins, Recombinant DNA Technology, Gene cloning, Plasmids, bacteriophage, phagemids, cosmids, YAC, BAC, HAC, Generation of genomic and cDNA libraries, Restriction enzymes, types, classifications and examples, Laboratory facilities for Animal Tissue culture, Tissue culture; Slides, Flasks, Test tube culture, Primary culture, cell line and cloning, Disaggregation of tissue, Maintenance of cultured-cell lines, Large scale cell culture, Tissue and organ culture, Whole embryo culture, Tissue engineering: Artificial skin

and artificial cartilage, Gene Therapy, Transgenic Animals, Analysis of Nucleic acids and proteins, Isoelectric focusing gels, Demonstration of ELISA, RFLP analysis, Electrophoresis of DNA

UNIT-6: FUNCTIONAL ANATOMY AND ENDOCRINOLOGY Principles of hydrostatic skeleton: Locomotion based on hydrostatic skeleton, Functional significance of coelom in locomotion in Echinodermata and Mollusca, Skeletal system in vertebrates, Mechanism of food intake, Fluid/liquid feeding, Particulate solid feeding mechanism, Basic digestive mechanisms, Filter Feeding mechanism in: Polychaetes, Crustaceans, Mollusca, Respiration: Branchial, Tracheal, Pulmonary, Cutaneous, Excretion: Comparative study of excretory organs in Invertebrates & Vertebrates, Thermoregulation in vertebrates, Nerve net in coelenterate, Nervous system in Echinodermata,, Hemichordata, Annelids, Arthropods, Mollusca, Larval forms in Crustacean, Insecta, Echinodermata, Metamerism, Principles of flight in: Insects, Birds, Mammals, Endocrine glands, basic mechanism of hormone action, hormones and diseases, Pheromones: Types, Structure and Function, Hormonal action and assaying techniques

UNIT-7: ANIMAL PHYSIOLOGY Blood corpuscles, haemopoiesis and formed elements, plasma function, blood volume, blood volume regulation, blood groups, haemoglobin, immunity, haemostasis. 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. - Comparison of respiration in different species, anatomical considerations, transport of gases, exchange of gases, waste elimination, neural and chemical regulation of respiration. Neurons, action potential, gross neuroanatomy of the brain and spinal cord, central and peripheral nervous system, neural control of muscle tone and posture. Sense organs - Vision, hearing and tactile response. 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, Muscle Physiology, Digestive system - Digestion, absorption, energy balance, BMR, Enumerate the total RBC & WBC count, Examination of Human blood groups, Determination of Rh+ and Rh- blood groups, bleeding and clotting time of blood., Haemin crystal, preparation of blood smear and study the polymorph by Arneth's count of polymorph, structure of haemocytometer.

UNIT-8: BIOCHEMISTRY AND MICROBIOLOGY Composition, structure and function of biomolecules (carbohydrates, lipids, proteins, nucleic acids and vitamins), Fatty acid oxidation, Biosynthesis of saturated fatty acids, hormonal control of Adipose tissue, Lipolysis and Ketosis, Mechanism of oxidative phosphorylation, Glycolysis, Glycogenesis, Glycogenolysis & Gluconeogenesis, Oxidation of pyruvate to acetyl Co A, Citric acid cycle, Enzymes: General properties and classification, Coenzymes and their types, Isoenzymes, Kinetic properties of enzymes., Mechanism of enzyme activity, Inhibition of enzyme activity: Irreversible inhibition, Reversible inhibition., Competitive, Non-competitive, Uncompetitive, Structure and Function of carbohydrates, Glycoproteins and Glycophorins, Triacylglycerols, waxes, Phospholipids, Glycolipids, Steroids, Lipoprotein, Prostaglandins, Proteins : Structure, Function, Transamination & Deamination, Formation of Ammonia and its transport, Biosynthesis of Urea, Uric Acid & Creatinine, Quantification of the amount of carbohydrates, proteins, lipids, ash, moisture, Qualitative Analysis of Carbohydrates, Air borne diseases. Tuberculosis, Pneumonia, Diphtheria, Food/ water/ Soil borne diseases: Typhoid fever, Cholera, Tetanus, Viral diseases, Hepatitis, H1N1 infection, Rabies, Japanese Encephalitis, HIV AIDS, Biological nitrogen fixation: symbiotic and non symbiotic micro organisms, various bio-safety levels to be used in laboratory, working principle of autoclave & laminar air flow, Gram staining of bacteria, isolate and study bacteria from given sample of soil using serial dilution, pour plate and spread plate method, different techniques of streaking

UNIT-9: EVOLUTION Lamarck; Darwin—concepts of variation, adaptation, struggle, fitness and natural selection; Mendelism; Spontaneity of mutations, Taxonomic collections, preservation, curating, Taxonomic keys: Types, their merits and demerits, International code of Zoological Nomenclature (ICZN), The evolutionary time scale; Eras, periods and epoch, Evidences of Biological evolution, Comparative anatomy and morphology, Vestigial organs, Atavism and reversion, Paleontological: Formation and types of fossils, Connecting and missing links : Zoo geography and its significance, Evolution of Man, Allopatry and sympatry, Adaptive radiations, Isolating mechanisms

UNIT-10: REPRODUCTIVE AND DEVELOPMENTAL BIOLOGY Gonadotropin: types and functions, Sex steroids : structure, Biosynthesis & Role in Reproduction, Gametogenesis, Types of eggs and Egg membranes, Fertilization process, Capacitation, Recognition between male and female gamete, Acrosome reaction of sperm, Cortical reaction of egg, Sperm penetration into egg, Amphimixis, Environmental factors affecting breeding in fishes, amphibians, reptiles, birds, Secondary sex characters & Breeding Behaviour, Reproductive cycles in mammals, Patterns of cleavage, Types of blastula, factors involved in shaping the blastula (Blastulation in sea urchin, frog, chick, mammals), Process of gastrulation, Early development of chick., Development of Excretory organs, eye, ear, Extra embryonic membrane, Tissue interaction and induction in organogenesis, Metamorphosis in Amphibians, axes and pattern formation in *Drosophila*, amphibia and chick; organogenesis – vulva formation in *Caenorhabditis elegans*