

SYLLABUS OF ZOOLOGY

UGZY-01

Animal Diversity-I

Block-01 Diversity of Animal Life-I (Organisation)

Matter - Living and Non-living, Chemistry of Living Matter, Specific Organisation, Metabolism, Growth and Development, Reproduction, Irritability, Adaptation, Homeostasis, Movement; Viruses- A Borderline case between Living and Non-living Things; Acellular and Cellular Organism, Cell Theory – Exceptions to the Cell Theory, Unified Cell Theory; Prokaryotes and Eukaryotes; Classification of Living Organisms – Species, Concepts in Classification, Binomial Naming of Organisms, Classification Systems – Two Kingdom Classification, Three and Four Kingdom Classification, Five Kingdom Classification, Limitations of Five Kingdom Classification, Interrelationships and Implications of Classification. Protozoans; General Characteristics, Structural Organisation and Function – Bodyform, Locomotor Organelles, Nutrition, Osmoregulation and Excretion, Respiration, Mechanisms for Response, Reproduction and Life Cycles, Encystment; Classification of Protozoa – Flagellated Protozoans, Amoeboid Protozoans, Spore forming Protozoans, Ciliated Protozoans; Parasitic Protozoans- Amoebae, Flagellates, Sporozoans, Ciliates. Levels of Body Organisation; Characteristics of Metazoa; Symmetry – Asymmetrical and Spherical, Radial and Biradial, Bilateral; Development Patterns – Cleavage, Fate of Blastopore; Germ Layers; Body Cavity- Pseudocoelom, Coelom; Cephalisation and Segmentation; Origin and Evolution of Metazoa – Syncytial Theory, Colonial Theory, Polyphyletic Theory.

Block-II Diversity of Animal Life-II (Classification)

Metazoan branches – Metazoa, Parazoa and Eumetazoa; Parazoa: Phylum Porifera - Sponges, Characteristic features, Classification; Phylum Cnidaria- Characteristic features, Classification, Coral Reefs; Phylum Ctenophora – Characteristic features, Classification; Phylum – Platyhelminthes – Characteristic features, Classification. Pseudocoelomata: Phylum Nematoda – Characteristic features, Classification; Phylum Rotifera – Characteristic features, Classification. Coelomata: Eucoelomata: Phylum Annelida, Coelom, Metamerism, Characteristic features, Classification; Phylum Arthropoda – Trilobitomorpha, Chelicerata, Crustacea, Uniramia; Phylum Onychophora; Phylum Mollusca – Monoplacophora, Polyplacophora, Aplousobranchia, Gastropoda, Bivalvia, Scaphopoda, Cephalopoda; Phylum Echinodermata – Asterozoa, Ophiurozoa, Echinozoa, Holothurozoa, Crinozoa; Other Phyla. Skeleton – Exoskeleton, Endoskeleton, Hydroskeleton; Polymorphism – Polymorphism in Cnidaria, Polymorphism in Insecta.

Block-III Comparative Forms and Functions

Locomotion; Significance of Hydraulic Pressure in Locomotion, Locomotion in Coelenterates, Locomotion in Flatworms, Nematodes, Annelida – Body Musculature, Hydrostatic Skeleton, Locomotor Structures, Mechanics of Locomotion; Arthropoda, Mollusca – Foot as a Creeping and Crawling Organ, Foot as a Burrowing Organ, Foot as a Leaping Organ, Foot as a Swimming Organ; Locomotion in Echinodermata. Nutrition in Non-Chordates – Feeding and Digestion in Sponges, Coelenterates, Flatworms, Annelids, Molluscs, Echinoderms, Arthropods; Excretion in Non-Chordates – Protonephridia and Metanephridia, Malpighian Tubules, Coelomoducts of Molluscs; Osmoregulation in Freshwater Non-Chordates and in Marine Non-Chordates, Water Conservation in Terrestrial Non-Chordates. Respiratory Systems – Respiratory Organs, Process of Respiration, Respiratory Pigments; Circulatory System – Open type and Closed type of Circulatory Systems. Organisation of Nervous System – Nerve Cell, Neuroglia,

Ganglia, Nerves; Primitive Nervous System: Nerve Net; Advanced Nervous Systems – Platyhelminthes, Annelids, Arthropods and Molluscs; Giant Nerve Fibre; Information Processing; Receptors – Properties, Mechanoreceptors, Chemoreceptors, Photoreceptors. Endocrine versus Neural Integration; Endocrine Organs – Neurosecretory Cells and the Concept of Neurosecretion, Neurosecretory Systems, Endocrine Organs; Hormones in Growth and Reproduction – Annelida, Mollusca, Arthropoda; Hormones Controlling other Functions. Asexual Reproduction – Binary Fission, Multiple Fission, Fragmentation, Budding, Strobilation, Formation of Special Reproductive Units – The Gemmules; Regeneration; Autotomy and Regeneration, Epitoky, Polarity and Regeneration; Asexual Reproduction. Prevalence and Significance; Sexual Reproduction – The Gametes and Significance of Sexual Reproduction, Sexual Dimorphism, Patterns of sexual reproduction, The Reproductive Organs, Accessory Sex Glands, Mating and Fertilization, Ovary, Vivipary and ovovivipary; Hermaphroditism; Parthenogenesis; Alternation of generations; Reproduction, Life Cycles and Larval Forms.

Block-IV Adaption and Behaviour Pattern

Solitary and Colonial Forms – Colonial Forms Among Protozoans and Metazoans; Adaptive radiations, Adaptive Radiations in Annelida, Arthropoda and Mollusca, Flight in Insects; Migration in Insects. Taxis and Kinesis; Biological Rhythms – Control of Biorhythms, Biological Clock; Communication Behaviour – Visual Signals, Mechanical Signals, Chemical Signals, Communication among Honeybees, Dance Language; Courtship Behaviour – Need for Courtship Behaviour, Sex Differences in Courtship Behaviour, Visual, Mechanical and Chemical Displays, Nuptial Gifts, Sperm Competition and Mate Guarding, Alternative Tactics of Mate Competition, Rejection and Deceit in Courtship; Social Organisation in Insects – Advantages and Disadvantages of Social Behaviour, Social Wasps, Ants, Honey Bees, Termites; Parasitism – Types of Parasites, Effects of Parasitism on Parasites. Parasitic Platyhelminthes – Class Monogenea, Class Trematoda, Class Cestoidea; Parasitic Nematelminthes – Class Nematoda; Injurious and Harmful Arthropods – Arachnids of Medical, Veterinary and Agricultural Importance, Insects of Medical, Veterinary and Agricultural Importance, House Hold Insects. Beneficial Nature of Non-Chordates; Phylum Arthropoda and Mollusca as source of food; Kinds of Honey Bees, Production of Honey, Composition of honey, Honey produced; Non Chordates yielding Industrial Products – Silk, Lac, Beewax, Shells, Pearls, Precious Corals, Sponges, Dyes and Pigments; Uses of Non-chordates; Agriculture, Soil, fertility; Non-chordates as pollinators and Destroyers of pests; Non-Chordates as Components in Food Chains and as Scavengers.

UGZY-02

Animal Diversity-II

Block-01 Diversity in Chordates

Phylum Hemichordata–Basic Adaptive Features, Affinities; Phylum Chordata: General Characters, Classification, Basic Adaptive Features, Affinities; Ancestry and Evolutionary Trends. Agnatha: General Characters and Classification; Pisces: General Characters and Classification; Some Common Fresh Water Fishes of India; Class Amphibia: Salient Features and General Organisation. Reptiles: Origin and Adaptive Radiation, Changes in Traditional Classification, Classification of Extant Reptiles, Main Characteristics, Distinguishing Features of Reptiles as Compared to Amphibians; Birds: Ancestry and Evolution, Classification,

Characteristics, Form and Function, Social Behaviour of Birds. Mammals: General Characters and Classification; Natural History: Monotremata/Prototheria, Marsupialia, Eutheria, Primates, Economic Importance; Evolution and Affinities; Threatened Species in India.

Block-II Function Anatomy of Chordates-II

Integument: Embryonic Origin; General Features of the Integument, Integument of Fishes, Tetrapods; Specialized Derivatives of the Integument–Nails, claws, Hooves, Horns, Antlers, Baleen, Scale. Dentition (Comparative Account of Dental Formula); Feeding Mechanisms: Fishes and Amphibians, Reptiles and Birds, Mammals; Digestive System in Non-mammalian Vertebrates: Fishes and Amphibians, Reptiles and Birds; Digestive System in Mammals. Respiratory System of Aquatic Vertebrates: *Amphioxus*, Cyclostomes, Fishes, Accessory Respiratory Organs in Fishes, Amphibians; Respiration in Terrestrial Vertebrates: Fishes with Lungs, Amphibians, Reptiles, Birds, Mammals; Voice Apparatus. Heart: Protochordate, Piscine, Early Tetrapod, Ectotherm and Endotherm Heart; Arterial System: Aortic Arches, Venous System; Embryonic Development of Cardiovascular System; Blood: Composition, Respiratory Pigments; Lymphatic System.

Block-III Functions Anatomy of Chordates-II

Urinary System in Protochordates and Vertebrates; Embryonic Development; Uriniferous Tubules; Kidney: Structure, Phylogeny, Succession of Kidney; Functions of Urinary System; Variation in Plan. Genital System: Embryonic origin, Functions, Genital System in Protochordates. Male Genital System: Testes, Accessory Sex Glands, Intromittent Organ. Female Genital Organs; Ovary, Ducts, External Genitalia, Mammary Apparatus. Survey of Gonads in Vertebrates. Nervous System; Central, Peripheral, Autonomic Nerves, Brain: Comparative Structure; Sense Organs; Specialised Sense Organs. Skeletal system: Cartilage and Bones; Classification of Skeleton: Axial and Appendicular; Skeleton of Frog and Rabbit: Skull, Ribs and Sternum, Skeleton of Limbs; Functional Adaptations. Endocrine Glands in Mammals: Pituitary, Thyroid, Parathyroid, Pancreas, Adrenals, Gastrointestinal and Gonadal Hormones; Endocrine Glands in Agnatha, Fishes, Amphibians, Reptilians, Birds.

Block-IV Adaptations & Behavioural Patterns

Definition of Behaviour; Importance of Studying Behaviour; Bases of Behaviour. Causes of Behaviour: Anatomical, Physiological, Ecological, Genetic; Innate Behaviour; Learning and Experience, Associative Learning, Extinction, Habituation, Latent and Insight Learning, Imprinting; Evolution of Behaviour; Adaptiveness of Behaviour. Organisation of Behaviour: Neural Command Centers, Rhythmic, Hormones; Social Organisation, Costs and Benefits, Types, Primate Social Organisation; Communication; Types of signals, Migratory Behaviour. Adaptive Behaviour: Colouration; Mimicry; Bioluminescence; Defence in Animals; Echolocation in Bats, Mammals and Birds, Locomotion in Vertebrates–Basic Plan in Water, Air, Ground.

UGZY-03

Animal Diversity Lab

Block-I

Unit-01 Non- Chordates (Practical Based On UGZY-01&02)

Block-II

Unit-02 Chordates (Practical Based On UGZY-01&02)

UGZY-05

Cell Biology

Block-01 Introduction to Cell Biology

Evolution of the Cell; Prokaryotic Structure, Bacteria, Virus; Evolution of Photosynthesis and Aerobic Respiration; Prokaryotes to Eukaryotes; Animal and Plant Cells. Light Microscopy, Electron Microscopy, Radioisotopes, Autoradiography and Antibodies; Tissue Culture and Cinemicrography. Details of Cell Structure and Functions of Cell Organelles. Chemical Components of Cell, Isolation and Detection of Cellular Macromolecules – Methods of Molecular Separation. Types of Bonds, Proteins, Nucleic Acids, Carbohydrates and Lipids

Block-02 Cell membranes and Enzymes

Self-Assembly; Self-Assembling Aggregates – Collagen, Actin, Cellulose; Nucleoprotein Aggregates – Tobacco Mosaic Virus, Ribosome; Cell Membrane, Membrane Fluidity, Membrane Asymmetry. Fluxes, Forces; Membrane Transport Processes – Free Diffusion, Osmosis, Facilitated Diffusion, Active Transport, Shuttle Processes; Electrical Potential Across Membrane. Transport Molecules; Inhibitors; Ion Gradient and Energy Exchange; Proton Pumps. Enzymes; Activation Energy, Coupled Reactions; Cofactors; Mechanism of Enzyme Action, Factors Affecting the Rate of Enzyme Action, Enzyme Kinetics; Allosteric Enzymes; Isoenzymes; Inhibitors; Assay of Enzyme Activity. Regulation of Enzyme Activity, Techniques for the Study of Metabolic Pathways

Block-III Metabolism and Communication in Cells

Energy Releasing Pathways; Functional Groups and Common Reactions, Glycolysis, Tricarboxylic Acid Cycle, Electron Transport Chain, Regulations; Degradation of Lipids and Proteins. Biosynthesis; Carbohydrates – Interconversion and Regulations, Structure of Glycogen and Starch, Sucrose and Starch Interconversions; Gluconeogenesis; Ketone Bodies; Glyoxylate Cycle; Synthesis of Fats. Nuclear Envelope and Components – Organisation and Functions, Replication of DNA, Enzymes involved in DNA Replication; Transcription in Prokaryotes and Eukaryotes, Types of RNA; RNA Processing in Eukaryotes. Protein Biosynthesis, Rate of Protein Synthesis; Processing of Protein Molecule; Regulation of Protein Synthesis. Strategies of Chemical Signalling, Signalling Mediated by Intracellular Receptors and Cell-surface Receptors, Second Messenger, Target Cell Adaptation; Bacterial Chemotaxis

Block-IV Cell Division, Cell movement & Differentiated Cell Types

Cell Cycle – Phase and Events; Determination of Cell Cycle Times; Regulation of Cell Division, Mitosis. Meiosis. Molecular Theory of Recombination; Differences between Meiosis and Mitosis; Cytokinesis, Distribution of Cytoplasmic Components. Intercellular Recognition and Cell Aggregation; Cell Junctions – Desmosomes, Tight Junctions, Gap Junction, Plasmodesmata; Cell Movements – Pseudopodia, Lamellopodia, Filopodia, Ciliary and Flagellar Movements, Phagocytosis; Extracellular Matrix – Components, Basal Lamina. Differentiated Animal Cell Types – A General Classification and functions; Tissues and cells. Differences between Plant and Animal Cells; Plant Cell Wall; Plant Cell and Tissue Types; Meristems and their Distribution; Plant Cell Growth.

UGZY-06

Animal Ecology

Block-01 Environment and its Components

Concepts of Ecology, Environment, Population, Community, Ecosystem, Biosphere; Detailed studies on the environmental components: Light, Temperature, Atmosphere, Water, and Soil .

Block-II Ecosystem: Functioning Types

Ecosystem as a unit of nature; Components of ecosystem; Tolerance range and limiting factor; Trophic level; Ecological pyramids; Energy input in ecosystem; Energy flow; Food chain and Food web; Ecosystem control; Biogeochemical cycling: Carbon cycle, Nitrogen cycle, Sulphur cycle, Phosphorus cycle, Nutrient budgets and Cycling in forests. Biomes of the world; Forests; Grasslands; Deserts; Aquatic ecosystems; Lentic ecosystems; Lotic ecosystems, Marine ecosystems; Estuaries.

Block-III Community Ecology

Community studies; Community gradients and boundaries, Analytic characters: Qualitative characters, and Synthetic characters; Succession: Primary and Secondary succession, Autotrophic and Heterotrophic succession, Autogenic and Allogenic succession; Processes in succession; Kinds of succession; Models of succession; Trends in succession. Community organisation – Habitat and Niche, Functional roles and Guilds, Keystone species, Dominant species, Stability, Community organisation; Species interaction; Evolution of competitive ability; Predation, Co-evolution of Predator-Prey system; Herbivory – Defence mechanisms in plants, Herbivore interactions and counter-measures. Population – Density, Natality, Mortality, Dispersal, Age distribution, Population distribution; Population growth – Factors affecting biotic potential, Carrying capacity; Population regulation – Density dependent factors, Genetic diversity of the population; Evolutionary implications of natural regulation.

Block-IV Humans and Ecology

Human evolution in relation to environment – Historical overview; Characteristics of human population growth, Trends in growth of human population; Population growth by region; Problems of resource use related to population growth; Future Trends. Causes of degradation of ecosystem; Defining wildlife; Threats to wildlife; Extinct, Threatened and Out of danger species; The Red Data Book; Importance of conserving wildlife. Measures for conservation of wildlife, Conservation in India; Pollution of Air, Fresh-water bodies, Ground water, and Marine water, Land; Pollution due to noise; radiation pollution; Control of pollution.

UGZY-07 Genetics

Block-01 Heredity and Phenotypes

Genetics - A historical perspective; Basic terminology; Mendel's classical experiments with pea, Law of Segregation, Law of Independent Assortment; The use of test crosses, Reasons for Mendel's success. Extensions and modifications of Mendelian genetic analysis – Dominance, Multiple alleles, Rh Factor alleles in humans, Incompatibility alleles in plants; Gene interactions and modified Mendelian ratios; Lethal alleles; Pleiotropy; Sex-linked genes; Degrees of gene expression; Environmental modifications of gene expression. Sex determination in prokaryotes and eukaryotes, Effects of environmental factors on sex determination; Genetic basis of sex determination. Sex linkage and dosage compensation – The Chromosome Theory of Inheritance; Sex-linkage; Sex-limited and Sex-influenced traits. Developmental basis of sex, Gonad formation: Role of hormones, Role of genes; Intersexes; Sex mosaics; Sex reversal; Sex ratio; Sex selection of the offspring. Linkage, Crossing-over and chromosome mapping – The Concept of crossing-over, Cytological basis and molecular mechanism; Genetic mapping, Why didn't Mendel find Linkage?

Block-II The Physical Basis of Heredity

Extra-nuclear inheritance – Early experiments; Maternal vs. extra-nuclear inheritance; Systems of extra-nuclear inheritance; Characteristics of extra-nuclear genome; Organelle inheritance dependent on nuclear genome; Organelle-associated linear plasmid DNA; Origin of organelles. Human chromosomes – morphology; Making preparations for cytogenetic studies; Chromosome banding types, and uses; Karyotyping – organisation, nomenclature, analysis; Chromosome heteromorphism; Molecular organisation – packaging of DNA into chromosome; Chromosome banding and taxonomic relationships. Structural abnormalities in chromosomes and their effects – Deletions, Duplications, Inversions, Translocations, Ring Chromosomes and Isochromosomes. Numerical abnormalities in chromosomes and their effects – Euploidy, aneuploidy, autosomal and sex chromosome aneuploidies and associated syndromes. The nature and structure of genetic material – Experiments performed in the search for genetic material, DNA as the genetic material, RNA as genetic material; The chemical composition of DNA and RNA; The physical structure of DNA: The Double Helix, DNA denaturation and renaturation; Conformational flexibility of DNA molecules. Genetics of Bacteria and Bacteriophages – Structure of a bacteriophage; Life cycles of phages; Plaque assay technique; Genetic recombination in a phage; Complementation analysis; Bacterial genetic system; Recombination in bacteria; Transformation – Molecular mechanism, Competence, Transformation and mapping of genes; Conjugation – Directions of transfer of genetic information, F^+ and F^- factors, High frequency recombinant bacteria (Hfr Bacteria), Conjugation and genetic mapping; Transduction; Plasmids and Episomes.

Block-III Gene Structure and Function

Gene Fine Structure – Bacteriophage as a genetic system for studies; Fine structure analysis of a gene – Recombination in *rII* mutants, Deletion mapping; Applying complementation test to the *rII* locus; The ultimate in fine structure mapping; Overlapping genes. Regulation of gene expression in prokaryotes – Control points of gene expression; Induction and repression in prokaryotes; Lactose metabolism and the operon, Positive control of the *lac* operon by the CAP and cyclic AMP; The tryptophan operon. Temporal sequences of gene expression during phage infection, regulation of gene expression and development in eukaryotes – Genetic organisation of prokaryotes vs. eukaryotes; Short-term gene regulation, Hormonal regulation; Gene regulation in development and differentiation; Models of gene regulation in eukaryotes. Mutations and mutagenesis – Somatic and gametic mutations, Spontaneous and induced mutations, Other categories of mutations; Detection of mutation; Molecular basis of mutations; Transposable genetic elements; Mutagenesis – physical and chemical mutagens, Environmental mutagens; Use of mutations. Carcinogenesis and teratogenesis – Chemical carcinogens, Radiation induced cancer, Oncogenic viruses, Genetic aspects of cancer; Prevention and cure of cancer; Teratogenesis. Immunogenetics – basic concepts, Non-specific defense system, Specific immune response, Antigen, antibodies; Cells involved in immune response – The cell types of immune system, Role of T and B lymphocytes in eliciting an immune response; Complement system; Genetics of antibody diversity; Major histocompatibility complex; Autoimmune diseases.

Block-IV Population and Applied Genetics

Genetics of blood – Chemistry and genetics of blood group systems; Haemoglobin gene in eukaryotes; Blood groups and medicine; Racial differences. Behaviour of genes in populations – Hardy-Weinberg Law; Determination of allelic and genotypic frequencies, Verification of Hardy-Weinberg law; Influence of evolutionary forces on gene frequencies. Continuous variations – origin; Quantitative inheritance, Polygenic hypothesis for quantitative trait; Effect of environment on quantitative traits; Components of phenotypic variance, Broad sense and narrow sense heritability, Estimation of heritability; Uses of

Heritability Estimates; Twin studies, Uses, Genetic inferences and problems. Behaviour and Genetics – methods, comparative approaches, Case studies on Behaviour; Genetics of human behaviour, Human behaviour traits with less defined genetical basis; Genetics and I.Q., Genetics and human welfare – Diagnosis through genetic counselling, Genetic screening, Therapy for inherited diseases; Recombinant DNA technique; Applications of genetic engineering. Genetics in agriculture and plant improvement – Regeneration of plants from callus tissues and protoplasts, The *Ti* plasmid of *Agrobacterium tumefaciens*, Gene transfer in monocotyledonous plants, Herbicide tolerant plants, Resistance to pests, Resistance to frost formation, Enhanced nitrogen utilisation, Improving nutritional value, Manipulating gene expression using antisense RNA.

UGZY-08

Animal Physiology

Block-01 Animal Physiology-I

Nutrition: Proteins, Carbohydrates, Lipids, Vitamins, Minerals and Trace Elements and, Water; Feeding Mechanisms; Digestive Tract and process of digestion, Digestive Enzymes, Maintenance of Gut Lining; Absorption of products of digestion; Energy Metabolism. **Respiratory System:** Respiratory Gases; Modes of Respiration; Gills, Lungs, Tracheae; Regulation of Respiration, Adaptations for Diving and Underwater Swimming; Transport of Gases in Blood: Haemoglobin. **Circulation:** Body Fluids: Composition of body fluids, Blood Plasma; General Plan of Circulatory Systems Structure of Mammalian Heart: Excitation of Heart, Cardiac Output; Blood Vessels: Blood Flow, Arteries, Veins, Capillaries, Blood Flow During Exercise, Lymphatic System; Haemostatic Mechanisms. **Excretion:** Nitrogen Excretion with Formation of Ammonia, Ammonotelism, Ureotelism, Uricotelism, Guanotelism; Excretory Organs: Functional Principles of osmolarity and membrane permeability, Contractile Vacuoles, Nephridia of Worms, Molluscan Kidney, Green Gland of Crustaceans, Malpighian Tubules of Insects, Structure of Vertebrate Kidney; Function and regulation of vertebrate kidney; osmotic and Ionic Regulation; **Problems of Osmoregulation:** Osmoregulation in Aqueous (Freshwater and Marine) and Terrestrial Environment; Hormones in Water and Electrolyte Regulation.

Block-II Animal Physiology-II

Movements: Amoeboid; Ciliary and Flagellar movements; **Muscle and Movements:** Structure of Vertebrate Skeletal Muscles, Mechanism and control of Muscle Contraction, Initiation of Muscle Contraction; Cardiac and Smooth Muscles. **Temperature Relations in Animals:** Effects of Temperature, Acclimation and Acclimatisation; Temperature Regulation in Poikilotherms and Homeotherms; Hibernation, Aestivation, and daily torpor Behavioural and Physiological Adjustments: Heat Production, Heat Loss, Heat Exchangers, Regulatory Mechanisms. **Reproduction:** Reproductive Mechanisms, Asexual and Sexual Reproduction; Functional Morphology of Reproductive Organs; Ovary, Testis, Accessory Reproductive Organs; Reproductive Cycles. **Communication I:** Nervous System and Nerve Cells; Nerve Impulse; Membrane Potential; Action Potential, All or None Response, Conduction of nerve impulse; **Synaptic Transmission:** Chemical Synaptic Transmission, Post Synaptic Potential, Electrical Synaptic Transmission; Neurotransmitters; Neural Circuits. **Communication-II:** Hormonal Control Systems: Chemical Nature, Synthesis and Storage of hormones: Secretion of Hormones:

Steroid Thyroid and Peptide Hormones; Neuroendocrine Connection: Hypothalamus and Pituitary, Regulation of Hormone Secretion; Insect Hormones; Pheromones.

Block-III Plant Physiology

Plant Water Relations: Early History of Ascent of Sap; Cohesion Theory of Ascent of Sap; The Pathways of Transport of Water; The Concept of Upper lower case Diffusion, Osmosis, Osmotic Pressure, Imbibition; Chemical and Water Potentials and factors affecting them; Resistance to Water Movement and Water Flux; Movement of Water in a Single Cell; Water Relations of a Tissue; Water Relations of a Whole Plant; Water Absorption: Soil Characteristics, Field Capacity; Water Loss: Stomata Structure, Frequency and Stomatal Resistance, The Mechanism of Stomatal Opening; Factors Controlling Stomatal Aperture. Nutrient Elements of Plants: Criteria of Essentiality; Classification and Functions of Essential Elements; Nutrient Absorption; Nutrients and the Soil, Uptake of Mineral Ions, Movement of Nutrients into the Roots; Transport of Ions: Ion Transport Across the Plasma Membrane, Transport with the Help of Membrane Proteins, Radial Movement of Ions into the Roots, Long Distance Transport; Role of Essential Elements: Macronutrients, Micronutrients. Photosynthesis: Formulation of Basic concepts; Formulation of the Equation of Photosynthesis; Evidence for the Existence of Light and Dark Reactions, The Role of Light Reaction; Chemistry of Chloroplast Pigments; Discovery of Two Light Reactions: Quantum Requirement of Photosynthesis, Red Drop, Emerson Enhancement Effect.

Photosystems I and II; The Dark Reactions: The Calvin Cycle; Photorespiration and the C₄ Plants; The CAM Plants; The Chloroplast – Ultrastructure and Organisation of Photosynthetic Machinery; Photosynthesis, Agriculture and Human Welfare: Efficiency of Photosynthesis, Environment and Photosynthesis, Agricultural Biotechnology; Evolutionary Aspects of the Chloroplast. Translocation in Plants: The Transport. Network; Origin and Delivery – The Source and the Sink; The Phloem elements – The Structural and Functional Relationship; Loading and Unloading of Sieve Tubes; Experiments on Phloem Transport.

Brief Account of Munich Pressure Flow Model; Fensom and Spanner Electro-osmotic Flow Hypothesis; Protoplasmic Streaming and Tubular Peristaltic Flow Model; Proto-osmotic Model.

Block-IV Plant Physiology-II

Biological Nitrogen-Fixation: The Gifted Species; Requirements of Nitrogen-Fixation, Development and Formation of Nodules in Legumes, Biochemistry of Nitrogen-Fixation: Factors Influencing Functions of Nitrogenase enzyme; Genetics of Nitrogen-Fixation, Measurement of Nitrogenase Activity; Nitrate Assimilation: Biochemical Reactions, Assimilatory Nitrate Reductase and Nitrite Reductase, Regulation of Nitrate Assimilation; Interaction between Nitrogen and Carbon Assimilation; Ammonia Assimilation: Biochemical Reactions, Uptake of Ammonia, Regulation of Ammonia Assimilation; Nitrogen Control of Nitrogen Assimilation; Sulphate Assimilation; Metabolic Interrelation of Nitrogen, Carbon and Sulphur. Hormones: Discovery and Characteristics of Plant Hormones; Role of Auxins, Gibberellins, Cytokinins, Ethylene, Abscisic Acid; Other Growth Regulators; Hormones Action; Applications. Development and Differentiation: Vegetative Development: Definitions, Seed Formation and Germination, Dormant Vegetative Structures; Flowering: Plant Response to Light-Dark Cycles, Importance of Dark Period, Flowering Hormone, Chilling and Flower Induction, Biochemical Changes; Phytochrome: Discovery of Phytochrome, Properties of Phytochrome, Biological Responses Controlled by Phytochrome, Mechanism of Action; Senescence: Regulation of Senescence, Biochemical Changes Associated with Senescence; Tissue Culture: Historical Perspective and Development of Techniques, Organ, Tissue and Protoplast

Culture; Biological Clocks: Factors Affecting Rhythms. Plant and Stress: The Nature of Stress: Physical, Chemical and Biological Stress; Ways to Adapt to Stress: Altering the Molecules at Work, Changes in the Morphology and Behaviour of Plants, Use of Alternate Metabolic Pathways; Plant Responses to Specific Stress Conditions; Future Prospects.

UGZY-09 Development Biology

Block-01 Plant Development-I

Gametogenesis Anther and Ovule; Pollination and Fertilization – Incompatibility – types and biological significance, Overcoming incompatibility; Apomixis – types and their peculiarities, Parthenogenesis and Significance of apomixis. Endosperm – Development, structure, fate and morphological nature, Types, Endosperm haustoria; Variants. Embryogenesis – Histogenesis and organogenesis; Dicotyledonous and Monocotyledonous embryo; Polyembryony and its uses. Seed – Parts; Developments; Appendages; Stored metabolites; Fruit – Development and Dispersal; Vivipary.

Root and shoot Morphogenesis; Topology and organ shapes; Tropic responses. Plant growth regulators and development, Apical dominance and genetic studies; Applications. Secondary growth in typical dicotyledonous stem; Secondary growth in monocot stem; Periderm – structure, origin and development, Cambial variants – In stems and roots. Plant tissue and organ culture – Cellular totipotency – Organogenesis, Somatic embryogenesis; Applications. Current trends in developmental studies – The future.

Development in Eukaryotic Unicellular Animals; Structure of the Sperm and Spermatogenesis and Spermiogenesis, Oogenesis. In Amphibians and Mammals Egg structure and fertilization. Events Prior to and Post Sperm-Egg Fusion, Fusion of Sperm and Egg Pronuclei, Initiation of zygote and development cleavage: Yolk; Planes; Patterns; Products; Gastrulation: Fate Maps, Morphogenetic Movements; Gastrulation in some Animals. Morphogenetic Processes, Morphogenesis of an Ectodermal Derivative: Neurulation in Amphibians, Chick, Mechanisms of Neural Plate Formation; Morphogenesis of Mesodermal Derivatives: Development of Heart in Amphibians and Chick, Development of Blood Cells; Morphogenesis of Endodermal Derivatives: Origin of Endodermal Organs, Origin and Migration of Primordial Germ Cell (PGC) in Frog, Chick and Mammals. Mechanisms of Cell Interaction: Totipotency and Pluripotency, Analysis of Genomic Equivalence of Nuclei, Developmental Potency of Nuclei by Nuclear Transplantation in Eggs; Cell Interactions and Ooplasmic Determinants and Germ Cell Lineage in Eggs of *Ascaris*, Ooplasmic Determinants and Somatic Cell Determination in Tunicates; Embryonic Induction and Cell Determination: Primary and Secondary Induction, Instructive Interaction Between Ectoderm and Mesenchymal Cells, Permissive Interaction. Organogenesis of Vertebrate Eye: Adult Eye, Eye Field, Development and Differentiation of Retina, Lens and Cornea Tissue Interactions; Vertebrate Limb: Basic Structural Pattern, Limb Field, Determination, Pattern of Limb Polarities, Development, Role of Mesoderm and Ectoderm, Apical Ectodermal Ridge (AER), Control of Pattern Formation; Common Features of Eye and Limb Development

Block-II Plant Development-II

Metamorphosis: Types of Development; Types of Metamorphic Changes; Larval Forms in Various Animal Groups; Metamorphosis in Amphibians; The process of metamorphosis in anurans and urodeles. Hormones in Metamorphosis of Amphibia, Neoteny; Development, Growth and Metamorphosis in

Insects; Factors Controlling Metamorphosis in insects, Comparison between Metamorphosis in Amphibians and Insects. Regeneration: Types of Regeneration: patterns of Reparative Regeneration: Limb Regeneration in Amphibians, The Origin of Regeneration cells of Blastema, Role of Wound Epidermis and Apical Epidermal cap, Role of Nerves and Hormones, Role of distal Transformation of Blastema; Lens Regeneration in Amphibians; Regeneration in Hydra; Regeneration in Planarians; Comparison between Regeneration and Embryonic Development; a Survey of Regenerative Capacity in the Animal Kingdom; Heteromorphosis. Growth: Allometric and Isometric Growth, Measurement of Growth, Factors Governing Growth; Aging; Consequences, Theories of Cellular Aging; Cancer – Result of Development Error: Characteristics of Malignant Cells, Causes, Stages and, Mechanism of Carcinogenesis, Multicausal Nature of Cancer. Human development: Gametogenesis: Spermatogenesis, Oogenesis; Female Reproductive Tract; Pre-Embryonic Development: Fertilization, The Pre-embryo, Embryonic and Foetal Development; Development Changes After Birth, Extra Embryonic Membranes and Placenta, Flaws in Development.

Block-III Animal Development-I

Beginning of a New Organism: Development in Eukaryotic unicellular animals; Structure and types of sperms, Process of Spermatogenesis and Spermiogenesis in sperm formation; Oogenesis in Amphibians and Mammals, Types of eggs on basis of presence of yolk and details of Egg Envelopes, Process of fertilization involving events before and after fusion of egg with sperm and at the time of fusion of egg and sperm pro-nuclei, Initiation of development. Cleavage and Gastrulation: Cleavage of Zygote and influence of yolk on cleavage; Planes, Patterns and Mechanisms of Zygote cleavage; Products of cleavage-Morula and Gastrula; Epiboly and Emboly Morphogenetic movements in gastrulation; Process of Gastrulation in sea urchins, amphibians and amniotes (chick and mammals especially eutherians). Morphogenesis and Tissue Organisation: Types of Morphogenetic processes and Modes of Cell movement in the formation of the Germ layers; Morphogenesis of Ectodermal derivatives namely neurulation in Amphibians and Chick, Mechanisms of neural plate formation, Morphogenesis of Mesodermal derivatives, Development of heart in amphibians and chick, development of blood cells, Origin and Morphogenesis of Endodermal derivatives, Origin and Migration of Primordial germ cells in Frog, Chick and Mammals. Mechanisms of Cell Interactions: Totipotency and pluripotency, Mechanisms of Cell interaction, Analysis of genomic equivalence of Nuclei, Analysis of developmental potency of nuclei by method of nuclear transplantation in eggs. Cell determination, interactions and ooplasmic determinants, ooplasmic determinants and somatic determination in Tunicates, Embryonic induction and cell determination in neural ectoderm by induction from dorsal mesoderm (primary embryonic induction), Induction of mesoderm in amphibians, Secondary induction, instructive interaction between ectoderm and mesenchymal cell, Permissive interaction in Pancreas development, Organogenesis of Eye and Limb: Structure of adult vertebrate eye, Eye field, Development of vertebrate eye and differentiation of retina, lens and cornea, Tissue interactions in development of eye. Vertebrate limb and its basic structural pattern, limb field, Determination of limb polarities and pattern of limb development.

Block-IV Animal Development-II

Metamorphosis: Types of Development and Metamorphic Changes, Larval Forms in Various Animal Groups; Metamorphosis in Amphibians; the process of metamorphosis in anurans and urodeles; Hormones and their interactions in Metamorphosis of Amphibia, Neoteny; Development, Growth and Metamorphosis in Insects, Factors Controlling Metamorphosis in insects, Comparison between

Metamorphosis in Amphibians and Insects. Regeneration: Types of Regeneration, Patterns of Reparative Regeneration: Limb Regeneration in Amphibians, The Origin of Regeneration cells of Blastema, Role of Wound Epidermis, Apical Epidermal cap, Role of Nerves and Hormones in regeneration, Role of Distal Transformation of Blastema; Lens Regeneration in Amphibians, Regeneration in Hydra; and in Planarians, Comparison between Regeneration and Embryonic Development, A survey of Regenerative Capacity in the Animal Kingdom, Heteromorphosis. Growth, Aging, Cancer: definition of Growth, Allometric and Isometric Growth, Measurement of Growth, Factors Governing Growth, Aging and its Consequences, Theories of Cellular Aging; Cancer as a result of Developmental Error, Characteristics of Malignant Cells, Causes, Stages and, Mechanism of Carcinogenesis, Multicausal Nature of Cancer, Human development: Gametogenesis, Spermatogenesis and Oogenesis in humans, structure of Female Reproductive Tract, Pre-Embryonic Development: Fertilization, The Pre-embryo development and implantation, Embryonic and Foetal Development; Developmental Changes After Birth, Extra Embryonic Membranes and Placenta, Flaws in Development.

UGZY-10

Taxonomy and Evolution

Block-01 History and Concept of Taxonomy

Taxonomy; Aims, Objectives and Importance; Principles of Taxonomy and Systematics; History of Plant Classification; History of Animal Taxonomy; Plant Taxonomy in Ancient India. Types of Classification; Linnaeus Era: Artificial system of Classification, Natural System of Classification Bentham and Hooker; Phylogenetic Systems of Classification – Engler and Prantl's, Hutchinson's, Takhtajan System of classification of animals. Types of Classification – Phenetic Classification, Natural Classification, Phylogenetic or Cladistic Classification, Evolutionary Classification, Omnispersive Classification, Taxonomic Hierarchy. The Five Kingdom System. Development of Concepts, Binomial Nomenclature; Important Rules of Nomenclature; Binomial System.

Block-II Tools and Trends in Taxonomy

Tools of Taxonomist: Field Observations, Ecological-Physiological; Herbaria and Museums, Botanical gardens, Zoological Parks; National Parks. Approach in Taxonomy, Morphological, Anatomical, Palynological, Embryological, Cytological, Paleobotanical, Physiological, Ecological Evidences, Taxonomy Library Documentation; Keys to Identification; Herbarium Ethics – Modern trends in Plant Taxonomy, Alpha and Omega Taxonomy; Chemotaxonomy; Numerical Taxonomy, Immunotaxonomy.

Block-III Evolution -I

Concept of Organic Evolution: Pre-Darwinian Evolutionary Thinking; Lamarckism; Darwinism – The Significance, Neo-Darwinism and Modern Synthesis; From Modern Synthesis to Molecular Genetics; Challenges to Darwinism; Creationism. The Geological Records, Evolution of the Horse; Evidences of Evolution; Biogeography, Comparative Anatomy, Comparative Embryology, Comparative Physiology and Biochemistry. Basis for Natural Selection; Sources and Expression of Variability; Concept of Fitness; Natural Selection Under Different Environmental Conditions.

Block-IV Evolution -II

Natural Selection in Action: Industrial Melanism; Interspecific Competition, Coadapted Communities, Character Displacement and Ecological Exclusion; Parasitism, Predation and Coevolution; Sexual Selection; Kin and Group Selection. Concept of Species; Mechanisms of Speciation; Genetic Repatterning during Isolation; Isolating Mechanisms. Human Evolution – Primate Heritage; Trends in Human Evolution; An Overview of Hominid Phylogeny. Symbolising and Language Skills; Evolution of Culture; Natural Selection and Future of Man.

UGZY-11 *Statistical Methods*

BLOCK – I . Data Collection and Its Representation

Unit-I- Data Collection and Tabulation :

Meanings, Definitions and Applications of Statistics, Measurements and Scale, Measurements of qualitative data, Methods of data collection, Types of data.

Unit-II- Representation of Data- I (Diagrammatical representation):

Frequency distribution, Tabulation of data, Diagrammatical Representation of data, Bar diagram, Multiple bar diagram, Divided bar diagram, Percentage bar diagram, Pie chart, Pictogram, leaf chart,

Unit-II- Representation of Data- I (Graphical representation):

Graphical representation of frequency distribution, Histogram, Frequency polygon, Frequency curve, Ogive.

BLOCK – II . Measures of Central Tendency and Dispersion

Unit-I- Measures of Central Tendency :

Types of measures of central tendency, Arithmetic mean, Fundamental Theorems on Arithmetic mean, Geometric mean, Harmonic mean, Median, Mode, Percentiles, Deciles, and Quartiles.

Unit-II- Measures of Dispersion :

Types of measures of Dispersion, Range, Mean Deviation, Variance and Standard deviation, Effect of change of origin and scale, Relationship between measures of central tendency and measures of dispersion, Coefficient of variation.

BLOCK – II . Moments, Skewness and Kurtosis

Unit-I- Moments, Raw Moments and Central Moments :

Definition of moments, raw moments for ungrouped data, raw moments for grouped data, Central moments, Factorial moments, Interrelationship between

various moments, effect of change of origin and scale on moments, Charlier's checks, Sheppard's correction for moments.

Unit-II- Skewness and Kurtosis :

Definition of skewness, Measures of skewness, Pearson's coefficient, Bowley's coefficients, Kurtosis, Measures of Kurtosis, effect of change of origin and scale.

UGZY (L)-1

Laboratory Work-I - Lab Work Practical's Based on UGZY-05 & 06

UGZY (L)-2

Laboratory Work-II - Plant Diversity: Lab Work Practical's Based on UGZY-07 & 08