

**SYLLABUS FOR
M.Sc. COURSE IN ZOOLOGY
(With effect from the academic year 2021-22 Under CBCS system)**



**DEPARTMENT OF ZOOLOGY
KAKATIYA UNIVERSITY
HANMAKONDA 506 009
TELANGANA STATE**

KAKATIYA UNIVERSITY, DEPARTMENT OF ZOOLOGY
(With effect from the academic year 2021-22 Under CBCS system)

S.No	Paper Code	Title of the Paper	Instruction Hrs/Week	No. of Credits	Marks		Total Marks
					External	Internal	
SEMESTER-I							
1	101	Biosystematics, Structure & Function Of Invertebrates	4	4	80	20	100
2	102	Tools and Techniques in Biology	4	4	80	20	100
3	103	Animal Physiology and Ethology	4	4	80	20	100
4	104	Genetics and Evolution	4	4	80	20	100
5	105	Practical-I	4	4	100	--	100
6	106	Practical-II	4	4	100	--	100
7	107	Seminar	--	1	--	25	25
		Total		25	520	105	625
SEMESTER-II							
1	201	Structure and Function of Vertebrates	4	4	80	20	100
2	202	Environmental Biology	4	4	80	20	100
3	203	Biochemistry	4	4	80	20	100
4	204	Biostatistics and Computer Applications	4	4	80	20	100
5	205	Practical-I	4	4	100	--	100
6	206	Practical-II	4	4	100	--	100
7	207	Seminar	--	1	--	25	25
		Total		25	520	105	625

S.No	Paper Code	Title of the Paper	Instruction Hrs/Week	No. of Credits	Marks		Total Marks
					External	Internal	
SEMESTER-III							
1	301	Molecular Biology	4	4	80	20	100
2	302	Immunology	4	4	80	20	100
3	303	Subject Elective – I Parasitology (OR) Subject Elective – II Clinical Science	4	4	80	20	100
4	304	Subject Elective – III Endocrinology & Reproductive Physiology (OR) Subject Elective – IV Bioinformatics	4	4	80	20	100
5	305	Practical – I	4	4	100	--	100
6	306	Practical – II	4	4	100	--	100
7	307	Seminar	--	1	--	25	25
		Total		25	520	105	625
SEMESTER-IV							
1	401	Cell Biology	4	4	80	20	100
2	402	Developmental Biology	4	4	80	20	100
3	403	Subject Elective – I Fisheries And Aquaculture (OR) Subject Elective – II Neurophysiology	4	4	80	20	100
4	404	Subject Elective – III Animal Biotechnology (OR) Subject Elective – IV Entomology	4	4	80	20	100
5	305	Practical – I	4	4	100	--	100
6	406	Practical – II	4	4	100	--	100
7	407	Seminar	--	1	--	25	25
		Total		25	520	105	625
GRAND TOTAL (Sem I+II+III+IV)				100	2080	420	2500

FIRST YEAR – ZOOLOGY

SEMESTER – I AND SEMESTER - II

Kakatiya University - Faculty of Science
M.Sc, Zoology, SEMESTER – I
Paper Code: 101
BIOSYSTEMATICS, STRUCTURE & FUNCTION OF INVERTEBRATES

Unit – I: Diversity of Life Forms

- 1.1. **Principles** and methods of taxonomy: Concepts of species and hierarchical taxa, biological nomenclature.
- 1.2. Classical and quantitative methods of taxonomy of animals (organism)
- 1.3. **Levels of structural organization:** Unicellular, colonial and multicellular forms; levels of organization of tissues, organs and systems; comparative anatomy.
- 1.4. **Outline classification:** Important criteria used for classification in each taxon; Classification of animals; Evolutionary relationships among taxa

Unit –II: Nutrition & Respiration

- 2.1 Patterns of feeding and digestion in metazoan.
- 2.2 Filter feeding in polychaeta
- 2.3 Modifications in the digestive system of invertebrates with Special reference to modifications in Arthropoda & Mollusca
- 2.4 Respiration: Respiratory pigments, Organs of respiration-gills, trachea and lungs; mechanism of respiration.

Unit – III: Excretory and Nervous systems

- 3.1 Organs of excretion-coelome, coelomoducts, Nephridia, Malpighian tubules. Mechanism of excretion and osmoregulation
- 3.2 Nervous system: coelenterates and Echinodermata
- 3.3 Nervous system: arthropods (Crustaceans and insects) and Molluscs Cephalopoda)
- 3.4 Trends in Evolution of nervous system.

Unit – IV: Minor phyla and invertebrate larvae

- 4.1 General organization and affinities of Mesozoa, sipunculida and chaetognatha.
- 4.2 Larval forms of free living invertebrates (Coelenterata, Annelida, Arthropoda, mollusca and Echinodermata).
- 4.3 Larval forms of helminth and crustacean parasites.
- 4.4 Evolutionary significance of larval forms.

PRACTICALS :

1. Observations of nervous system development from lower to higher invertebrates and write the indentified modifications in the record. Dissection of the following
 - a) Nervous system of Leech
 - b) Nervous system of Cockroach & Reproductive system
 - c) Nervous system of *Aplsia*
 - d) Nervous system of *Unio mytilus*
 - e) Nervous system of Cabs
 - f) Nervous system of Sepia
2. Modifications of Mouth parts in insects. Separate the mouth parts from the insects, mount and observe the modifications and write the adaptations – Chewing, Piercing and Sucking etc..
3. Collect 10 invertebrates and prepare permanent slides and submit in the examinations (Parasites – 5 and Non-parasites – 5).
4. Museum specimens (from each phylum not less than 10 specimens).
5. Slides and preserved animals (from each phylum not less than 5 slides).
6. Karyotype studies for Numerical Taxonomy.
7. Hemoglobin Variation in different phyla for Evolutionary Studies.
8. Species variation – *Drosophila* Variants.
9. Collection of Termites to observe variants.
10. Collection of Fresh Water Molluscs.
11. Collection of Endo- parasites for species variations Trypanosomes from Rats

REFERENCE BOOKS

1. Invertebrate Zoology ----- EL Jordan; P.S. Verma
2. A Text Book of Zoology Vol.I ----- P.S. Dhami; Jk.Dhami.
3. A Text Book of Invertebrate zoology ----- R.L.Kotpal.
4. Biology of Animals --- Cleveland P. Hickman JR Larryds. Roberts.

Kakatiya University - Faculty of Science
M.Sc, Zoology, SEMESTER – I
Paper Code: 102
TOOLS AND TECHNIQUES IN BIOLOGY

Unit – I: Microscopy, Histological and Immunotechniques in Biology

- 1.1. **Microscopic techniques:** Visualization of cells and subcellular components by light microscopy, resolving powers of different microscopes, microscopy of living cells, image processing methods in microscopy.
- 1.2. Scanning and transmission electron microscopes, different fixation and staining techniques for EM (Electron Microscopy), freeze-etch and freeze-fracture methods for EM.
- 1.3. **Histochemical and immunotechniques:** Antibody generation, detection of molecules using ELISA, RIA, western blot, immunoprecipitation, flow cytometry and immunofluorescence microscopy.
- 1.4. Detection of molecules in living cells, *in situ* localization by techniques such as FISH and GISH.

Unit –II: Electrophysiological & Radiolabeling Techniques

- 2.1 **Electrophysiological methods:** Single neuron recording, patch-clamp recording, ECG, Brain activity recording, lesion and stimulation of brain pharmacological testing.
- 2.2 **Brain Scanning Techniques:** MRI (Magnetic resonance imaging), fMRI, CT (Computerised tomography), PET (Positron emission tomography)
- 2.3 **Radiolabeling techniques:** Properties of different types of radioisotopes normally used in biology, their detection and measurement.
- 2.4 Incorporation of radioisotopes in biological tissues and cells, molecular imaging of radioactive material.

Unit-III: Computational & Biophysical Methods

- 2.5 **Computational methods:** Nucleic acid and protein sequence databases; data mining methods for sequence analysis,
- 2.6 Web-based tools for sequence searches, motif analysis and presentation.
- 2.7 **Biophysical methods:** Analysis of biomolecules using UV/visible, fluorescence, circular dichroism, NMR and ESR spectroscopy,
- 2.8 Structure determination using X-ray diffraction and NMR; analysis using light scattering, different types of mass spectrometry.

Unit – IV: Molecular and Recombinant DNA techniques in Biology

- 4.1 Isolation and purification of RNA, DNA (genomic and plasmid) and proteins. Different separation methods; analysis of RNA, DNA and proteins by one and two dimensional gel electrophoresis.
- 4.2 Molecular cloning of DNA or RNA fragments in bacterial and eukaryotic systems; expression of recombinant proteins using bacterial, animal and plant vectors;
- 4.3 Isolation of specific nucleic acid sequences; generation of genomic and cDNA libraries in plasmid, phage, cosmid, BAC and YAC vectors;
- 4.4 Gene knock out in bacterial and eukaryotic organisms.

PRACTICALS :

1. Separation of cell organelles by Differential centrifugation.
2. Separation of protein by electrophoresis (Native & SDS page).
3. Separation of amino acids by paper and thin layer Chromatography Demonstration of column Chromatography.
4. Validation of Beer-Lambert's law of a coloured compound (CuSO_4).
5. Measurement of pH meter Preparation of buffer.
6. Light microscope and its parts Observation of unstained and stained cells.
7. Demonstration of a fixation, dehydration, sectioning and staining of any animal tissue.
8. Demonstration of Carbohydrates, Proteins Lipids and nucleic acids in tissue sections.
9. Preparation of chick fibroblast culture and viability testing.

REFERENCE BOOKS :

1. Principles and Techniques in biochemistry and molecular biology - Wilson & Walker
2. Culture of animal cells - Freshney
3. Sharma V.K. (1991), Techniques in microscopy and cell Biology, Tata-Mc Graw Hill.
4. Robert Braun Introduction to instrumental analysis - Mc.Graw.Hill
5. Bisen & Mathw. Tools and Techniques in Life Sciences,- CBS Publishers & distributors.
6. Principles of Animal Cell Culture - Basant Kumar & Rinesh Kumar, Int.Bork 2008,XXII edn.

Kakatiya University - Faculty of Science
M.Sc, Zoology, SEMESTER – I
Paper Code: 103
ANIMAL PHYSIOLOGY AND ETHOLOGY

Unit – I: Digestion and Respiration

- 1.1. Digestion and absorption, Energy Balance, BMR.
- 1.2. Respiratory system-Anatomical considerations.
- 1.3. Transport of gases, exchange of gases, waste elimination, Respiratory quotient.
- 1.4. Neural and chemical regulation of respiration.

Unit –II: Circulation and Excretion

- 2.1. Blood corpuscles, haemopoiesis and formed elements, Plasma function, blood volume, blood volume regulation.
- 2.2. Anatomy of heart structure, myogenic heart, specialized tissue, ECG – its principle and significance, cardiac cycle, heart as a pump, blood pressure, neural and chemical regulation of cardiovascular system.
- 2.3. Physiology of excretion, kidney, urine formation, urine concentration, waste elimination, Micturition.
- 2.4. Regulation of water balance, blood volume, blood pressure, electrolyte balance, acid-base Balance, Homeostasis.

Unit – III: Neuro – Muscular Physiology

- 3.1. Gross neuro-anatomy of the brain and spinal cord, central and peripheral nervous system
- 3.2. Structure of neuron, Fundamentals of nerve impulse- resting potential, Action potential.
- 3.3. Types of synapses- electrical and chemical, Mechanism of synaptic transmission.
- 3.4. Types of muscles, Ultra structure of striated muscle and Muscle contraction, neural control of muscle tone and posture.

Unit – IV: Ethology

- 4.1 Stress and adaptation, Comfort zone, body temperature – physical, chemical, neural regulation, Acclimatization.
- 4.2 Dance language of honeybees, pheromones, and aggression.
- 4.3 Foraging and Predation. Defensive secretions in Insect.
- 4.4 Social behavior in Insects.

PRACTICALS:

1. Action of pepsin in digestion of proteins.
2. Estimation of salivary amylase activity.
3. Estimation of lipase activity.
4. Oxygen consumption and estimation in an aquatic or terrestrial animal.
5. Demonstration of fermentation.
6. Action of insulin on blood sugar level.
7. Experiments on urine analysis in human urine sample:
 - a) Test for urea, blood cells, bile salts, albumin, ketone bodies and sugar in human urine sample.
8. Determination of cell fragility by osmotic hemolysis experiment.
9. Identification of relation between temperature and heart beat in freshwater mussel.
10. Water and ionic regulation of freshwater animal in different osmotic media.
11. The Study of changes in the earthworm's responsiveness to the stimulus of touch.
12. Observation of an earthworm's responses in the cases of repeated stimulation and dual stimulation.
13. Observation of the response of invertebrates to different lighting conditions.

REFERENCE BOOKS :

1. Animal Physiology ----- Samson & Writy
2. Animal Physiology ----- Nelsion & Nelsion
3. Animal Physiology ----- Medical Physiology-Guiton
4. Text book of Animal Physiology ----- Nagbhushenen
5. Text book of Animal Physiology ----- Guize
6. Text book of Animal Physiology ----- A.K. Berry.

Kakatiya University - Faculty of Science
M.Sc, Zoology, SEMESTER – I
Paper Code: 104
GENETICS AND EVOLUTION

Unit I: Mendelian Principles

- 1.1 **Mendelian principles:** Dominance, segregation, independent assortment, deviation from Mendelian inheritance
- 1.2 **Concept of gene:** Allele, multiple alleles, pseudoallele, complementation tests.
- 1.3 **Extensions of Mendelian principles:** Codominance, incomplete dominance, gene interactions, Pleiotropy.
- 1.3 Genomic imprinting, penetrance and expressivity, phenocopy.

Unit II: Population Genetics

- 2.1 **Gene mapping methods:** Linkage maps, tetrad analysis. Mmapping with molecular markers, mapping by using somatic cell hybrids.
- 2.2 **Recombination:** Homologous and non-homologous recombination, including transposition, site-specific recombination.
- 2.3 **Extra chromosomal inheritance:** Inheritance of mitochondrial and chloroplast genes, maternal inheritance.
- 2.4 **Human genetics:** Pedigree analysis, lod score for linkage testing, karyotypes, genetic disorders.

Unit-III: Quantitative Genetics

- 3.1 **Quantitative genetics:** Polygenic inheritance, heritability and its measurements, QTL mapping.
- 3.2 **Microbial genetics:** Methods of genetic transfers – transformation, conjugation, transduction and sex-duction, mapping genes by interrupted mating, fine structure analysis of genes.
- 3.3 **Mutation:** Types, causes and detection, mutant types – lethal, conditional, biochemical, loss of function, gain of function, germinal verses somatic mutants, insertional mutagenesis.
- 3.4 **Structural and numerical alterations of chromosomes:** Deletion, duplication, inversion, translocation, ploidy and their genetic implications.

Unit IV: Concepts of Evolution

- 4.1 **Emergence of evolutionary thoughts:** Lamarck; Darwin–concepts of variation, adaptation, struggle, fitness and natural selection; Mendelism; spontaneity of mutations; the evolutionary synthesis.
- 4.2 Population genetics – populations, gene pool, gene frequency; Hardy-Weinberg law; concepts and rate of change in gene frequency through natural selection.
- 4.3 Isolating mechanisms; speciation; allopatricity and sympatricity; convergent evolution.
- 4.4 Origins of unicellular and multicellular organisms; Stages in primate evolution including Homo.

PRACTICALS:

1. Problems based on multiple alleles – Blood groups
2. Problems based on Mendel's Laws – monohybrid and dihybrid ratios
3. Problems based on gene frequency – Hardy Weinberg Law
4. Karyotype studies
5. Haemoglobin variations
6. Insulin variations
7. Collection of termites to observe variants

REFERENCE BOOKS:

1. Genetics by Monroe W Strickberger
2. Evolution by Monroe W Strickberger
3. Genetics by Peter J Russell
4. Evolution by Dobzhansky, Ayala, Stebbins, Valentine
5. Genetics by P.K.Gupta
6. Human molecular Genetics by Tom Strachan and Andrew Rea

Kakatiya University - Faculty of Science
M.Sc, Zoology, SEMESTER – II
Paper Code: 201
STRUCTURE AND FUNCTIONS OF VERTEBRATES

Unit – I: Chordates, Proto chordates and Vertebrate Integument

- 1.1 Characters and Classification of proto-chordata, significance of protochordates in the evolution.
- 1.2 Origin of chordates and classification
- 1.3 Vertebrate integument, development, structure of skin in vertebrates.
- 1.4 Derivatives of Integument glands, scales, horns, claws, hoofs, feathers & hair.

Unit – II: Skeletal and Digestive system

- 2.1 Comparative account of jaw suspension
- 2.2 Comparative account of vertebral column
- 2.3 Comparative account of girdles and limbs.
- 2.4 Anatomy of gut in relation of to feeding habits- herbivores, carnivores and omnivores.

Unit – III: Circulation and respiration

- 3.1 Evolution of heart
- 3.2 Evolution of aortic arches and portal system
- 3.3 Respiratory organs in fishes and amphibians
- 3.4 Air sacs in birds

Unit – IV: Nervous and Urino-genital systems

- 4.1 Comparative anatomy of brain in relation to its function
- 4.2 Nerves - cranial, peripheral and Autonomous nervous system
- 4.3 Sense organs, simple receptors, organs of olfaction and taste, Lateral line system and Electric organs
- 4.4 Evolution of Urino-genital system in vertebrate series.

PRACTICALS :

1. Cranial Nerves of Labeo (5th and 7th and 9th and 10th weberian oscicles)
2. Dissection demonstration of Brain and Heart of Fish, Calotes, Chick and Rat
3. Demonstration of flight muscles and Air Sacs in Birds.
4. Demonstration Vascular and urinogenetal system of Rat.
5. Collect 10 vertebrates and submit in the examinations
6. Museum specimens (from each Class not less than 15 specimens).
7. Slides related to vertebrate parts.
8. Mounting of Amphioxus, Doliolum and Scales of fishes.
9. Sketelation System (Vertebra , limbs, Girdles)

REFERENCE BOOKS :

- 1 Vertebrate Zoology ----- EL Jordan; P.S. Verma
- 2 A Text Book of Zoology Vol.II ----- P.S. Dhami; Jk.Dhami.
- 3 A Text Book of Vertbrate zoology ----- R.L.Kotpal.
- 4` Biology of Animals --- Cleveland P. Hickman JR Larryds. Roberts.

Kakatiya University - Faculty of Science
M.Sc, Zoology, SEMESTER – II
Paper Code: 202
ENVIRONMENTAL BIOLOGY

Unit – I: Environment

- 1.1. **The Environment:** Physical environment; biotic environment; biotic and abiotic interactions.
- 1.2. **Habitat and niche:** Concept of habitat and niche; niche width and overlap.
- 1.3. Fundamental and realized niche; resource partitioning; character displacement.
- 1.4. **Species interactions:** Types of interactions, interspecific competition, herbivory, carnivory, pollination, symbiosis.

Unit – II: Population Ecology

- 2.1 **Population ecology:** Characteristics of a population; population growth curves; regulation; life history strategies (r and K selection).
- 2.2 Concept of metapopulation – demes and dispersal, interdemec extinctions, age structured populations.
- 2.3 **Community ecology:** Nature of communities; community structure and attributes; levels of species diversity and its measurement; edges and ecotones.
- 2.4 **Ecological succession:** Types; mechanisms; changes involved in succession; concept of climax.

UNIT – III: Fundamentals of Ecosystem

- 3.1 **Ecosystem:** Structure and function; energy flow and mineral cycling (CNP); primary production and decomposition.
- 3.2 Structure and function of some Indian ecosystems: terrestrial (forest, grassland) and aquatic (fresh water, marine, eustarine).
- 3.3 **Biogeography:** Major terrestrial biomes; theory of island biogeography; biogeographical zones of India.
- 3.4 **Natural history of Indian subcontinent:** Major habitat types of the subcontinent, geographic origins and migrations of species; common Indian mammals, birds; seasonality and phenology of the subcontinent.

Unit – IV: Conservation Biology and Biodiversity

- 4.1 **Applied ecology:** Environmental pollution; global environmental change.
- 4.2 **Biodiversity-**status, monitoring and documentation; major drivers of biodiversity change; biodiversity management approaches.
- 4.3 **Conservation biology:** Principles of conservation, major approaches to management.
- 4.4 Indian case studies on conservation/management strategy (Project Tiger, Biosphere reserves).

PRACTICALS:

1. Collection and identification of animal Biodiversity of selected ecosystem.
2. Physico-chemical analysis of soil pH, soil moisture soil , temperature, humidity estimation soil, soil organic matter.
3. Air Monitoring – Particulate Matter.
4. Water Monitoring - five important parameters from drinking water. 1) Dissolved Oxygen 2) Biological Oxygen demand (B O D) 3) Chemical Oxygen demand 4) Chlorides 5) salinity.
5. Bio remediation of waste water using soil micro organisms.
6. Bioconversion of municipal waste by vermi-composting.
7. Collection, preservation and estimation of Zooplankton.
8. Mapping of national parks and wild life sanctuaries in India with a note of important wild life fauna.
9. Estimation of LC50 or LD50 of an organo phosphorous pesticide.
10. Determination of pesticide residues in soil or water.

REFERENCE BOOKS:

1. Fundamental of Ecology. E.p.odum, G W Barrett.
2. Environmental Science . Willam .P.Cunninsham Barbora woodworth saigo.
3. The use of Earthworms in waste disposal by . Edward, C.A.
4. Introduction to Environmental Engineering & Science Gilbert M. Masters.
5. Essential of Ecology by colin R. Townsend Michael Begon John.L.Harper.
6. Environmental Biology -- A.G.Agarwal.
7. Environmental Science by G.Tyler Miller.
8. Toxicology -- Y.K.Lahir.

Kakatiya University - Faculty of Science
M.Sc, Zoology, SEMESTER – II
Paper Code: 203
BIOCHEMISTRY

Unit- I: Biomolecules :

- 1.1. Carbohydrates – Composition, structure and function.
- 1.2 Proteins- Composition, structure and function.
- 1.3 Lipids- Composition, structure and function
- 1.4 Composition, structure and function of Nucleic acids and vitamins.

Unit- II: Enzymes:

- 2.1. Principles of catalysis (energy activation, Substrate binding and active site, enzyme flexibility, induced fit theory, Reaction types.
- 2.2. Enzymes: Classification, co-enzymes and Enzyme Kinetics (Transformations of the Michaelis-Menten Equation)
- 2.3. Enzyme regulation (feedback inhibition, allosteric inhibition, competitive and uncompetitive inhibition)
- 2.4. Mechanism of enzyme catalysis, isozymes

Unit-III: Bioenergetics:

- 3.1. Stabilizing interactions (Van der Waals, electrostatic, hydrogen bonding, hydrophobic interaction, etc.).
- 3.2 Principles of biophysical chemistry (pH, buffer, reaction kinetics, thermodynamics, colligative properties).
- 3.3. Conformation of nucleic acids (A-, B-, Z-,DNA), t-RNA, micro-RNA).
- 3.4. Conformation of proteins (Ramachandran plot, secondary, tertiary and quaternary structure; domains; motif and folds).

Unit-IV: Metabolism:

- 4.1. Stability of protein and nucleic acid structures.
- 4.2. Metabolism of carbohydrates, lipids, amino acids,
- 4.3. Metabolism of nucleotides and vitamins.
- 4.4. Bioenergetics, glycolysis, oxidative phosphorylation, coupled reaction, group transfer, biological energy transducers.

PRACTICALS:

1. Estimation of muscle and liver glycogen
2. Estimation of protein by Biuret and Lowry methods
3. Estimation of amino acid by Ninhydrin method
4. Estimation of serum total cholesterol
5. Estimation of vitamin – C by 2,6- dichlorophenol indophenols method
6. Estimation of Ammonia (nesslerisation method) and uric acid
7. The effect of Ph and temperature (α -amylase) activity
8. The effect of concentration of enzyme (trypsin) activity

REFERENCE BOOKS:

1. Principles of biochemistry, by Lehninger
2. Biochemistry , by Donald Voet and Judith Voet.
3. Biochemistry , by Harper.
4. Biochemistry . Jeremy M.Berg, JohnL.Tymovzko, Lubert Stryer

Kakatiya University - Faculty of Science
M.Sc, Zoology, SEMESTER – II
Paper Code: 204
BIostatISTICS AND COMPUTER APPLICATIONS

Unit – I: Biostatistics

- 1.1. Measures of central tendency and dispersal;
- 1.2. Probability distributions (Binomial, Poisson and normal); sampling distribution; difference between parametric and non-parametric statistics;
- 1.3. Confidence interval; errors; levels of significance; regression and correlation;
- 1.4. T-test; analysis of variance (ANOVA); X^2 test; basic introduction to Multivariate statistics, etc.

Unit – II: Basics of Computers

- 2.1. Basic components of computers – Hardware (CPU, input, output storage devices), Software (operating systems).
- 2.2. Introduction to MS EXCEL – use of worksheet to enter data, edit data, copy data, move data and Graphical tools in EXCEL for presentation of data.
- 2.3. MS – WORD – editing, copying, moving, formatting, table insertion, drawing flow charts etc.,
- 2.4. Introduction to Power Point, image, data handling and Graphical tools in PPT for Presentation.

Unit – III: Internet Basics

- 3.1. Introduction to Internet – Basics and Applications of Internet, Internet working Internet access.
- 3.2. Understanding the World Wide Web (WWW).
- 3.3. Searching Tools – World Search Engines, Search Directories and Encyclopedias.
- 3.4. Online safety – spywares and viruses.

Unit – IV: Bioinformatics

- 4.1. Introduction, scope and applications of bioinformatics.
- 4.2. Biological databases – Protein and DNA sequences data bases; importance.
- 4.3. Genomics & Proteomics – Definitions, Pharmacogenomics, taxicogenomics, human genomics, prokaryotic and eukaryotic genomes and genome relationships.
- 4.4. Computational Biology – Multiple Sequence Analysis and Phylogenetic alignment.

PRACTICALS:

(a) Statistics

1. Problems on Mean and Median.
2. Problems on Standard Deviation.
3. Problems related to X² test, Student T Test . And Probability
4. Problems on Correlation.

(b) Computers

1. Literature collection using INTERNET, search engines, websites, browsing and downloading for scientific investigation.
2. Creating an e-mail account, sending and receiving mails.
3. Application of excel sheet for data processing.
4. Preparation of power point presentation with software.
5. Representation of statistical data by Histograms and Pie diagrams.

(c) Bioinformatics

1. Study of Internet resources in Bioinformatics. E.g. NCBI and EMBL.
2. Searches on MEDLINE and PubMed bibliographic databases.
3. Multiple Sequence Alignment.
4. Construction of Phylogenetic Trees for DNA and Proteins.
5. Sequence Retrieval from Databases.
6. Building of Molecules.
7. BLAST, FASTA programs for sequence database search.

REFERENCE BOOKS:

1. Statistical methods, Snedecor, G.W. and W.G. Cochran, Iowa State Univ. Press Biometry by W. H. Freeman and Francisco
2. Fundamentals of Biometry by L.N. Balaram (1980)
3. Biostatistics by N. Gurumani
4. Biostatistics-Arora and Malhan
5. Biostatistics- Jasraj and Gurudeep Raj
6. Biostatistics- P. Ramkrishan
7. Methods in Biostatistics-Mahajan
8. Mount W. 2004. Bioinformatics and sequence genome analysis 2nd Editon CBS Pub. New Delhi.
9. Bergman, N. H. Comparative Genomics. Humana Press Inc. Part of Springer Science+BusinessMedia, 2007.
10. Baxevanis, A. D. Ouellate, B. F. F. 2009. Bioinformatics: A Practical Guide to the analysis of genes and proteins. John-Wiley and Sons Publications, New York.
11. Campbell A. M. and Heyer, L. J. 2007. Discovering Genomics, Proteomics and Bioinformatics, 2nd Edition. Benjamin Cummings.

SECOND YEAR – ZOOLOGY

**SEMESTER – III
AND
SEMESTER - IV**

Kakatiya University - Faculty of Science
M.Sc, Zoology, SEMESTER – III
Paper Code: 301
MOLECULAR BIOLOGY

UNIT- I: DNA replication, repair and recombination

- 1.1 Concept of gene, non-coding DNA, transposons; DNA damage and repair mechanisms.
- 1.2 Unit of replication, enzymes involved, replication origin and replication fork, fidelity of Replication; Extra-chromosomal replicons
- 1.5. Regulation of phages, viruses; Prokaryotic and eukaryotic gene expression.
- 1.6. Role of chromatin in regulating gene expression and gene silencing; Regulation of gene expression by intra cellular receptors.

UNIT- II: RNA synthesis and processing

- 2.1. Structure and function of different types of RNA.
- 2.2. Transcription factors and machinery, formation of initiation complex, transcription activators and repressors. RNA polymerases.
- 2.3. Capping, elongation and termination, RNA processing.
- 2.4. RNA editing, splicing, polyadenylation, RNA transport.

UNIT- III: Protein synthesis and processing

- 3.1. Ribosome structure, Genetic code (codon anticodon recognition).
- 3.2. Formation of initiation complex, initiation factors and their regulation, elongation and elongation factors, termination.
- 3.3. Aminoacylation of tRNA, tRNA-identity, aminoacyl tRNA synthetase.
- 3.4. Translational proof-reading, translational inhibitors, post- translational modification of proteins.

UNIT- IV: Molecular biology and recombinant DNA techniques

- 4.1 DNA sequencing methods, strategies for genome sequencing; methods for analysis of gene expression at RNA and protein level.
- 4.2 Micro array based techniques; isolation, separation and analysis of carbohydrate and lipid molecules; RFLP, RAPD and AFLP techniques.
- 4.3 Generation of genomic and cDNA libraries in plasmid, phage, bcosmid, BAC and YAC vectors.
- 4.4 Expression of recombinant proteins using bacterial and animal vectors.

PRACTICALS :

1. Isolation of DNA from goat spleen
2. Estimation of DNA (diphenyl method)
3. Estimation of RNA (Orcinol method)
4. UV absorption spectra of native and denatured DNA
5. Agarose gel Electrophoresis of DNA
6. DNA amplification by PCR
7. Gel Documentation

REFERENCE BOOKS:

1. Molecular Cell Biology by Lodish et al
2. Molecular Cell Biology by Alberts et al
3. Principles of Biochemistry by Lehninger
4. The Cell by Geoffrey Cooper
5. Genetics , A molecular approach by Peter J Russell
6. Biochemistry by Voet and Voet
7. Principles of Genetics by Tamarin
8. GENES VIII by Lewin
9. Biochemistry by U.Satyanarayana and U Chakrapani
10. Benjamin Lewin. GENES IX 2008. Ninth edition

Kakatiya University - Faculty of Science
M.Sc, Zoology, SEMESTER – III
Paper Code: 302
IMMUNOLOGY

UNIT-I: INTRODUCTION TO IMMUNE SYSTEM

- 1.1 Cells and tissues of the immune system.
- 1.2 Innate and acquired immunity.
- 1.3 Antibody – Structure, types and functions; Primary and Secondary Ab responses.
- 1.4 Antigen, antigenicity and immunogenicity, B and T cell epitopes.

UNIT-II: MATURATION ACTIVATION AND REGULATION OF LYMPHOCYTES

- 2.1 T-cell maturation and differentiation.
- 2.2 T-cell receptors, molecular components and structure.
- 2.3 TH -cell activation mechanism. Cell death and T-cell regulation of immune response.
- 2.4 B-cell receptors B-cell generation, activation, differentiation and proliferation.

UNIT-III: EFFECTOR MECHANISM AND REGULATION OF IMMUNE RESPONSE

- 3.1 Structure of MHC molecules – Class -I and Class-II MHC in mouse and HLA system in human.
- 3.2 Structure and functions of cytokines.
- 3.3 Cytokine receptors and signaling, Toll-like receptors
- 3.4 Components of Innate Immune system. NK cells mechanism and action.

UNIT-IV: IMMUNITY IN DEFENCE AND DISEASE

- 4.1 Immunity responses during Bacteria (TB), parasitic (Malaria) and viral (HIV) infections.
- 4.2 Bone marrow Transplantation Immunology. Mechanism of Allograft rejection Graft -Versus-Host Disease.
- 4.3 Recognition and entry processes of different pathogens like bacteria, viruses into animal.
- 4.4 Hyper sensitivity, AutoImmunity, Congential and Aquired Immuno Deficiency disease

PRACTICALS:

1. Agglutination Reaction:
 - a) Tube Agglutination Reaction
 - b) Slide Agglutination Reaction
 - c) Indirect Agglutination Inhibition Reaction
2. Precipitation Reaction
 - a) Double Diffusion Reaction
 - b) Single Diffusion Reaction
3. Erythrocyte Rosette-forming Cell Test.
4. Separation of Lymphocytes
5. Enzyme-Linked Immunosorbent Assay
6. Measurement of Phagocytosis by Phagocytes
7. Demonstration of Immunolectrophoresis
8. Neutralization and complement fixation
9. Collection of macrophages and their characterization
10. Identification of histological slides of lymphoid tissue - Spleen, thymus, lymphnode and bone marrow

REFERENCE BOOKS:

1. Abul K. Abbas – Cell And Molecular Immunology
2. Kuby. Immunology, W.H Freeman, USA
3. W.Pual, Fundamentals of immunology.
4. I.M. Roitt , Essential immunology, ELBS Edition.

Kakatiya University - Faculty of Science
M.Sc, Zoology, SEMESTER – III
Paper Code: 303
Subject Elective – I:
PARASITOLOGY

Unit-I: Introduction to Parasites

- 1.1 Introduction to parasites of man, scope and definition of parasites/parasitology
- 1.2 Animal Association, Types of Parasites and Hosts
- 1.3 Interrelationship between Host and Parasites responses and hosts to parasitic infection
- 1.4 Mode of transmission of parasite, Host specificity and parasitic adaptation

Unit-II: Protozoa and Cestoda

Classification, Geographical distribution, Morphology, Life-cycle, Transmission, Pathogenicity, Treatment and Prophylaxis of:

- 2.1 Protozoan parasites: *Entamoeba* Sps, *Trypanosoma* Sps., *Leishmania* Sps.
- 2.2 Intestinal flagellates *Giardia* Sps, *Trichomonas* Sps
- 2.3 Cestodes: *Taenia* Sps, *Diphilabothrium* Sps.
- 2.4 Classification of Parasitic Protozoans and parasitic cestodes

Unit-III: Trematoda and Nematoda

Classification, Geographical distribution, Morphology, Life-cycle, Transmission, Pathogenicity, Treatment and Prophylaxis of:

- 3.1 Trematodes: *Schistosomo* Sps, *Faciola* Sps, *Echinococcus* Sps.
- 3.2 Nematodes: *Wuchereria* Sps, *Ancylostoma* Sps, *Dracunculus* Sps.
- 3.3 Plant & Soil nematodes: Cyst nematode, citrus nematode
- 3.4 Biodiversity & Taxonomic overview of Helminth Parasites

Unit-IV: Immunology, Genetics & Molecular Biology of Parasites

- 4.1 *Trypanosoma*: Diploid & Sexual stage, Molecular characteristics of surface coat, Variable surface glycoprotein (VSG) and VSG gene expression.
- 4.2 *Plasmodium*: Diploid & haploid stages, Chromosome polymorphism, gene encoding Circum sporozoite protein & merozoites S- antigens, surface antigen diversity. Resistance of Malaria to drugs, its mechanism & assessment.
- 4.3 Platyhelminthes: Inseminative behaviour, parthenogenesis and polyspermy, sex determination, sex linked inheritance in Schistosomes.
- 4.4 Nematoda: chromosome germ line limited DNA & chromatin diminution in *Ascaris*.

PRACTICALS:

1. Study of prepared slides and museum specimens of selected parasites of representative groups of protozoans, helminths and arthropods
2. Smear preparation for protozoa
3. Study of life cycle, role as vector & control measures of:
 - a) Ticks (*Argas*, *Boophilus*)
 - b) Mosquito - anyone from- *Anopheles/ Aedes/ Culex*
 - c) Any two flies: *Tabanus/ Phlebotomus/ Sarcophaga. Cyclops*
4. Ectoparasites & Endoparasites of wild rat, cattle, dog, chick & human including stages in excreta.
5. Culturing insect parasitic nematode, and chasing the lifecycle of the nematode on the insect host.
6. Preparation of whole mounts for helminthes
7. Collection of Parasites from digestive tract of Cockroach/gut / parasites of hen and their identification and preservation.
8. Spotters based on theory.

REFERENCE BOOKS:

1. Comparative protozoology, Ecology, Physiology, Life history, Anderson, O.R. , Springer verlag, Berlin.
2. General Parasitology, Cheng T. C., Academic Press.
3. Modern Parasitology, Cox F.E.G.,Eds.Parasitology in focus, facts & trends, Melhorn h., Eds., Spriger Verlag, Beriin.
4. Medical Parasitology, Piakarsky G. L., Springer Verlag, Berlin.
5. Modern Parasitology, Cellular immunological & immunological aspects, Wyler D. J., Eds., W. H. Freeman, NY
6. Helminths, Arthropods and Protozoa of domesticated animals. ELBS and Bailliere Tindall. London. Soulsby, E. J. L. (1982).
7. A Text book of Parasitology, Bombay popular prakashan – by S.S. Kelkar and Rohini S. Kelkar.
8. Parasitology – by Chandler and Chands
9. Parasitology, Medical Pulisher Calcutta, 1987. K.D. Chaterjee.
10. Parasitology – By Ramnik sood, C.B.S. Publisher, New Delhi – 1993.

Kakatiya University - Faculty of Science
M.Sc, Zoology, SEMESTER – III
Paper Code: 303
Subject Elective – II:
CLINICAL SCIENCE

Unit-I: Introduction to Clinical Research

- 1.1 Introduction to Clinical research; Terminology and definition in clinical research; Origin and History of Clinical research.
- 1.2 Difference between Clinical research and Clinical Practice; Types of Clinical research; Phases of Clinical research.
- 1.3 Clinical trials in India – The national perspective; Clinical trial market; Career in clinical research
- 1.4 Pharmaceutical Industry-Global and Indian Perspective; Post marketing surveillance.

Unit-II: Ethics and Guidelines in Clinical Research

- 2.1 Historical guidelines in Clinical Research - Nuremberg code, Declaration of Helsinki, Belmont report
- 2.2 International Conference on Harmonization (ICH) - Brief history of ICH, Structure of ICH, ICH Harmonization Process
- 2.3 Guidelines for Good Clinical Practice (GCP) - The Principles of ICH GCP, Institutional Review Board / Independent Ethics Committee, Clinical Trial Protocol and Protocol Amendment(S)
- 2.4 Regulation in Clinical Research – Introduction of Clinical trial regulation; Food and Drug administration (FDA); Drug and cosmetic act.

Unit-III: Clinical Pharmacology and Drug Development

- 3.1 Introduction to pharmacology; concept of essential drugs; Routes of drug administration
- 3.2 Introduction to Drug discovery and development; Hurdles in Drug Development; Sources of Drugs
- 3.3 Approaches to drug discovery; Evolutionary classification of the strategies for drug discovery
- 3.4 Preclinical testing; Clinical trials; Emerging technologies in Drug discovery

Unit-IV: Clinical Trial Management

- 4.1 Project Management; Protocol in clinical research; Quality assurance & Clinical data management.
- 4.2 Informed consent; Case report form; Investigator's Brochure (IB).
- 4.3 Ethical and regulatory submission; Roles and Responsibilities of Clinical research professionals.
- 4.4 Retention of Clinical trial subjects; Monitoring visits; Documentation of clinical trials

Kakatiya University - Faculty of Science
M.Sc, Zoology, SEMESTER – III
Paper Code: 304
Subject Elective – III
ENDOCRINOLOGY & REPRODUCTIVE PHYSIOLOGY

UNIT-I : Endocrine Glands

- 1.1 Endocrine glands, their hormones and classification of hormones
- 1.2 Bio synthesis, storage and mechanism of hormonal action.
- 1.3 Hormonal receptors; Neuroendocrine regulation.
- 1.4 Hormonal regulation of Carbohydrates, Lipids and endocrine disruptors.

UNIT-II : Reproduction

- 2.1 Spermatogenesis and its hormonal regulation.
- 2.2 Accessory reproductive organs (glands) and semen composition.
- 2.3 Sexual cycles, oogenesis and their hormonal regulation.
- 2.4 Fertilization , inplantation, gastrulation, Parturition, lactation and structure and function of mammary glands.

UNIT – III : Reproductive Biotechnology

- 3.1 Assisted reproductive techniques and teratogenesis
- 3.2 Transgenic animals and gene knock outs.
- 3.3 Sexually transmitted diseases, symptoms pathogenesis and prevention.
- 3.4 Programmed cell death, aging and senescence.

UNIT –IV : Designing Experiments For The Study Of Breeding And Fertility

- 4.1 Care and breeding techniques of laboratory animal (rats & rabbits)
- 4.2 Surgical techniques in the study of mammalian reproduction.
- 4.3 Techniques in radio-immunoassay, enzyme immunoassay and radio receptor assay.
- 4.4 Use of monoclonal and polyclonal antibodies in the study of reproduction.

PRACTICALS:

1. Histological slides pertaining to endocrine glands.
2. Alloxan diabetes induction and insulinization study by blood glucose and liver glycogen estimation.
3. Effect of thyroids and anti-thyroidal agents on O₂ Consumption in the rat./ crab
4. Effect of oxytocin on uterine contractility.
5. Estrogen bioassay using immature female rats / mice.
6. Study of male and female reproductive systems in some reproductive animals.
7. Histology of ovary and testes.
8. Study of estrus cycle (Rat).
9. Diagnosis of pregnancy by the presence of HCG in urine (Acheim Zondek test)
10. Sperm morphology, motility, count and effect of some antifertility agents.
11. Models pertaining to ART(Assisted reproductive techniques), Transgenic techniques. STDs contraception, teratogenesis.
12. Visit to Veterinary Institutes to learn breeding techniques.

REFERENCE BOOKS :

1. E.J.W. Barington , General and comparative Endocrinology.
2. P.J.Bentley , Comparative Vertebrate Endocrinology.
3. R.H. Williams, Text book of Endocrinology.
4. A.Gorbman *et.al.*, Comparative Endocrinology.
5. Austen,C.R. and Short R.V. Reproduction
6. R.G.Edwards, Human Reproduction
7. E. Knobil and J.D Neill, The physiology of Reproduction volume I & II
8. E.S.E .Hafeez, Reproduction and breeding techniques for laboratory animals
9. Vander and Sherman, Human Physiology.
10. Kamini A.Rao, The infertility manual
11. A.V.Nalbondov, Reproduction Physiology.
12. K.Murray and K. Granner, Harper Biochemistry
13. J.Farris and John Griffith, The rat in laboratory investigation.
14. R.Mathur and S.Shukla ,Reproductive Biology.
15. B.P.Setchell, The mammalian testis.
16. S.F.Gilbert, Developmental Biology.
17. Vinod K. Sharma., Sexually Transmitted Diseases and ADIS
18. Gayathri Prakash, Reproductive Biology.

Kakatiya University - Faculty of Science
M.Sc, Zoology, SEMESTER – III
Paper Code: 304
Subject Elective – IV
BIOINFORMATICS

Unit-I: Introduction to Bioinformatics

- 1.1 Scope of bioinformatics - history, scope of bioinformatics in research, business and employment opportunities.
- 1.2 Human genome project and online Mendelian inheritance in man (OMIM).
- 1.3 Bioinformatics in India- current status and future implication.
- 1.4 Bioinformatics and its relation with molecular biology. Examples of related Tools (FASTA, BLAST, BLAT, RASMOL), databases(GENBANK, Pubmed, PDB) and software(RASMOL,Ligand Explorer).

Unit II : Biological Database and its Types

- 2.1 Introduction to data types and Source. Population and sample.
- 2.2 Classification and Presentation of Data. Quality of data, private and public data sources.
- 2.3 General Introduction of Biological Databases; Nucleic acid databases (NCBI, DDBJ, and EMBL). Protein databases (Primary, Composite, and Secondary).
- 2.4 Specialized Genome databases: (SGD, TIGR, and ACeDB). Structure databases (CATH, SCOP, and PDBsum)

Unit-III: Data Storage and retrieval

- 3.1 Flat files, relational, object oriented databases and controlled vocabularies. File Format (Genbank, DDBJ, FASTA, PDB, SwissProt).
- 3.2 Introduction to Metadata and search; Indices, Boolean, Fuzzy, Neighboring search.
- 3.3 The challenges of data exchange and integration. Ontologies, interchange languages and standardization efforts.
- 3.4 General Introduction to XML, UMLS, CORBA, PYTHON and OMG/LIFESCIENCE.

Unit IV : Sequence Alignments and Visualization

- 4.1 Introduction to Sequences, alignments and Dynamic Programming.
- 4.2 Local alignment and Global alignment (algorithm and example).
- 4.3 Pairwise alignment (BLAST and FASTA Algorithm) and multiple sequence alignment (Clustal W algorithm).
- 4.4 Methods for presenting large quantities of biological data: sequence viewers (Artemis, SeqVISTA), 3D structure viewers (Rasmol, SPDBv, Chime, Cn3D, PyMol),

Reference Books:

1. Mount W. 2004. Bioinformatics and sequence genome analysis 2nd Editon CBS Pub. New Delhi.
2. Bergman, N. H. Comparative Genomics. Humana Press Inc. Part of Springer Science+BusinessMedia, 2007.
3. Baxevanis, A. D. Ouellate, B. F. F. 2009. Bioinformatics: A Practical Guide to the analysis of genes and proteins. John-Wiley and Sons Publications, New York.
4. Campbell A. M. and Heyer, L. J. 2007. Discovering Genomics, Proteomics and Bioinformatics, 2nd Edition. Benjamin Cummings.
5. Des Higgins and Willie Taylor 2000. Bioinformatics: Sequence, structure and databanks. Oxford University Press.
6. Rashidi H. H. and Buehler 2002. Bioinformatics Basics: Applications in Biological Science and Medicine, CRC Press, London.
7. Gibas Cynthia and Jambeck P. 2001. Developing Bioinformatics Computer Skills: Shroff Publishersand Distributors Pvt. Ltd. (O'Reilly), Mumbai
- 8.
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- 14.

Kakatiya University - Faculty of Science
M.Sc, Zoology, SEMESTER – IV
Paper Code: 401
CELL BIOLOGY

Unit-I: Introduction to cell biology and Biomembranes.

- 1.1. Membrane structure and function: Structure of model membrane, lipid bilayer and membrane protein diffusion, osmosis, ion channels, active transport, ion pumps
- 1.2 Mechanism of sorting and regulation of intracellular transport, electrical properties of membranes.
- 1.3 Structural organization and function of intracellular organelles: Cell wall, nucleus, mitochondria, Golgi bodies, lysosomes, endoplasmic reticulum, peroxisomes.
- 1.4 Plastids, vacuoles, chloroplast, structure & function of cytoskeleton and its role in motility.

Unit-II: Intracellular Compartments and protein sorting

- 2.1. Organization of genes and chromosomes: Operon, interrupted genes, gene families, structure of chromatin and chromosomes.
- 2.2 Unique and repetitive DNA, heterochromatin, euchromatin, transposons.
- 2.3 Cell division and cell cycle: Mitosis and meiosis, their regulation, steps in cell cycle, and control of cell cycle.
- 2.4. Microbial Physiology: Growth, yield and characteristics, strategies of cell division, stress response.

Unit III: Cell Communication and Cell Signaling.

- 3.1. Cell signaling: Hormones and their receptors, cell surface receptor, signaling through G-protein coupled receptors, signal transduction pathways, second messengers, regulation of signaling pathways.
- 3.2 Bacterial and plant two-component signaling systems, bacterial chemotaxis and quorum sensing.
- 3.3 Cellular communication: Regulation of hematopoiesis, general principles of cell Communication.
- 3.4 Cell adhesion and roles of different adhesion molecules, gap junctions, extracellular matrix, integrins, neurotransmission and its regulation.

Unit IV: Cell cycle, apoptosis and cancer

- 4.1. Genetic rearrangements in progenitor cells, oncogenes, tumor suppressor genes.
- 4.2. Cancer ad Cell cycle, virus-induced cancer, metastasis, interaction of cancer cells with normal cells.
- 4.3 Apoptosis, therapeutic interventions of uncontrolled cell growth.
- 4.4. Cell senescence, telomerase.

PRACTICALS:

1. Observation of a Eukaryotic cell under higher microscope.
2. Preparation of mitotic chromosomes from roots tips.
3. Preparation of mitotic Chromosomes from testis of grasshopper.
4. Membrane fragility as a measure of osmotic tolerance
5. Lysosome isolation in isotonic sucroses.
6. Isolation & determination of number of mitochondria
7. Extraction of nuclear Chromatin
8. Extraction of membrane lipids and observation of lipid bilayer formation

REFERENCE BOOKS:

1. Molecular cell biology : Lodish, et al.
2. Molecular cell biology : Bruce Alberts, et al.
3. Cell Biology : DeRobertis.
4. Cell and molecular biology, :Gerard karp
5. Molecular cell biology : David Baltimore.
6. Cell Biology :Sc Rostogi.

Kakatiya University - Faculty of Science
M.Sc, Zoology, SEMESTER – IV
Paper Code: 402
DEVELOPMENTAL BIOLOGY

UNIT-I: Basic concepts of development

- 1.1 Potency, commitment, specification, induction, competence, determination and differentiation.
- 1.2 Morphogenetic gradients; cell fate and cell lineages.
- 1.3 Stem cells, cytoplasmic determinants, genomic equivalence and genomic imprinting.
- 1.4 Mutants and transgenics in analysis of development.

UNIT-II: Gametogenesis, fertilization and early development

- 2.1 Production of gametes, cell surface molecules in sperm-egg recognition in animals.
Activation of Sperm and Sperm-Oocyte Interaction.
- 2.2 Fertilization and Early Embryogenesis.
- 2.3 Zygote formation, cleavage, blastula formation, embryonic fields,
- 2.4 Gastrulation and formation of germ layers in Animals; embryogenesis.

UNIT-III: Morphogenesis and organogenesis in animals

- 3.1 Axes and pattern formation in *Drosophila*, Amphibia and Chick.
- 3.2 Organogenesis – vulva formation in *Caenorhabditis elegans*, eye lens induction, limb development and regeneration in vertebrates.
- 3.3 Differentiation of neurons, post embryonic development-larval formation.
- 3.4 Metamorphosis; environmental regulation of normal development; sex determination.

UNIT-IV: Ramifications of Developmental Biology

- 4.1 Environmental regulation of animal development.
- 4.2 Hox Genes: Descent with Modification.
- 4.3 Homologous Pathways of Development.
- 4.4 Teratogenesis: Introduction, Principles and Teratogenic agents.

PRACTICALS:

1. Observation of living Chick embryo.
2. Dissection and Morphology observation of the 4-14 somite chick embryo (24-34 hours).
3. Dissection and Morphology observation of the 24-38 somite chick embryo (48-85 hours).
4. Culture of Early chick embryo *in vitro*.
5. Mounting of 72 and 96 hours chick embryo.
6. Chorio-Allantoic Membrane Grafting.
7. Various patterns of Cleavage and development in freshwater Snail.
8. Larval Developmental stages of *Drosophila*.
9. Chromosome squash preparation from *Drosophila* larval salivary glands.
10. Patterns of regeneration in the Planarian/Regeneration in the Tail of Frog Tadpoles.

REFERENCE BOOKS:

1. Gilbert, S.F. Developmental Biology. 10th Edition, Sinauer Associated Inc., Massachusetts
2. Balinsky, B.I. Introduction to Embryology. Saunders, Philadelphia
3. Berril, N.J. and Karp, G. Development Biology. McGraw Hill, New York
4. Hamburger V and Hamilton HL. Handbook of chick developmental stages. Saunders Publications. 1965.
5. Berril, N.J. and Karp, G. Development Biology. McGraw Hill, New York
6. Embryology-An Introduction to Developmental Biology—Stanley Shostak
7. Muthukaruppan and Pitchappan. Animal development – a laboratory guide. CoSIP-ULP Publications, India. First Edition, 1979.

Kakatiya University - Faculty of Science
M.Sc, Zoology, SEMESTER – IV
Paper Code: 403
Subject Elective – I
FISHERIES AND AQUACULTURE

UNIT – I

1. Introduction, Definition, Scope, and Importance of Fisheries
2. Origin and Evolution of Teleosti Fishes.
3. Classification and general characters of Fishes up to Sub-class.
4. Taxonomic identification of Fresh Water fishes by the Morphometric Method.

UNIT – II

1. Origin and Classification of Fresh water bodies – Rivers,Lakes and Ponds.
2. Ecology of Lentic and Lotic water bodies.
3. Physico- Chemical (Temperature, Light, Hardness, pH, Chlorides, Dissolved Oxygen Alkalinity and Acidity) and Biological characteristics of water bodies
4. Productivity of water bodies and its importance.

UNIT – III

1. Structure and Management of Culture ponds, types of Fish seed
2. Mono culture, Polyculture and Composite fish culture.
3. Integrated Aquaculture and its relevance.
4. Plankton and its significance in Aquaculture

UNIT – IV

1. Determination of Health Condition in Fishes and Ectoparasites of Fishes
2. Helminthes parasites of fishes and their pathogenesity.
3. Protozoan diseases of fishes and their pathogenesity.
4. Bacterial and Fungal diseases of fishes and their pathogenesity.

PRACTICALS:

1. Visit to local Fresh water bodies to study their Ecology.
2. Collection, Identification and Screening of fish for Ecto and Endo parasites
3. Morphometric and Meristic data of Fishes (At least 3 types).
4. Estimation of Productivity of local Fresh water bodies.
5. Collection and preservation of Water and Soil from water bodies.
6. Collection, Preservation and Identification of plankton.
7. Estimation of PH, Temperature, Chlorides, Dissolved Oxygen from water samples.
8. Estimation of Organic matter of bottom soil.
9. Visit to local fish seed production centre.
10. Visit to local fish farms.

REFERENCE BOOKS:

1. Business Management in Fisheries and Aquaculture, Fishing News, Chaston, I (Books) Ltd., 1984.
2. Aquaculture Management, Meade, J.W. Van Nostrand, New York, 1989.
3. Aquaculture principles and practices, Pillay, T.V. R. Fishes News (Books) Ltd., London, 1990.
4. Water Quality Management for Pond Fish culture, Boyd, C.E. Elsevier Scientific publishing company, 1982.
5. Principles of Fresh Water Aquaculture, Stickney, R.R. John, Wiley & Sons, New York, 1979
6. Aquaculture – The Farming and Husbandry of fresh water and marine organisms, Bardach, et al., John Wiley & Sons, New York, 1979.
7. A manual of Freshwater Aquaculture, Santhanam, R. et al., Oxford & IBH Publishing Co. Pvt. Ltd., 1987.
8. Advances in Aquaculture, Pillay, T.V.R. & M.A., DIII. Fish News (Books) Ltd., England, 1979.
9. Limnology, Welch, P.S, Mc. Grew Hill, New York, 1952.
10. Text book of Limnology, Cole, C.A., The C.V. Mosby Co., 1983.
11. Fundamentals of Limnology, Ruttner, F, Translated by D.G. Frey and F.E. Fry, University of Toronto Press, 1968.
12. The Fresh Water Fishes of India, Pakistan, Bangladesh, Burma and Sri Lanka, Hand Book , Jayaram , K.C., (1981), Zoological survey of India, Calcutta.
13. Fishes, An Introduction of Ichthyology, Moyle Peterb, Prentice Hall, (1979).
14. Principles of Systematic Zoology, Mayer and Ashok..
15. Fish and Fisheries of India, Jhingran, V.G. Hindustan Publishing Co., Calcutta, (1975).
16. Fish and Fisheries, Yadav, B.N. Daya Publishing House,
17. The Biology of Animal Parasites, Chang. T.C. Saunders, Philadelphia, (1964).
18. Text book of Fish Diseases. Conroy. D.A. and R.C. Heanean, (1968).
19. Fish Diseases Vol. I & II, Schaperclaus,
20. Methods for assessment of Fish Production in Fresh Water, Ricker, W.K. (1984), Blackwell Publications.

Kakatiya University - Faculty of Science
M.Sc, Zoology, SEMESTER – IV
Paper Code: 403
Subject Elective – II
NEUROPHYSIOLOGY

Unit-1: Basics of Neurophysiology

- 1.1 An overview of the nervous system
- 1.2 Neurons: Introduction to neurons, The Neuron Doctrine, The Nissl and Golgi stains, Components of neurons.
- 1.3 Classification and types of neurons, Cytology of neurons.
- 1.4 Dendrites structure and function, Axons structure and functional aspects, ultrastructure, myelination and synapses.

Unit-II: Neuroanatomy

- 2.1 Gross anatomy of the adult brain; organization of the nervous system; Subdivisions of the nervous system; Concept of CNS, ANS & PNS; The scalp, skull and meninges; Cerebrospinal fluid.
- 2.2 Constitutions of CNS with gross anatomy.
- 2.3 Functional aspects of cranial nerves and scheme of thalamic organization.
- 2.4 Dendritic properties and functional operation of: Auditory system; Visual system; Olfactory and Limbic system; Autonomic system

Unit-III: Cellular Neurophysiology

- 3.1 Electrical properties of excitable membranes: Basic electricity and electric circuits, neurons as conductors of electricity, equivalent circuit representation.
- 3.2 Electrical properties of excitable membranes: Membrane conductance, linear and nonlinear membrane, ionic conductance, current-voltage relations.
- 3.3 Ion movement in excitable cells: active transport of ions, movement of ions across biological membranes, Membrane potential and role of sodium and potassium pumps.
- 3.4 Action potential, non-gated ion channels and generation of action potential; Electrical properties of neurons, quantitative models of simulations, Voltage gated channels; Biophysical, biochemical and molecular properties of voltage gated channels.

Unit-III: Neural Signaling

- 4.1 Overview of Neurons, Synapses and Networks.
- 4.2 Chemical and Electrical Signaling Within a Circuit; Methods to Record Electrical Activity of a Neuron.
- 4.3 Synaptic vesicles, Principles of synaptic transmission: Electrical and chemical synapses; Calcium hypothesis: Control of transmitter release; Synthesis and trafficking of neuronal proteins.
- 4.4 Synaptic transmission at nerve-muscle synapses; Synaptic transmission at central synapses; Second messengers and synaptic transmission.

Kakatiya University - Faculty of Science
M.Sc, Zoology, SEMESTER – IV
Paper Code: 404
Subject Elective – III
ANIMAL BIOTECHNOLOGY

UNIT-I: Basics of Animal Biotechnology

- 1.1 History and Scope of Animal Biotechnology; Current status and Future Applications of Animal Biotechnology.
- 1.2 History and Scope of Animal Cell Culture; Types of Cell Culture.
- 1.3 Laboratory facilities for Animal Cell Culture; Culture Media and Culture Procedures.
- 1.4 Stem Cells: Definition and Meaning of Stem Cells; Functions and origins of Stem Cells; Types of Stem Cells; Stem Cell Therapy.

UNIT-II: Applied Animal Biotechnology

- 2.1 Concepts of r-DNA Technology; Genetic Engineering through Plasmids, Cosmids and Lambda phages.
- 2.2 Animal Cloning Methods and Utility; Transfection Methods and Transgenic Animals.
- 2.3 Biosensors: History of the Development of Biosensors; Working Principle and Protein Engineering for Biosensors; Applications of Biosensors.
- 2.4 Nucleic acid Hybridization; Establishment and importance of Gene Banks; Construction of Genomic libraries and DNA libraries.

UNIT-III: Pharmaceutical Animal Biotechnology

- 3.1 Introduction to Pharmaceutical Biotechnology; Basics on Products of Pharmaceutical Biotechnology (Lymphokines, Interferon's, Human Growth Hormone and Insulin).
- 3.2 Genetic Engineering for the production of Insulin.
- 3.3 Production and Applications of Monoclonal Antibodies (MAbs).
- 3.4 Vaccines: Preparation and role of Genetic Engineering in the production of Vaccines.

UNIT-IV: Medical Animal Biotechnology

- 4.1 Animal and Human Health Care: Diagnosis and Treatment of Diseases; Genetic Counseling; Forensic Medicine (DNA Finger Printing).
- 4.2 Gene Therapy: Human Diseases Targeted for Gene Therapy; Vectors and other Delivery systems for Gene Therapy.
- 4.3 Gene Therapy for Genetical and Acquired Diseases; Gene therapy using Nanotechnology.
- 4.4 Intellectual Property Rights: Introduction to Intellectual Property; Types of IP; Patents, Trademarks, Copyright & Related Rights, Protection of GMOs; IPs of relevance to Biotechnology; Types of patent application.

PRACTICALS:

1. Laboratory demonstration on safe handling of microorganisms.
2. Isolation of plasmid DNA from E-Coli .
3. Isolation of yeast DNA and Transformation of E-Coli.
4. Qualitative assay of B.Galactosidase in yeast Colonies/cell extracts.
5. Propagation & maintenance of tissue culture.
6. Isolation of Bone marrow and culture of mesenc hymel stem cells from isoleted murine/sleep/rat bone marrow.
7. Try pan blue exclusion method for cell viability estimation.
8. Mycoplasma detection method using PCR.
9. Production of penicillin and testing of antimicrobial activity.
10. Production of monoclonal of tissue culture.

REFERENCE BOOKS:

1. Culture of Animal cells – manual of basic Technique by R. Iam Freshney published by
2. Molecular Biotechnology by john Wiley & Sons Primrose Published by parima publishing corporation.
3. Principles and practice of Animal tissue culture by Sudha Gangal Published by University Pren
4. Laboratory procedures in Biotechnology--- Alam Doyle ,J.Bryan Griffiths.wiley publisher
5. Animal Biotechnology- A Laboratory course, --- Jeddrey M.Beeker. Elsevien IInd edition,2007.
6. Tools & Techniques in Biotechnology – Mousami Debnath, pointer publishers,2002
7. Principles & techniques of Biotechnology & Muecular Biology-- 6th edition, keith Wilson& John Walker
8. Gene cloning & manipulation, Christopher howe, Combridge Publications.
9. A manual of Laboratory Practices. Good

Kakatiya University - Faculty of Science
M.Sc, Zoology, SEMESTER – IV
Paper Code: 404
Subject Elective – IV
ENTOMOLOGY

Unit-I: Entomology Basics

- 1.1 Insectan characters, Origin of insect, Evolution of Insect.
- 1.2 The Head: Head Segmentation, structure of definitive head, modifications in structure of head, Cephalic appendages. The Thorax and its appendages, The Abdomen.
- 1.3 Classification and Historical Background of insects.
- 1.4 Details of the Habitat, External Morphology, Internal anatomy and Classification upto families with examples.

Unit-II: Insect Anatomy and Physiology

- 2.1 The integument: Structure, physiology and functions of integument, The Alimentary canal and associated glands.
- 2.2 Respiration- organization and structure of tracheal system, types of tracheal systems, respiration in aquatic and parasitic insects.
- 2.3 Circulation- Haemolymph composition and function, haemocytes types and functions and structure of circulatory organs.
- 2.4 Excretion – Malpighian tubules and other excretory structure, Endocrine system and sense organs of insects.

Unit-IV; Applied Entomology

- 3.1 Sericulture: History of Sericulture, Life cycles of Mulberry and Non-mulberry, Silkworms, Rearing technology of mulberry silkworm, Diseases and pests of Mulberry silkworm, Moriculture and cultural practices, Diseases and pests of Mulberry.
- 3.2 Apiculture: The honey bees, Social organization of honey bees, Life history of honey bees, Methods of bee keeping.
- 3.3 Lac culture: Lac insect- Taxonomy, distribution and life history, Host plants and lac insects, Strains of lac insect and their propagation.
- 3.4 Forensic entomology: History, Corpse- Associated arthropod classes, Role of arthropods in forensic entomology, Examples.

Unit-IV: General Entomology

- 4.1 Metamorphosis - Introduction – Types with examples, Larva and pupa – structure and types.
- 4.2 Insect behaviour - Feeding behaviour: types of feeding and damage, host range, Specialisation and host selection, Reproductive behaviour: mate location, Social Insects - Life cycle and Social organization of termites, honeybees and ants.
- 4.3 Sound production - Structure of the organs, Mechanism of sound production, Significance.
- 4.4 Bioluminescence - Structure of organs, Brief mechanism of light production, Significance