

M.Sc. ZOOLOGY

I SEMESTER

19ZOOT11 TOOLS AND TECHNIQUES FOR BIOLOGY

UNIT- I

Assay- Definition, Biological & Chemical assay. Microscopy- Principles and applications of light, dark field, phase contrast, fluorescence, transmission, electron, scanning electron microscopes. Different fixation and staining techniques for EM. Freeze-etch, freeze-fracture methods for EM, Image processing methods in microscopy. pH meter: Operation of pH electrodes, Principles and applications of Ion-selective and gas sensing electrodes, Oxygen electrodes.

UNIT - II

Centrifugation -Basic principles of centrifugation, types of centrifuges, applications of preparative and analytical ultra-centrifuges. Principles and applications of sedimentation, lyophilization. Chromatography: Principles and applications of gel-filtration, ion-exchange and affinity chromatography; TLC, GC & HPLC.

UNIT - III

Properties of electromagnetic radiations; Principles, instrumentation and applications of UV, visible, infrared, NMR spectroscopy; Spectrofluorimetry and mass spectrometry. X-ray diffraction, Incorporation of radio-isotopes in biological tissues and cells. Radiolabeling techniques: Detection and measurement of different types of radio-isotopes used in biology, Molecular imaging of radio-active material, safety guidelines.

UNIT - IV

Micro-biological Techniques: Media preparation & sterilization, Inoculation & Growth monitoring, Biochemical Mutants & their uses, Microbial assays.

Suggested Reading Material:

1. Introduction to Instrumental Analysis. Robert Braun. McGraw Hill International Editions
2. A Biologist Guide to Principles and Techniques of Practical Biochemistry. K. Wilson & K.H. Goulding, ELBS Edn.



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19ZOOT12 BIOSYSTEMATICS, BIODIVERSITY AND EVOLUTION

UNIT - I

Biosystematics- Definition and basic concepts. Importance and applications of biosystematics. Material Basis of Biosystematics. Biological classification-Theories and objectives. Procedures in taxonomy - Taxonomic collections. taxonomic keys. Types of taxonomy-Conventional types, Cytotaxonomy. Chemotaxonomy and Molecular taxonomy. Concept of Zoological Nomenclature.

UNIT - II

Origin of basic biological molecules. Abiotic synthesis of organic monomers and polymers. Concept of Oparin and Haldane. Experiment of Miller. Evolutionary time scale – Eras, Periods and epochs. Origin and diversification of eukaryotes - Origin of cells and first organisms. Evolution of eukaryotic cell from prokaryotes. Evolution of eukaryotic genomes. duplication and divergence. Molecular divergences, molecular clocks and molecular drive. Phylogenetics- Molecular tools in phylogeny.

UNIT - III

Universal common ancestor and tree of life – three domain concepts of living kingdom. hierarchical components of bio-diversity. Evolutionary relationships among taxa. Concepts of species. Species category, subspecies and other infraspecific categories. Hierarchy of categories. Speciation- Genetics of speciation, modes of speciation, Patterns and mechanisms of reproductive isolation. Allopatry, sympatry, Convergent evolution, Sexual selection, Co-evolution.

UNIT - IV

Concepts of evolution – An overview of evolutionary biology, & theories of organic evolution. Concepts of Neutral Evolution, Population genetics- Populations, gene pool, Gene frequency; Hardy Weinberg law. Concepts and rate of change in gene frequency through Natural selection, mutation, migration and random genetic drift. Phylogenetic gradualism, punctuated equilibrium and origin of higher categories

Suggested Reading Material:

1. M. Kato. The Biology of Biodiversity, Springer.
2. J.C. Avise. Molecular Markers. Natural History and Evolution, Chapman & Hall, New York.
3. E.O. Wilson. Biodiversity, Academic Press, Washington.
4. G.G. Simpson. Principles of Animal Taxonomy. Oxford IBH Pub. Co.
5. E. Mayr. Elements of Taxonomy.
6. E.O. Wilson. The Diversity of Life (The College Edition), W.W. Northern & Co.
7. Dobzhansky, Th. Genetics and origin of species, Surjeet Publication, Delhi
8. Dobzhansky, Th., F.J.Ayala, G.L.,Stebbens and J.M. Valentine Evolution, Surjeet Publication, Delhi

9. Futuyama, D.J. Evolutionary Biology, Suinuer Associates, INC, Publishers, Dunderland
10. Hartl. D.L.A. Primer of population Genetics, Sinauer Associates, INC Massachusetts.
11. Jha, A.P. Genes and Evolution, John Publication, New Delhi
12. King, M. Species Evoluution -the role of chromosomal change. The Cambridge University Press, Cambridge.
13. Strikberger, M.W. Evolution, Jones and Bartett Publishers, Boston London
14. TandonRK.1999.Biodiversity, Taxonomy & Ecology. Prithipal singh Scientific Publishers, Jodhpur.



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19ZOOT13 BIOMOLECULES

UNIT - I

Chemical foundations of biology, Amino acids – classification, Peptide bond, Proteins – classification, structural organization of proteins, primary structure, secondary structure, tertiary structure, quaternary structure, Conformation of proteins (Ramachandran plot) - domains, motifs and folds. Denaturation & renaturation of proteins.

UNIT - II

Carbohydrates: Definition and classification of carbohydrates, nomenclature, Reaction of Mono-saccharides, Acid derivatives of Mono-saccharides, amino-sugars, Oligo-saccharides, structure and properties, Chemistry and biological roles of homo and hetero-polysaccharides, peptidoglycan, glycosaminoglycans, glycoproteins and other glycoconjugates.

UNIT - III

Classification of Lipids & Fatty acids and their physicochemical properties, characterization of fats and oil; Structure, properties and biological roles of triacylglycerol, phospholipids, sphingolipids, Gangliosides, Prostaglandins, Thromboxanes, Leukotrienes and steroids.

UNIT - IV

Nucleic acids – nitrogen bases, nucleosides, nucleotides, physicochemical properties of nucleic acids, cleavage of nucleic acids by enzymatic and non-enzymatic methods, chemical synthesis of DNA; Nucleic acid sequencing, chromatin structure, Three dimensional structure of DNA; Types of RNA, Structure of RNAs – Secondary and Tertiary structure; DNA denaturation and renaturation.

Suggested Reading Material:

1. Nelson.D.L, Cox. M. M. Lehninger's Principle of Biochemistry. Freeman.
2. Murray. R.K, Granner.D.K, Mayes. P. A, Rodwell. V. W. Harper's Biochemistry, McGraw Hill.
3. Fundamentals of Biochemistry by Donald Voet.
4. Textbook of Biochemistry West, E.S., Todd, Mason & Vanbruggen, Macmillian&Co.
5. Biochemistry, Lubert Stryer.




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19ZOOT14 MOLECULAR CELL BIOLOGY

UNIT - I

Introduction: Experimental system in Cell Biology

Biomembranes

Molecular composition and arrangement, functional consequences

Transport across cell membrane: diffusion, active transport, pumps, uniports, symports and antiports

Membrane potential

Co-transport by symporters or antiporters

Transport across epithelia: Transport of macromolecules

UNIT - II

Cytoskeleton

Microfilaments and microtubules – structure and dynamics

Microtubules and mitosis

Cilia and flagella

Cell movements – intracellular transport, role of kinesin and dynein, signal transduction mechanisms

UNIT - III

Cell-Cell Signaling

Cell surface receptors

Second messenger system

MAP kinase pathways

Apoptosis: Definition, mechanism and significance

Cell-Cell adhesion and communication

Ca⁺⁺ dependent homophilic cell-cell adhesion

Ca⁺⁺ independent homophilic adhesion

Gap junctions and connections

Integrins

Collagen

UNIT - IV

Cell cycle

Cyclins and cyclin dependent kinases

Regulation of CDK-cyclin activity

Genome organization

Hierarchy in organization

Chromosomal organization of genes and non-coding DNA

Mobile DNA

Morphological and functional elements of eukaryotic chromosomes

Intracellular protein traffic

Protein synthesis on free and bound polysomes

Uptake into ER

Membrane proteins, Golgi sorting, post-translational modifications

Biogenesis of mitochondria and nuclei

Trafficking mechanisms

Suggested Reading Material:

1. Molecular Cell Biology, J. Darnell, H. Lodish and D. Baltimore, Scientific American Book INC, USA.

2. Molecular Biology of the Cell, B. Alberts, D. Bray, J. Lewis, M. Raff, K. Roberts and J.D. Watson Garland Publishing INC, New York.



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I SEMESTER PRACTICALS

19ZOOP15 Tools and Techniques for Biology lab:

1. Spectrophotometer – Estimation of biomolecules
2. Centrifugation – Demonstration and working
3. Separation Techniques - Paper chromatography
4. Electrophoresis – Demonstration and usage
5. pH Meter – Preparation of Phosphate buffer Preparation
6. Microscope –
 - a) Demonstration of oil immersion – WBC & RBC
 - b) Preparation of tissue for SEM & TEM procedure

19ZOOP16 Biosystematics, Biodiversity and Evolution Lab:

1. Invertebrate and Vertebrate Phyla
2. Types of Speciation-Models/Charts
3. Problems on Hardy-Weinberg law
4. Random genetic drift causing change in gene frequency-Practical demonstration.
5. Recent studies in Evolution- Examples

19ZOOP17 Biomolecules lab:

1. Estimation of glycine by formal titration
2. Estimation of proteins by Lowry and Biuret methods
3. Analysis and identification of monosaccharides
4. Estimation of mallose by DNS method
5. Determination of Iodine value of oils
6. Estimation of Cholesterol
7. TLC of Amino acids

19ZOOP18 Molecular cell Biology lab:

1. Light microscopic examination of tissues
2. Preparation of different cell – types Hepatic parenchymal cells, adipocytes, macrophages, neuronal cells, epithelial cells
3. Stages of Mitosis and Meiosis
4. Squash preparation
5. Sub-cellular fractionation – separation of macromolecules

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M.Sc. ZOOLOGY

II SEMESTER

19ZOOT21 BIOSTATISTICS & BIOINFORMATICS

UNIT - I

Biostatistics- Introduction and Scope of biostatistics. Sampling. Primary and Secondary data, Frequency distribution, Graphic representation of data- bar diagram, histograms, pie diagram, frequency polygon and Ogive. Measures of central tendency- mean, median, mode. Measures of Dispersion- variance, standard deviation, coefficient of variation

UNIT - II

Probability and probability distributions-definition of probability - Bernoulli, binomial, Poisson and normal distributions; Correlation and regression Tests of Significance - hypothesis, critical region and error probabilities, t- test, chi-square test for independence, one way and two- way analysis of variance.

UNIT - III

Basic components of computers- hardware (CPU, input, output, storage devices), Software (operating systems), Application software; Introduction to MS-EXCEL. Use of in-built statistical functions for computations of mean, SD, correlation, regression coefficients, Use of bar diagram, histogram, scatter plots, Graphical tools in EXCEL for presentation of data; Introduction to MS- WORD, word processor- editing, copying, moving, formatting, table insertion, drawing flow charts etc; Introduction to Power Point, image and data handling.

UNIT - IV

Bio-informatics –Introduction, History, Internet, Knowledge. Review of relevant definitions in molecular biology. Biological Databases –introduction. Examples of databases together with steps involved in use and interpretation of results). Sequence alignment. Phylogenetic analysis with the program PHYLIP. Introduction to computational genomics and proteomics.

Suggested Reading Material:

1. Batschelet, E., Introduction to Mathematics for Life Scientists. Springer- Verlag, Berlin.
2. Principles of Biostatistics, Pagano M., Gauvreau, K, (2000), Duxbury Press, U.S.A
3. Murray, J.D. Mathematical Biology. Springer – Verlag, Berlin.
4. T.K. Attwood & D.J. Parry-Smith 1999, Introduction to Bioinformatics. Pearson Education Asia.
5. Stephen Misener & S.A. Krawez 2000. Bioinformatics: Methods and Protocol.
6. Bioinformatics: Sequence and Genome Analysis, Mount, D. W. (2nd Ed., 2001), Cold Spring Harbor Laboratory Press, New York, USA
7. Bioinformatics for Dummies, Claverie J. M., Notredame C., (2nd Ed., 2007). Wiley Publishing, Inc., New York, USA
8. Sokal, R.R. & F.J. Rohlf. Biometry. Freeman, San Francisco.
9. Snedecor, G.W. and W.G. Cochran, Statistical methods for environmental biologists. John Wiley Sons, New York.



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19ZOOT22 ANIMAL PHYSIOLOGY

UNIT - I

Muscle: Molecular Structure and properties of Muscle and muscle contraction , Sliding filament theory

Blood and Circulation – Blood corpuscles, haemopoiesis and formed elements, plasma function, blood volume, blood volume regulation, Blood groups, Haemoglobin, immunity, haemostasis , factors affecting blood coagulation

Nerve impulses , Synaptic transmission & Neurotransmitters,

Nervous system : Neurons, action potential, gross neuro anatomy of the brain and spinal cord, central and peripheral nervous system, neural control of muscle tone and posture

UNIT - II

Thermoregulation: Comfort zone, body temperature- Physical, chemical, neural regulation, acclimatization.

Osmoregulation in aquatic and terrestrial Environments mechanism of ionic regulation

Stress Physiology: Responses to biotic and abiotic factors: Light, temperature, salts

UNIT – III

Digestion: absorption, energy balance of BMR

Respiratory system - comparison of respiration in different species, anatomical considerations, transport of gasses, exchange of gases, waste elimination, neural and chemical regulation of respiration.

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.

Cardiovascular System: Comparative anatomy of heart structure, myogenic heart, specialized tissue ECG - its principle and significance, heart as a pump, blood pressure.

UNIT - IV

Sensory physiology: Photoreceptors, Auditory, Chemoreceptor, Mechanoreceptors

Physiological Adaptation: Marine environment, shores, Estuaries

Fresh water and Terrestrial environment

Role of Yoga and meditation on Health.

Suggested Reading Material:

- 1) Eckert, R .Animal Physiology: Mechanisms and adaptation, W .H.Freeman and Company, New York
- 2) Hochacka,P.W. and Somero, G.N.Biochemical adaptation,Princeton,N.J.
- 3) Hoar,W.S.General and comparative Animal physiology prentice Hall of India.
- 4) Schimdt Neisen,Animalphysiology ,Adaptation and Environment,Cambridge.
- 5) Stamd,F.L.Physiology: A regulatory systems approach,Macmillan publishing Co., NewYork.
- 6) Punmer, L,Practical Biochemistry,Tata McGraw-Hill.
- 7) Prosser,C.L. and Brown .Comparative Animal physiology.
- 8) Wilson,K. and Walker, j,Practical Biochemistry.
- 9) Willmer, PIG Sone and I.Johnson, Environmental physiology,Black Well Science,Oxford, U.K. 944p

- 10) Newell, R. C. (ed.) 1976, Adaptation to environment, Essays on the physiology of marine animals. Butterworths, London, UK 539pp
- 11) Townsend, C. R. and P. Callow, physiological Ecology An evolutionary approach resource use, Blackwell Sci. publication, Oxford, UK.

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19ZOOT23 IMMUNOLOGY

UNIT - I

Immunity-innate and acquired, innate immune mechanisms, acute phase reactants, properties of acquired immunity
Immunogens and antigens- Properties, factors governing immunogenicity, haptens, epitopes size and identification. Adjuvants- properties and mechanism of action.
Immunoglobulins- structure, isotypes, allotypes and idiotypes. Functions of antibody in relation to structure

UNIT - II

Antigen-antibody interactions- affinity of antibody, avidity, bonus effect, classical precipitin reaction, antigen-binding site of antibody, forces involved in antigen - antibody complex formation.
Lymphoid tissue- primary and secondary lymphoid organs, structure and cellular organization. Lymphocyte traffic.
Cells involved in the immune response- T cells, B cells, CD antigens, neutrophils, eosinophils and natural killer cells.
Antigen presentation - pathways of antigen processing and presentation of intracellular and extracellular antigens.

UNIT - III

Antibody response - Primary and secondary antibody response, antibody response to haptens, enumeration of antibody-forming cells, T- dependent and T- independent antigens.
Macrophage- role in immune response and activation.
Cell mediated immunity- helper, cytotoxic, suppressor T cells. In vivo and in vitro assays for assessment of cell mediated immunity
Complement- classical and alternative pathways of activation. Regulation of complement activation and functions.
Antigen receptors -On T and B cells. Generation of receptor diversity.

UNIT - IV

Development of immune system- T cell ontogeny in thymus, thymic hormones, cell development. Immunological tolerance - pathways of tolerance and mechanisms of tolerance in T and B cells. Immunological tests- Immunodiffusion, immunoelectrophoresis, immunofluorescence, radioimmunoassay and enzyme-linked immunosorbent assay.

Suggested Reading Material:

1. Immunology and Immunopathology by Stewart.
2. Cellular and Molecular Immunology by Abul K. Abbas et. al.
3. Textbook of Immunology by Roitt.
4. Essential Immunology by Roitt, Brostoff, Male, Harcourt Brace & Company (5th Ed), Mosby (6th Ed).
5. Immunology by Kuby, Richard A. Goldsby, Thomas, J. Kindl, Barbara A. Osborne, Freeman & Company, Mosby publishers.
6. Immunobiology – The immune system in Health disease by Janeway and Travers.
7. Immunology – An introduction by Tizard.
8. Text book of Immunology by Unani and Benacerraf.
9. Fundamentals of Immunology by Paul.
10. Immunology – A short course by Benjaini, Sunshine and Lesrowitz.

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19ZOOT24 MOLECULAR BIOLOGY

UNIT - I

History and scope of Molecular Biology
DNA Structure and Replication
Prokaryotic and Eukaryotic DNA Replication
Mechanics of DNA Replication
Enzymes and accessory proteins involved in DNA Replication

UNIT - II

Transcription
Prokaryotic Transcription
Eukaryotic Transcription
RNA Polymerases
Post-transcriptional modifications in RNA
Cap formation
Transcription
Nuclear Export of m-RNA

UNIT - III

Translation
Genetic Code
Prokaryotic and eukaryotic Translation
Mechanisms of initiation, elongation and termination
Regulation of translation
Antisense and Ribozyme technology
Molecular mechanisms of antisense molecules
Inhibition of splicing, polyadenylation and translation

UNIT - IV

Recombination and Repair
Holiday junction, gene targeting and gene disruption
RecA and other Recombinases
DNA repair mechanisms
Molecular mapping of genome
Genetic and physical maps
Physical mapping and map-based cloning
Southern fluorescence insitu hybridization (FISH) for genome analysis

Suggested Reading Material:

1. J.D. Watson, N.H. Hopkins, J.W. Roberts, J.A. Steitz and A.M. Weiner. Molecular biology of Gene. The Benjamin/Cummings Pub. Co. Inc., California.
2. Alberts, B., D. Bray, J. Lewis, M. Raff, K. Roberts and J.D. Watson. Molecular Biology of the Cell. Garland Publishing Inc., New York.
3. Benjamin Lewin. Gene IV, Oxford University Press, U.K.
4. Meyers, R.A. (Eds.) Molecular Biology and Biotechnology : A comprehensive desk reference. VCH Publishers Inc., New York.
5. Sambrook, J., E.F. Fritsch and T. Maniatis. Molecular cloning : A Laboratory Manual. Cold Spring Harbor Laboratory Press, New York.
6. Daber, P.D. Introduction to practical Molecular Biology John Wiley & Sons Ltd., New York.

7. Brown, T.a. (Eds.). Molecular Biology Lab Fax. Bios Scientific Publishers Ltd., Oxford.



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II SEMESTER PRACTICALS

19ZOOP25 Biostatistics & Bioinformatics lab:

1. Sampling and Frequency distribution
2. Graphical presentation of the data
3. Measures of Central Tendency – Mean, median and mode
4. Measures of Dispersion – Standard deviation and Coefficient of variation
5. Correlation and Regression
6. Nucleic acid and protein databases.
7. Retrieval and analysis of DNA or protein sequence from NCBI
8. Sequence Alignment in excel sheet for data processing.

19ZOOP26 Animal Physiology lab:

1. Digestive enzymes
2. Effect of body size vs oxygen consumption
3. oxygen consumption vs temperature
4. Osmotic regulation
5. Ion concentration measurements
6. Spotters
7. Dissection- Pituitary gland of fish
8. Dissection- Nervous system of prawn.

19ZOOP27 Immunology lab:

1. Blood grouping
2. Widal test for detection of typhoid bacteria
3. VDRL Test
4. SRID
5. Ouchterlony DID
6. Immunoelectrophoresis
7. Blood clotting time and bleeding time.
8. RIA -Demonstration
9. ELISA - Demonstration

19ZOOP28 Molecular Biology Lab:

1. Estimation of DNA (Colorimetric method)
2. Estimation of RNA in tissue (Colorimetric method)
3. Fulgen reaction method for DNA localization
4. Localization of RNA by methyl green pyronin – ‘Y’
5. SDS PAGE of serum proteins.
6. Testing purity of DNA



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M.Sc. ZOOLOGY

III SEMESTER

19ZOOT31 APPLIED ZOOLOGY

UNIT - I

Microbial fermentations: Batch, continuous culture techniques. Design, operation, principle and types of fermenters and biosensors. Industrial production of chemicals - solvents (alcohol), acids (citric, lactic), antibiotics (penicillin and streptomycin), Vitamins (Riboflavin and Vitamin B12), amino acids (lysine and glutamic acid), Single Cell Protein (SCP).

UNIT - II

Animal Breeding: Principles, Structure of livestock breeding – poultry, sheep and cattle. Marker - assisted selection. Artificial insemination (AI) techniques, in vitro fertilization. Preservation of endangered species. Germplasm bank.

UNIT - III

Production of transgenic animals and their applications: mice, sheep and fish. Molecular farming and animal cloning. Somatic cell nuclear transfer in humans – Legal and ethical aspects. Potential applications of transgenic animals – Animal models for diseases and disorders.

UNIT - IV

Bioremediation - solid and liquid waste treatment. Biomass and energy production from waste. Bioleaching – Microbial recovery of metals and acid mine drainage. Water pollution and its control. Microbiological approach of waste water treatment.
Biofertilizers – Blue green algal fertilizers – Azolla, Anabaena, symbiotic association. Sea weed fertilizers. Mycorrhizal biofertilizers, bacterial fertilizers. Biopesticides in agricultural production.

Suggested Reading Material:

1. Fermentation Technology, Standury (Pergman press)
2. Industrial Microbiology, L.E.Casida, JR. New Age International.
3. Industrial Microbiology by Prescott and Dunn.
4. Biotechnology by BD Singh (Kalyani).
5. Plant Biotechnology by A. Slater, N.W. Scott and M.R. Fowler (Oxford University press).
6. Biotechnology in Agriculture by Swaminathan, M.S (Mc. Millan India Ltd).
7. Biotechnology and its applications to Agriculture, by Copping LG and P.Rodgers (British Crop Projection).



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19ZOOT32 DEVELOPMENTAL BIOLOGY

UNIT - I

Gametogenesis, Fertilization and Cleavage:

Introduction to animal development, pattern of embryonic development, Fertilization (species specific recognition of egg and sperm, acrosome reactions, fast and slow block to polyspermy); oogenesis & gameto genesis. Cleavage (patterns, molecular mechanism of cleavage)

UNIT - II

Early embryonic Development:

Gastrulation (frog, chick) Neurulation (Establishment of neural tube, Tissue architecture of CNS, cerebral organization, differentiation of neural tube, neurons and neural crest cells); Specification of cell fate and cellular basis of morphogenesis, Autonomous development, Regulative development, Syncytial development.

UNIT - III

Organogenesis:

Mechanism of cellular differentiation – Ectoderm (CNS and Epidermis), Mesoderm (Chorda Mesoderm, paraxial, intermediate and lateral plate mesoderm) and Endoderm (digestive tube and its derivatives), Cell-cell communication, Development during organ formation: introduction and competence, paracrine and other factors (the inducer molecules), Signal transduction cascades. Birth defects -Malformations & Disruptions.

UNIT - IV

Gene expression during development:

Establishment of body axes. Anterior-posterior polarity-role of maternal effector, segmentation and homeotic selector genes, Dorso-Ventral polarity. Differential gene expression during animal development, Differential gene transcription, Selective nuclear RNA processing and mRNA translation. Differential protein modification. Regeneration of organs.

Suggested Reading Material:

1. Scott F. Gilbert. Developmental Biology, Latest Edition, Sinauer Associates, Inc., Publishers Sunderland, Massachusetts, USA
2. L. Wolpert Rosa Beddington Thomas M. Jessell Peter Lawrence Elliot M. Meyerowitz and Jim Smith (2002) Principles of Development Lates Edition Oxford University Press.
3. JMW Slack (2005) Essential Developmental Biology Latest Edition Blackwell Publishing Australia.
4. Mac E. Hadley Endocrinology Sixth Edition Prentice hall International, Inc. Arizona (For Section 9).
5. Medical Implications of Developmental Biology



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19ZOOT33 PRINCIPLES OF ECOLOGY

UNIT - I

Introduction to Ecology, Environmental concepts, Ecosystem structure and function-Biotic and Abiotic environments. Habitat and Ecological Niche. Dynamics of ecosystem- energy flow, food chain, food web, Ecological pyramids. Concepts of primary productivity. Mineral cycling.

UNIT - II

Population Ecology- Characteristics of population. Population growth. Growth models. Optimal yield. Life histories strategies(r and K Selection). Intraspecific and Interspecific interactions. Concept of metapopulation. Population Demography and life tables- mortality, natality, age structure, fecundity, net reproductive rate

UNIT - III

Evolutionary ecology. Community ecology- Nature of communities. community structure and attributes. Community composition. Concept of Ecological succession. Patterns of biodiversity. Latitudinal and altitudinal gradients: Theory of Island biogeography. Biogeographic realms of the world. Biogeographic zones of India and faunal diversity. Hotspots the world & in India.

UNIT - IV

Environmental stress- environment pollution. Major drivers of bio-diversity change. Biodiversity status, Monitoring and documentation. Biodiversity conservation-Threats, major approaches to management. IUCN classification of wild life. Indian case studies on conservation/management strategy. Concepts of sustainable development.

Suggested Reading Material:

1. Begon, M., J.L. Harper and C.R. Townsend. Ecology, Individuals, Populations and Communities. Blackwell Science, Oxford, UK.
2. Koromondy, E.J. Concepts of ecology. Prentice Hall, New Delhi.
3. Clarke, G.L. Elements of Ecology, John Wiley & Sons, New York.
4. Odum, E.P. Fundamentals of Ecology. W.B. Saunders, Philadelphia.
5. Krebs, C.J. Ecology. Harper & Row, New York.
6. Chapman JL and Reiss MJ. 1995; Ecology Principles and Application. Cambridge University Press.
7. Trivedy RK, Goel and Trisa. 1997. Practical methods in Ecology & Environmental Science.
8. Agarwal KC. 1998. Biodiversity. India.
9. Peggy I. Fieldler and Peter M. Kareiva. 1997. Conservation Biology.
10. Prabodh K. Maiti and Paulami Matti. 2011. Biodiversity: Perception, Peril and Preservation.
1. Saharia VV. 1982. Wildlife in India. Natraco Publishers, Dehradun.



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19ZOOT34 METABOLIC CELL FUNCTIONS & REGULATION

UNIT - I

Thermodynamic principles and steady-state conditions of living organisms
Organization and methods to study metabolism
Degradation of glucose, palmitic acid, phenylalanine

UNIT - II

Energy metabolism and high energy compounds
Redox potentials
Mitochondrial electron transport chain
Oxidative phosphorylation
Storage and utilization of biological energy
Biosynthesis of Urea, Glucose, Glycogen, Oleic acid and prostaglandins

UNIT - III

Nature of Enzymes
Classification and nomenclature of enzymes
Kinetic analysis of enzyme catalysed reactions
Metabolic profile of adipose, neural, hepatic, and muscle tissues

UNIT - IV

Metabolic Engineering
Immobilized enzymes and their applications

Suggested Reading Material:

1. Voet, D. and J.G. Voet. Biochemistry. J. Wiley & Sons
2. Foster, R.L. Nature of Enzymology
3. Lodish et. al. Molecular Cell Biology
4. Annual Reviews of Biochemistry
5. Garrett and Grisham. Biochemistry.



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III SEMESTER PRACTICALS

19ZOOP35 Applied Zoology lab:

1. Production of protease/amylase by batch fermentation.
2. Selective isolation of Actinomycetes from soil samples
3. Microbial growth curve.
4. Production of alcohol by *S.cerevisiae* and its estimation.
5. Production of streptomycin by fermentation.
6. Production of citric acid by *A.niger*.
7. Production of red wine from grapes.
8. Determination of suspended solids in industrial effluents.
9. Removal of color of the industrial effluents by biological methods.
10. Reduction of pollution load in effluents by biological methods (laboratory models).

19ZOOP36 Developmental Biology Lab

1. Estimation of shell calcium during the development of chick and its role
2. Estimation of phosphorous during the development of chick
3. Observation of spermatozoa in vertebrates
4. Effect of Iodine in the metamorphosis of frog.
5. Effects of Thyroxine in the metamorphosis of frog.
6. Preparation of sperm smear from goat testis
7. Observation of slides: Cleavage, Morula, Blastula, Gastrula
8. Neurulation slides: Neural plate, Neural fold, Neural tube.

19ZOOP37 Metabolic cell function and regulations lab:

1. Enzyme kinetics
2. Dehydrogenase assay
3. Lactic acid estimation
4. Proteins, glucose and Lipid estimations
5. DNA, RNA estimation
6. Transaminases

19ZOOP38 Principles of Ecology Lab

1. Ecosystem-structure and function-demonstration.
2. Populations interactions.
3. Local fauna- Identification. Conservation activities for any
4. Enumeration of Plankton.
5. Estimation of Population-Plant/Animal sps by quadrant method
6. Diversity indices- Abundance, dominance and Diversity
7. Creation of Life tables



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M.Sc. ZOOLOGY

IV SEMESTER

19ZOOT41 NEUROBIOLOGY & ANIMAL BEHAVIOUR

UNIT - I

Introduction to Neurobiology: Organization of the Brain: Functional Anatomy of the brain. Systems neurobiology – Visual systems, Hearing systems. Neurons, astrocytes, oligodendroglia, Schwann cells, microglia, ependymal cells, neuroglial cell interaction.

UNIT - II

Neuron: Passive and membrane properties, information flow in neurons, compartments, spike initiation zone. Neuron – Excitability, conductivity, Membrane potentials (Resting & Action). Single neuron recording, Patch-clamp recording, Nerve Impulse, Refractory period. The Nernst equation and Goldman equation.

UNIT - III

Signaling and Channels: Ion and Voltage-gated Channels. Sodium, Potassium & Calcium channels structure and function.

Neural Communication: Synapses- Electrical and Chemical synapses, Nerve-muscle synapse and signaling, Neurotransmitters (synthesis, storage and function), post-synaptic action of neurotransmitters, neuro-transmitter gated ionic channels; Dale's principle drugs affecting their activities, ionotropic and metabotropic receptors. Synaptic Integration, Synaptic Plasticity.

UNIT - IV

Cognitive Neuroscience: Nerve cells and their network, Role of limbic System in cognition. Cognitive skills, Learning and memory- Conditioning, habituation, insight learning, association learning. Imprinting – case studies of animal models.

Suggested Reading Material:

1. Fundamental Neuroscience by Haines, Duane E., Churchill Livingstone, New York.
2. Principles of Neural Science by Kandel Eric, James H. Schwartz, and Thomas Jessel; 4th ed. Mc Graw-Hill.
3. Basic Neurochemistry: Molecular, Cellular and Medical Aspects, by George M.D. Siegel, R. Wayne Albers, Scott Brady, Donald M. D. Price; Seventh Edition; Elsevier Academic Press.
4. Foundations of Neurobiology by Fred Delcomyn, N.Y. Freeman.
5. The Neuron: Cell and Molecular Biology 3ed by Irvin B. Levitan, Leonard K. Kaczmarek. (2002), Oxford University Press.
6. Neuroscience (Book with CD-ROM) 3ed by Dale Purves, George J. Augustine, David Fitzpatrick, William C. Hall, Lawrence C. Katz, Anthony-Samuel LaMantia, James O. McNamara, S. Mark Williams (2004) Sinauer Assoc.,
7. Fundamental Neuroscience, 2ed by Larry R. Squire, Floyd E. Bloom, Susan K. McConnell, James L. Roberts (Editor), Nicholas C. Spitzer, Michael J. Zigmond (2002) Academic Press.
8. An Introduction to Animal Behaviour, 5th Edition by Aubrey Manning and Marian Stamp Dawkins.



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19ZOOT42 ANIMAL CELL CULTURE & STEM CELL TECHNOLOGY

UNIT - I

Introduction to cell and tissue culture, Components of cell culture: cell types and cell lines, different substrates, Preparation of cell lines: viral and chemical induction; maintenance of cell lines. Types of culture processes.

Cancer Biology: Genetic rearrangements in progenitor cells, oncogenes, tumor suppressor genes, cancer and the cell cycle, virus-induced cancer, metastasis, interaction of cancer cells with normal cells, apoptosis, therapeutic interventions of uncontrolled cell growth.

UNIT - II

Hybridoma technology: methods of cell fusion, hybrid selection, cloning and in vitro & in vivo methods of hybridoma propagation, production and characterization of monoclonal antibodies and their applications. Vaccines: Conventional, peptide and recombinant vaccines. Production and characterization of recombinant chimeric & multimeric antibodies, immunoadhesins & immunotoxins and their uses, Principle of diagnostic kit development.

UNIT - III

The biology of stem cells: Overview; types of stem cells-embryonic stem cells, fetal tissue stem cells, adult stem cells; human & animal cloning. Isolation and propagation of embryonic stem cells. Differentiation of adult stem cells, Stem cell plasticity: self renewal potential; differentiation versus stem cell renewal; transdifferentiation. Yamanaka factors, Induced pluripotent stem cells, Ex- vivo expansion of haemopoietic cells for the production of blood cells and their products.

UNIT - IV

Stem cell assays and protocols: Isolation of defined stem cell populations; sources of progenitor cells, cytokine and chemotherapy approaches to mobilization of progenitor cells; flow cytometric techniques.

Clinical applications of stem cell therapy: neurodegenerative diseases, tissue systems failures-diabetes, cardiomyopathy, kidney failure, liver failure, hemophilia, lymphoma and leukemic malignancies requiring stem cell therapy.

Suggested Reading Material:

1. Culture of animal cells; a manual of basic technique, 5th ed. Freshney, R. Ian. Wiley-Liss.
2. Handbook of stem cells Volume 1 and 2 Eds Robert Lanza and others Elsevier Academic Press.



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19ZOOT43 AQUACULTURE

UNIT - I

Aquaculture- History, General Principles. Types of culture systems and economics of different kinds of aquaculture and productivity of culture ponds. Biological characteristics of aquaculture species. Fish seed Resources and Transportation - Fish seed technology - natural collection, bundh breeding, induced breeding, cryopreservation of gametes. Transport of finfish and shellfish- transport of eggs, fry, fingerlings and adults. Induced breeding. Fish hatchery.

UNIT - II

Construction of fish fresh water & brackish water farms. Pond preparation- and management.-Pre-stocking and post stocking. Integrated fish farming- Indian Major carp culture, catfishes, murelles and prawn culture. Ornamental fish culture

UNIT - III

Principles of fish nutrition - nutritional requirements of commercially important finfish and shellfish, feed types, feeding techniques and Feed management, role of probiotics in nutrition- Shell fish hatchery construction and management-., Role of genetics in aquaculture- gynogenesis, androgenesis, triploidy, tetraploidy, hybridization, sex reversal and breeding, production of transgenic fish, impact of GMOs on aquatic biodiversity Chanos chanos. Lates calcarifer. Litopenaeus vannamei.

UNIT - IV

Water quantity management in aquaculture. Overview of fish diseases in fish and shell fish culture- common fish pathogens, routes of pathogen entry in fish, methods of colonization and spread of pathogens, immune - evasion mechanisms of fish pathogens.. General principles of Molluscan culture. Pearl Oyster culture. Seaweeds culture. Environmental impact of aquaculture- aquacultural wastes and future developments in waste minimization, environmental consequences of hyper-nutritification.

Suggested Reading Material:

1. Pillay, T.V.R. 1990. Aquaculture – Principles and Practices. Fishing News Books Survey, U.K.
2. Jhingran, V.G. 1993. Fish and fisheries of India. Hindustan Publishing Corporation (India), New Delhi.
3. Ravishankar Piska, 1999. Fisheries and Aquaculture. Lahari Publications, Hyderabad.
4. Santanam, R., Ramanathan, N. and Jegatheesan, G. 1990. Coastal Aquaculture in India. CBS Publishers & Distributors, Delhi.
5. Bardach, J.E., Ryther, J.H. and McLarney, W.O. 1972. Aquaculture. John Wiley & Sons Inc., USA.
6. Ghosh, S., Palanisamy, K. and Pathak, S.C. 1994. Shrimp and Freshwater Hatchery Public Relations Division, National Bank for Agriculture and Rural Development, Bombay.
7. Fishponds in Farming Systems, Zijpp, V. D., Verreth, J. A. J., Tri, L. Q., van Mensvoort, M.
8. E. F., Bosma, R. H., and Beveridge, M. C. M., Wageningen Academic Publishers, Netherlands
8. Aquaculture and Fisheries Biotechnology Genetic Approaches, Dunham, R. A., CABI Publishing, USA



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19ZOOT44 ANIMAL BIOTECHNOLOGY & BIO-ETHICS

UNIT- I

Introduction to Animal Biotechnology, Recombinant DNA technology: Restriction endonucleases, Restriction maps, isolation of gene fragments using restriction endonucleases and mechanical shearing; Cloning vectors - Isolation and properties of plasmids, bacteriophage cosmids, Ti plasmid (binary vector), expression vectors, viral vectors, YAC, BAC, phagemids and vectors used for cloning in mammalian cells, Hosts - Prokaryotic: E.coli, B.subtilis, Eukaryotic: Yeast and mammalian cell lines; Ligation of fragments

UNIT - II

Gene transfer techniques: Biological and artificial delivery system, Cloning strategies, shot gun experiments, isolation of poly mRNA; synthesis of cDNA, cDNA cloning in bacteria; Genomic and cDNA libraries, Identification of recombinants - structural and functional analysis of recombinants; Design and preparation of DNA and RNA probes for hybridization, Southern and Northern blotting.

UNIT - III

DNA sequencing methods: Maxam and Gilbert's chemical and Sanger's chain termination methods, automated DNA sequencing, Base calling and sequencing accuracy. Introduction to next generation sequencing (NGS). DNA fingerprinting.
PCR amplification and diagnosis - Applications in forensic medicine. Genetic diseases. Gene therapy- Types and use of rDNA constructs for gene therapy.

UNIT - IV

Bioethics: Introduction – causes of unethical acts, ignorance of laws, policies and procedures, recognition, friendship, personal gains. Professional ethics – professional conduct. Ethical decision making, ethical dilemmas. Teaching ethical values to scientists, good laboratory practices, good manufacturing practices, laboratory accreditation.
Socio-economic and legal impacts of biotechnology, national and international guidelines, experimental protocols approval, levels of containment.

Suggested Reading Material:

1. Principles of Gene manipulation: An Introduction to genetic Engineering. R.V.Old and S.B.Primrose (Blackwell Scientific Publications).
2. Biotechnology by B.D.Singh (Kalyani).
3. Molecular Biology and Biotechnology by Meyers, RA, A comprehensive Desk reference (VCH Publishers).
4. Biotechnology by U. Satyanarayana (Books & Allied (P) Ltd).
5. Bioethics and Biosafety in Biotechnology by V. Sree Krishna, New Age International Publishers.



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IV SEMESTER PRACTICALS

19ZOOP45 Neurobiology & Animal Behaviour lab:

1. An introduction to animal behaviour – Animal Psychology – Classification of behavioural patterns
2. Perception of the environment – Examples
3. communication – Examples from invertebrates and vertebrates (Terrestrial, Aerial, Aquatic habitats)
4. Ecological aspects – Food selection, optimal foraging, prey and predator, Host-Parasite relations
5. Social behaviour – Aggregations – Examples from fishes, birds and mammals, social organization - insects
6. Reproductive behaviour – mating systems, sexual selection, parental care
7. Biological rhythms – examples – migration of fish, turtle and bird.

19ZOOP46 Animal Cell Culture & Stem Cell Technology lab:

1. Preparation of animal cell culture media
2. Preparation of single cell suspension from spleen and thymus
3. Viable cell counting.
4. Primary culture demonstration
5. Sub-culture preparations
6. Cell preparation for storage.
7. Cell preparation for feeding.

19ZOOP47 Aquaculture lab:

1. Spotters: cultivable species of finfish, shellfish and ornamental based on the theory
2. Analysis of water: Turbidity, pH, Dissolved oxygen, Alkalinity etc.
3. Primary productivity, Estimation by Light and Dark bottle method
4. Dissecting out the pituitary gland and preparing the extract
5. Identification of types of feeds
6. Feed analysis-Biochemical constituents
7. Visits to aquaculture farms, finfish and shellfish hatcheries

19ZOOP48 Animal Biotechnology and Bio-ethics Lab:

1. Isolation of genomic DNA
2. Agarose gel electrophoresis of genomic DNA.
3. Purification of bovine serum IgG by ammonium sulphate precipitation
4. Western Blotting of proteins.
5. Southern Blotting (Demonstration)
6. PCR diagnosis of white spot syndrome virus, monodon baculovirus, haemotopoietic necrosis virus - Demonstration
7. Intellectual property and India: comprehensive e-filing patents, Trademarks.
8. On line patent search.
9. Online patent register and application status.
10. WIPO online database search

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