

## 517. ZOOLOGY

### **Principles of Taxonomy and Functional Anatomy of Invertebrates & Vertebrates:**

Principles of taxonomy as applied to systematics and classification of Animal Kingdom.; Numerical taxonomy, phyletic relationship, cladistic and chondristic relationship.; Prokaryotic and eukaryotic organisms.; Symmetry, coelom and its origin, evolution and significance of Metamerism.; Concept of Protostomia and Deuterostomia; Inter specific associations – commensalism, symbiosis and parasitism.; Nutrition, reproduction and shell formation in protozoa; Cells and canal system in sponges.; General organization and affinities of Ctenophora, Rhynchocoela, Rotifera & Endoprocta.; Patterns of life cycles in helminthes and modes of transmission with reference to *Gyrodactylus*, *Fasciolopsis buski*, *Paragonimus*, *Diphyllobothrium* and *Loa loa*.; Filter feeding in polychaetes.; Parasites and larval forms in crustacean.; Social life in insects.; Metamorphosis in insects.; Vision in arthropoda.; Torsion, detorsion and their significance to gastropoda.; Phylogenetic significance of echinoderm larvae.; Systematic position and affinities of hemichordates.

Origin and salient features of Ostracoderms, Placoderms, Crossopterygians and Actinopterygi.; Origin, adaptive radiation and parental care in Amphibia.; Neoteny and paedogenesis and their evolutionary significance.; Origin and adaptive radiation in Reptiles.; Amniotic egg – structural engineering and evolutionary functions.; Origin and adaptive radiation in mammals.; Origin and evolution of molariform tooth.; Basic plan of Skull Vertebrate jaw suspension.; Joints – Diarthroses and synarthroses.; Microanatomy of purkinje cells, human retina and organ of corti.; Agricultural insect pests – their management.; Apiculture, sericulture and lac culture.; Culture of prawns, crabs mussels, pearls oysters, fish and frogs.; Poultry & Duck farming.

### **Genetics and Biostatistics:**

Mutation and chemical mutagenesis. Molecular basis of mutation; Chromosome structure (Prokaryote and Eukaryote) identification, banding techniques, Karyotype, Chromosome breakage and fragile sites.; Concepts of gene and genomics, gene regulation in prokaryotes and eukaryotes.; Genetic disorders – chromosomal disorders, inborn errors of metabolism, polygenic and environmental disorders and genetic counseling.; Quantitative genetics, gene frequency, gene pool, distribution patterns, Hardy Weinberg law of genetic equilibrium and disequilibrium, factors affecting gene frequency.; Population genetics: genetic variation, polymorphism, inbreeding, cogeneic animals, Pedigree analysis, H2 HLA antigens, multiple alleles, bloodgroup antigens.; Bacterial genetics transformation, transduction, conjugation, viral lytic and lysogenic cycle.; Measures of central values,

mean, median, mode, geometric mean (grouped and ungrouped data).; Measures of dispersion, range, quartile deviation, mean deviation, variance, standard deviation, co-efficient of variance.; Correlation and regression analysis concepts and their application.; Probability and probability distribution.; Concept of probability, addition and multiplication laws of probability and application to the problems of biology.; Concept of random variable, expectation and variance of random variable, probability distribution, binomial & Poisson distribution properties and applications to biological problems.; Normal distribution: Properties and application to biological problems.; Concept of sampling, sampling distribution of mean, standard error and mean.; Small sampling test, t-test for hypothetical population, mean difference in two samples means.; Chi-square test, test for goodness of fit, test of independence and heterogeneity. Analysis of variance – one way and two-way analysis.

### **Cell and Molecular Biology:**

Cell permeability – Transport across the cell membrane: Transport of small molecules, Carrier proteins. Ion pumps, Membrane bound enzymes.; Cell communications – Inter cellular communication and gap junctions chemical signaling between the cells. Strategies of chemical signaling.; Signaling mediated by intracellular receptors, signaling mediated cell surface receptors – second and third messengers, C – AMP, G proteins, Ca<sup>++</sup>, Ips and prostaglandins; Cell nucleus and organization of DNA into chromosomes, histones, formation of nucleosomes and packing of nucleosomes for higher order structures and pattern of nucleosome packing, role of histones. DNA sequence specific proteins and gene regulation. Higher level of organization of chromosomes - bands on mitotic chromosomes; Nucleic acids – Chemistry of DNA and polymorphism of DNA.; DNA replication – semi conservation, enzymology of DNA replication, replication of C-DNA, initiation, elongation and termination of replication process. Proof reading functions of DNA polymerases.; Chemistry of RNA – classes of RNA, mechanism and enzymology of RNA.; DNA repair mechanism – High fidelity of DNA sequence – Repair of damage caused by UV light. Eukaryotes repair systems.; Introduction of DNA technology – safety guidelines.; Restriction of endonucleases – generation of fragments, restriction fragment length polymorphism (RFLP), use of restriction enzymes in cloning, restriction mapping.; Applied molecular biology – DNA sequences – Maxim and Gilbert methods, Sanger's method Application of recombinant DNA technology with reference to the example of insulin, somatostatin, and interferon. DNA fingerprinting and its application.; Cloning strategies – Shotgun cloning, construction of gene libraries, genomic library and DNA library.

### **Physiological Chemistry & Animal Physiology:**

Osmoregulation - Osmoregulatory problems in brackish water, fresh water and marine organisms; Water and solute regulation; Osmotic problems in terrestrial animals.; Hormonal control of osmoregulation; Phylogeny of ADH in animal groups.; Excretion - detoxification of nitrogen products; physiology of excretion; Urine formation - counter current mechanism and hormonal

regulation.; Thermal physiology - Temperature and survival in Poikilotherms (or ectotherms), homeotherms and heterotherms, and their mechanisms of survival.; Overview of digestion and absorption in mammals.; Respiration - Transport of respiratory gases; factors influencing oxygen and carbon dioxide transport.; Circulation - Cardiac cycle and principles of hemodynamics.; Immune system - Antigen; Immunocomplement cells, Immunoglobulins.; Cell-mediated and humoral immunity; cellular co-operation and complement.;

Water in the cell environment, concept of pH-Henderson and Hasselbach equation.; Enzyme kinetics, derivation of  $K_m$ ,  $K_m$  values and LB plot/ Hill Plot.; Mechanism of enzyme action and regulation of enzyme activity.; Chemistry and structure of mono, di and polysaccharides.; Metabolism of carbohydrates – glycolysis; TCA cycle; gluconeogenesis and Hexomonophosphate shunt.; Biological oxidations, Role of respiratory chain in energy capture, ATP synthesis; Bioenergetics of high-energy compounds (ATP, GTP, ADP, CP and PEP).; Classification of proteins, Proteins, protein structures – primary, secondary, tertiary and quaternary.; Structure physical and chemical properties of amino acids.; Catabolism of amino acids – Transamination, deamination and decarboxylation.; Structure, classification and function of lipids, fatty acids, triglycerides. Phospholipids, cerebrosides, steroids and prostaglandins.; Oxidation and biosynthesis of fatty acids.; Porphyrins and bile pigments.

### **Environmental Biology**

Types of ecosystem – freshwater, marine and terrestrial.; Population characteristics and dynamics – conceptual approach.; Growth curves and pyramids: Sigmoid, J Curve and hyperbola; Logistic equation and concepts relating to growth.; Community analysis, species diversity, ecotone concept and edge effect. Interaction between environment and biota Habitat and ecological niche and niche overlap. Concept of Biome.; Concepts of productivity – Eutrophication of lakes. Biological indicator and water quality.; Human intervention and deforestation, erosion and leaching of essential minerals and fall of water tables.; Physical environment of high altitude, acclimation and adaptation to high altitude and aerospace environment.; Legislation and preservation of environment. Regulation and practices relating to environment of home and work place.; An outline classification of xenobiotics. Natural synthetic pesticides and their mode of action. Bioconcentration and biomagnification of toxicants.; Toxicity analysis – calculation of LC 50 and LD 50 values – Dose response curves.; Carcinogens and chemical carcinogenesis. Test for assessing carcinogenicity – Ames test, micronucleus test and karyotyping. Toxicity vs chemotherapy.

### **Developmental Biology and Evolution:**

Gametogenesis: spermatogenesis, oogenesis, vitellogenesis, polarity, symmetry and Chemodifferentiation.; Role of cytoplasm and nucleus during early development, presumptive areas and fate maps.; Gastrulation and organogenesis - morphogenetic movements: epiboly and emboly

with examples.; Concept of organizers and induction.; Morphogenetic fields; cytological, genetic and chemical basis of differentiation Organogenesis: limb, central nervous system, heart, kidney, alimentary canal and eye.; Role of hormones in metamorphosis of insects and frog.; Teratogenesis; genetic and environmental teratogenesis; developmental mechanisms of teratogenesis.; Oncogenesis and cell growth; differentiation - normal and malignant; oncogenesis by mutation, gene amplification, insertion, chromosomal rearrangement and by loss of tumor suppressor genes.; Senescence - cell death.; Speciation - allopatric and sympatric; geographical distribution and isolation.; Primate evolution and human evolution.; Genomic evolution - outline organization of prokaryote and eukaryote genome, C-value paradox, selfish gene.; Pseudogene and transposons.;

### **Immunology:**

Adoptive and innate immunity.; Activation of B and T Cells. Production of effectors - antibodies and cytokines. Control of immune response. Role of macrophages in immunity.; Antigens nature, epitope, haptens, antigen presenting cells, adjuvants, antigenicity.; Antibodies, structure and function. Classification of antibodies - genetic basis of antibody diversity.; Complement system. Components of complement system pathways the classical and alternative, biological consequences of complement activation complement significance.; Major histocompatibility complex MHC structure and function. Genetic control of Immune responses, MHC restriction.; Hypersensitivity - Immunological basis. Classification of hypersensitivity in immune pathology Reaction I - IV, Type-I - anaphylactic hypersensitivity. Type-II - Immune complex mediated hypersensitivity. Cell mediated (Delayed-hyper) sensitivity.; Autoimmune diseases., The association of autoimmunity with diseases, Genetic factors, pathogenesis, aetiology, Diagnostic and prognostic value of antibodies, Treatment.; Transplantation - Barriers to transplantation, Genetic predisposition for graft rejection, prevention of rejection.; Immunity to infection - viruses, bacteria Fungi, parasites, nature of interaction. Immunopathological considerations.; Tumor immunology. Immunity to tumors tumor specific antigens. Immune surveillance.;

### **Instrumentation, Computer Applications & Animal Biotechnology:**

Centrifugation techniques: Principles and applications; Cell fractionation, Preparative and Analytical centrifugation; Ultra centrifugation.; Chromatography techniques: Principles and applications; TLC, Column chromatography - Adsorption, Partition, Permeation and Ion-exchange, GC, HPLC.; Electrophoresis Technique: Principle and applications; SDS-PAGE, Immune electrophoresis, Isoelectric focusing and Isotachopheresis.; Spectroscopic techniques: Principles and applications of visible, UV, Fluorescence, IR, ESR, NMR mass spectroscopy.; Radio isotopic technique: Principle and applications; Geiger – Muller counter, Scintillation counter, tracer studies and autoradiography.; Cell & Tissue Culture : Equipment and materials for cell culture technology,

principles of sterile techniques and cell propagation, primary and established cell line cultures; disintegration of tissues, Maintenance and segregation of cells, Cell synchronization and Cell transformation, Cell, Tissue, Organ and embryo culture; Tissue engineering Hybridoma technology and Monoclonal antibodies. ; Immunological techniques:agglutination ,precipitation ,RIA,ELISA, Western Blotting.; Computer applications in biology,computer basics-operating system, user interface( MS-office; Word, Excel, Powerpoint.) Internet, Statistical analysis and datamining.; Transgenic animals: Methods of transformation - DNA microinjection, Electroporation and Retroviral vector mediated. Transgenic animals as bioreactors/improved production capabilities(Cattle, Sheep,Pig), Ethical issues related to transgenic animals.; Gene therapy and diagnosis of genetic diseases: DNA in disease diagnosis and medical therapy of tuberculosis, Malaria, AIDS, Sickle cell anemia, Alzheimer's, Cancer and Diabetes; Gene therapy methods; Bone marrow transplantation and liver transplantation. Animal models for Human diseases (Thalasemia) Recombinant vaccines.; Animals as bioreactors.; Bio-pesticides: *Bacillus thuringiensis*, *Baculo virus*, *Entamopathogenic fungi*.; Silk worm Life cycle, Synthesis of Silk proteins, Manipulation of Silk protein synthesis.;