

CET-2022
ZOOLOGY (R22-51)

UNIT – I

EVOLUTION, GENETICS& DEVELOPMENTAL BIOLOGY

1. Emergence of evolutionary theories: Lamarck, Darwin– Concepts of variation, adaptation, struggle, fitness and natural selection; Mutation-Types, causes and detection, mutant types – lethal, conditional, biochemical, loss & gain of function, germinal verses somatic mutants, insertional mutagenesis. The evolutionary synthesis.
2. Population genetics: Populations, Gene pool, Gene frequency, Hardy-Weinberg Law, Concepts and rate of change in gene frequency through natural selection, migration and random genetic drift. Convergent evolution.
3. Mendelian principles: Dominance, segregation, independent assortment. Concept of gene: Allele, multiple alleles, pseudo-allele, complementation tests.
4. Quantitative genetics: Polygenic inheritance, heritability and its measurements, Inbreeding, Genes and Environment. QTL mapping.
5. Molecular Evolution: Concepts of neutral evolution, molecular divergence and Molecular clocks; Molecular tools in phylogeny, classification and identification; origin of new genes and proteins; Gene duplication and divergence.
6. Human cytogenetics: Pedigree analysis. Karyotypes: Human Karyotype – banding techniques - nomenclature. Genetic disorders: Numerical and structural abnormalities of human chromosomes – Deletion, duplication, inversion, translocation, syndromes and cytogenetic implications.
7. Gametogenesis: Spermatogenesis & Oogenesis, fertilization, zygote formation and early development, cleavage patterns, blastula formation, gastrulation and formation of germ layers in animals.
8. Morphogenesis and organogenesis in animals: Cell aggregation and differentiation in Dictyostelium; Axes and pattern formation in Drosophila and chick; Organogenesis; vulva formation in Caenorhabditis elegans, differentiation of neurons, PostEmbryonic development, metamorphosis. Genetic and induced teratogenesis, role of thyroxine in control of development in amphibians. Placentation in mammals.
9. Advanced Technologies: Collection and cryopreservation of gametes and embryos. Embryo transfer technology (MOETT): *In vitro* oocyte maturation, Superovulation, *In Vitro* fertilization, Transgenic animals and knock-outs; Production, Applications.

CELL BIOLOGY&FUNDAMENTAL PROCESSES

10. Structure and function of model membrane, electrical properties of membranes.
11. Structural organization and function of intracellular organelles: Cell wall, nucleus, mitochondria, Golgi bodies, lysosomes, endoplasmic reticulum, peroxisomes, plastids, vacuoles, chloroplast, structure & function of cytoskeleton and its role in motility.
12. Cell division and cell cycle: Mitosis and Meiosis, Regulation and control of cell cycle.

13. Cell signalling & Cell movements: Intracellular transport. Hormones and their receptors, cell surface receptor, signalling through G-protein coupled receptors, signal transduction pathways, regulation of signalling pathways.

14. Genome organization: Molecular anatomy of eukaryotic chromosomes, Metaphase chromosome: centromere, kinetochore, telomeres and its maintenance. Heterochromatin and euchromatin. Giant chromosomes: Polytene and lamp-brush chromosomes.

15. DNA replication, repair and recombination: Unit of replication, enzymes involved, replication origin and replication fork, extrachromosomal replicons, DNA damage and repair mechanisms, homologous and site-specific recombination.

16. RNA synthesis and processing: Transcription factors and machinery, formation of initiation complex, transcription activator and repressor, RNA polymerases, capping, elongation, and termination, RNA processing, RNA editing, splicing, and polyadenylation. Molecular structure and function of different types of RNA.

17. Protein synthesis and processing: Ribosome, formation of initiation complex, initiation factors and their regulation, elongation and elongation factors, termination, genetic code, aminoacylation of tRNA, tRNA-identity, aminoacyl tRNA synthetase, and translational proof-reading, translational inhibitors.

18. Recombinant DNA Technology: Isolation of DNA (genomic and plasmid). Vectors and insertion of foreign DNA fragment. Cloning of DNA fragments in bacterial and eukaryotic systems. Expression of recombinant proteins using bacterial, animal and plant vectors. Molecular probes and Blotting techniques. Construction of Genomic and cDNA libraries.

BIOSYSTEMATICS, BIostatISTICS & COMPUTATIONAL BIOLOGY

19. Definition and basic concepts of biosystematics. Trends in biosystematics. History of Classification. Taxonomy and classification. Chemotaxonomy, Cytotaxonomy and Molecular taxonomy. Dimensions of speciation and taxonomic characters. Species concepts, species category. Theories of biological classification, hierarchy of categories. Taxonomic procedures: Taxonomic collections, preservation, curation, process of identification. Taxonomic keys, different types of keys. International code of Zoological nomenclature (ICZN): Operative principles & application of important rules, formation of scientific names of taxa Speciation; Allopatricity & Sympatricity.

20. Biostatistics: Introduction, scope, application and uses of statistics in biology. Sampling techniques, standard error. Collection and classification of data - Frequency distribution. Diagrammatic presentation of data. Skewness and Kurtosis. Measures of central tendency: Mean, median and mode. Measures of dispersion: Standard deviation, variance and coefficient of variance.

21. Computational Biology: Operating systems: DOS, WINDOWS. Application soft wares

MS Word, MS Access, MS Excel, MS Power Point. Internet and its uses.

UNIT – II

ANIMAL PHYSIOLOGY & ENDOCRINOLOGY

1. Blood and circulation - Blood corpuscles, haematopoiesis and formed elements, plasma function, blood volume, blood volume regulation, blood groups, haemoglobin, haemostasis, blood coagulation, Blood groups, Rh factor. Closed and open circulatory system.

2. Cardiovascular System – types of hearts, comparative anatomy of heart, myogenic heart, pacemaker system, ECG – its principle and significance, cardiac cycle, heart as a pump, blood pressure, neural and chemical regulation of all above.

3. Respiratory system - Comparison of respiration in different species, anatomical considerations, control of respiratory rhythm, External respiration, transport of gases, and internal respiration, exchange of gases, neural and chemical regulation of respiration.
4. Nervous system - Neurons, action potential, gross neuroanatomy of the brain and spinal cord, central and peripheral nervous system, neural control of muscle tone and posture.
5. Sense organs – Organs of taste and smell, olfactory and gustatory receptors. Vision - structure of eye, rods and cones, daylight and colour vision, myopia, colour blindness. Ear – anatomy, external, middle and internal ears, hearing mechanisms, “organ of corti”.
6. Excretory system - 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.
7. Thermoregulation – Temperature as a limiting factor, Poikilotherms and Homeotherms, Heat source in homeotherms, basal metabolism thermoregulation, adaptation.
8. Osmoregulation in iso-osmotic, hypo-osmotic and hyper-osmotic environments, osmoregulation in terrestrial animals. Osmo-conformers and osmo-regulators.
9. Muscle & Nerve- Classification and structure of muscle, skeletal muscle contraction, mechanical properties, twitch, summation, tetanus, heat production during muscle contraction, energy supply, Cori cycle. Structure of a typical nerve fibre, nerve conduction through myelinated and non-myelinated nerve fibres, neuro- muscular junction, synaptic transmission, neurotransmitters.
10. Bio-energetics – Structure and classification of carbohydrates, proteins and fats, Glycolysis, Krebs’s cycle, oxidation and reduction, oxidative phosphorylation, ATP cycle.
11. Endocrinology – Classification of hormones, synthesis of hormones, basic mechanism of hormone action, first messenger second messenger concept. Properties of hormones. Hormone receptors. Feedback mechanisms, long loop and short loop feedback.
12. Hormone levels in circulation and other body fluids. Biosynthesis of steroid hormones *de novo* Biosynthesis and amino acid derives small size hormones (eg: T4 Epinephrine, etc.), Biosynthesis and simple peptide hormones, Pre- and Pro-hormones, Co-translational and post-translational modifications of hormone structure.
13. Regulatory functions of hormones -Hormonal regulation of homeostasis, water regulation, Renin-angiotensin- Aldosterone system (RAA), fluid, Ca, Na, K regulation, hormonal regulation of carbohydrate metabolism.
14. Hormonal control of growth and reproduction in vertebrates, Neuro-endocrine integration in vertebrates. Hormonal control of reproduction in vertebrates, gonadotrophins, gonadal hormones, puberty, menopause. Role of hypothalamic principles on pituitary gland.
15. Concept of Neurosecretion and Neuro-endocrine system in invertebrate groups- Neuro-endocrine mechanisms of moulting and growth in crustaceans and insects.

IMMUNOLOGY AND DISEASES OF HUMAN & DOMESTIC ANIMALS

16. Immune System: Cells and Organs of the Immune System. Innate & Acquired immunity. Antigens & Epitopes.
17. Antibodies – Structure and Function. Antibody Classes and their effector functions. Ag. - Ab. reactions – Precipitation, Agglutination, Immunodiffusion, ELISA, RIA, Immunofluorescence.
18. Major Histo-compatibility Complex: MHC – Haplotypes, MHC molecules – Class I and Class II types, their Molecular Structure and function. MHC – Immune responsiveness and disease susceptibility.

19. T Cells & B- Cells: T- Cells - Maturation, activation and differentiation: B- Cells: Development, Activation and Differentiation. Humoral Immune response – Kinetics.
20. Hypersensitivity Reactions: IgE Mediated (Type I) and Ab - mediated (Type II) Hypersensitivity Reactions. Immune - complex mediated (Type III) and T_{DTH} mediated (Type IV) Hyper-sensitivity Reactions.
21. Parasites causing diseases in Humans: Life cycles, vectors and Pathogenicity of *Entamoeba histolytica*, *Plasmodium* spp., *Paragonimus westermani*, *Schistosoma* spp., *Taenia solium*, *T. saginata*, *Wuchereria bancrofti*, *Trichinella* spp.
22. Parasites causing diseases in Domestic animals: Life cycles, vectors and Pathogenicity of *Toxoplasma gondii*, *Babesia bigemina*, *Fasciola hepatica*, *Echinococcus granulosus*.
23. Host – Parasite Interactions: Commensalism, Mutualism, Symbiosis, Parasitism, Predation, Mutualism, Antagonism. Hyper parasitism.

ECOLOGY & ANIMAL BEHAVIOUR

24. Physical and biotic environment; biotic and abiotic interactions. Concept of habitat and niche; fundamental and realized niche; resource partitioning; character displacement.
25. Population dispersion- population density – estimation of fish population density natality- mortality- age structure- age pyramids- survival ship curves- Biotic potential- environmental resistance – carrying capacity. Population regulation.
26. Ecosystem structure - Ecosystem function; energy flow and mineral cycling (C, N, P); primary production and decomposition.
27. Applied Ecology: Environmental pollution; global environmental change; biodiversity: status, monitoring and documentation. Principles of conservation, major approaches to management, Indian case studies on conservation/management strategy (Project Tiger, Biosphere reserves).
28. Animal Behaviour: Classification of behavioural patterns, analysis of behaviour (ethogram). Social communication; Social dominance; Mating systems, Parental care; Aggressive behaviour; Habitat selection and optimality in foraging; Migration, orientation and navigation; Domestication and behavioural changes. Biological rhythms: Circadian and circannual rhythms, Orientation and navigation, Migrations of fish, turtle and birds. Biological clocks. Neural basis of learning, memory, cognition, sleep and arousal.

UNIT - III

AQUACULTURE

1. Principles involved in site selection and construction of fish farm, reclamation of swamps. Principles involved in the selection of species for Aquaculture, Preparation and management of nursery ponds, rearing ponds and stocking pond. Aquatic weeds and their control: Introduction, chemical, biological and mechanical control methods.
2. Fish seed resources- Procurement and transportation of seed from natural resources.
3. Induced breeding in Indian major carps and exotic carps. Construction of fish hatcheries and their management.
4. Freshwater fish culture - Indian Major carps and exotic carps; Air breathing fishes; Composite Fish Culture; Freshwater prawn culture. Integrated Fish Farming – Paddy cum Fish Culture and Fish cum Livestock Culture.
5. Eel and freshwater prawn culture and management of prawn hatchery, ornamental fish culture.

6. Brackish water Aquaculture - principles of pond design; traditional, extensive, modified extensive, semi-intensive, intensive and super intensive culture of shrimps and their management and economics.
7. Fertilization: Introduction, properties of chemical fertilizers, role of inorganic, organic and bio-fertilizers in aquaculture practices.
8. Liming: Introduction, properties of liming materials, effects of liming on pond ecosystem, exchange of acidity and lime requirements, application of liming materials of ponds, acid sulfate soils.
9. Water quality management – pH, turbidity, dissolved oxygen, BOD, COD, Nitrates, Phosphates, Ammonia etc.
10. Crab culture, Pond design, management of crab farm, fattening process of crab, economics – cage culture and pen culture.
11. Finfish culture – Mulletts (Mugil), Milk fish (Chanos) and sea bass (Lates).
- 12 Mariculture - Lobster culture, Mussel culture, Pearl oyster culture, Edible oyster culture, and Sea weed culture.
13. Shrimp hatchery management - Principles of shrimp hatchery establishment, Site selection, Water source, water management, maturation section, larval and post larval sections, feed management.
14. Feed management: Feed schedules, protein requirements at different ages of finfish and shellfish, feed formulations, wet and dry feeds.

UNIT - IV

FISHERIES

1. Origin and classification of water bodies – Rivers, lakes and ponds, Major rivers and freshwater lakes of India. Ecology of ponds, rivers and lakes – structure and dynamics, energy flow.
2. Physical characteristics of wate: Temperature, thermal stratification and thermalexchange – light, total hardness, pH.
3. Chemical characteristics of water – Chlorides, dissolved oxygen, alkalinity and acidity.
4. Major groups of freshwater, estuarine and marine fish. Classification of fish, taxonomic procedures.
5. Locomotion in fishes: Body form and locomotion, fins and locomotion, swimming and non-swimming locomotion.
6. Fish migrations, anadromous and catadromous migrations, daily migrations.
7. Basic fish anatomy, form and function of muscles, gills and gas bladder. Digestive system. Food and feeding apparatus, feeding habits.
8. Skin and its derivatives in fish, scales & significance. Skeleton – Endoskeleton, Neurocranium and visceral skeleton.
9. Blood vascular system- Circulation of blood, modification in relation to air breathing, Respiration and Respiratory organs of fish.
10. Nervous system, Sense Organs and Endocrine organs in fishes. Electric organs and Electroreception. Light organs and poison glands of fish. Lateral line organs.
11. Excretion and osmoregulation. Structure and function of the excretory organs – Major excretory products of fishes. Osmotic and ionic regulation, acid base balance, Patterns of nitrogen excretion.
12. Reproductive organs and parental care in fishes.
13. Age and growth in fishes: Determination of age, length-weight relationships. Annual growth marks, bone marks, determination of growth and factors.
14. Fish catch statistics of the world, A general survey of inland and marine fish catches of

India and the world. Fisheries of Indian Seas, Marine fish catch in India and fisheries of commercial importance, reservoir fisheries.

15. Fin fisheries - Oil Sardines; (2) Mackerels; (3) Tuna and allied fishes; (4) Seer fish; (5) Flat Fish.
16. Shell fisheries - Crustaceans; Molluscs; Sea weeds; Edible Oysters, crabs and lobsters.
17. Population Dynamics - Fish populations and factors affecting the population structures,
18. Estimation of fish yield and control of over-fishing. Estimation of fish populations.
19. Preservation and processing - Methods of preservation of finfish and shell fish and associated problems. Rigor mortis and post-mortem changes.
20. Fish products and By-products- different types of by-products from finfish and shellfish. Methods of chitin extraction and preparation - Fish meal and fish oil extraction procedures-industrial application. Nutritional Value .

UNIT - V

MARINE BIOLOGY

1. The sea as biological environment – General characters of populations and primary biotic divisions. Classification of the marine environment – Topographical features – Continental shelf, continental slope, submarine canyons, ridges, trenches, basins, guyots of the sea floor with special reference to Indian Ocean and adjacent seas
2. Chemistry of seawater – Major and minor constituents, trace elements, chlorinity and salinity – Dissolved oxygen and Carbon dioxide system.
3. A general account waves and tides in the sea. Spring tide, neap tide, causative agencies. Significance in mixing, water currents.
4. Biological productivity, primary production, methods of measuring Primary production, latitudinal variations, factors affecting primary production, productivity in relation to fisheries.
5. Phytoplankton composition, availability, seasonal variations and factors affecting distribution and abundance.
6. Zooplankton, composition distribution. Factors affecting abundance. Zoo-phytoplankton relationships, diurnal vertical migrations. Indicator species among Zooplankton. Measuring secondary production.
7. Oceanic Nekton - composition and ecological adaptations.
8. Life in intertidal zone, Rocky, sandy and muddy shores, intertidal fauna and faunal characteristics.
9. Benthos, methods of collection and analysis. Shallow water marine benthic communities. Meiobenthos, food chain.
10. Deep-sea environment - Life and environmental conditions
11. Seagrass and salt marshes, mangroves and mangrove communities. Biology of estuaries and estuarine adaptations of fauna. Coral reef communities, coastal lagoons.
12. Marine bioactive compounds. Marine Bio-deterioration – Fouling and boring organisms.
13. Integrated coastal zone management (ICZM), Exclusive Economic Zone (EEZ) and importance, UN laws of sea, ocean policy. Marine pollution, effect on coastal and marine biodiversity.
14. Oceanographic Instruments: Grab (Petersen, Van Veen, Smith-Mcintyre) for benthos collection, naturalist's dredge (Ekman, Sanders deep-sea anchor dredge), Plankton nets, Continuous plankton recorder, Multiple plankton, Sampling System, reversing Nansen bottles, reversing thermometer, salinometer, bathythermograph, secchi disc. Ekman current meter, echo-sounders, CTD, underwater photographic equipment, SCUBA apparatus.