

MASTER OF SCIENCE (ZOOLOGY) – FIRST SEMESTER

First Semester			
S. No.	Name of Subject	Credits	Total Marks
1	Genetics and Cytogenetics	4	100
2	Principles of Gene Manipulation	4	100
3	Comparative Animal Physiology	4	100
4	Metabolism: Concepts and Regulation	4	100
5	Practical	6	100
Total		22	

Subject Name: GENETICS AND CYTOGENETICS

Mendel's laws and their chromosomal basis; extension of Mendel's principles: allelic variation and gene function- incomplete dominance and co-dominance, allelic series, testing gene mutations for allelism; gene action- from genotype to phenotype- penetrance and expressivity, gene interaction, epistasis, pleiotropy; nature of the gene and its functions: evolution of the concept of the gene, fine structure of gene (rII locus); methods of gene mapping: 3- point test cross in *Drosophila*, gene mapping in humans by linkage analysis in pedigrees.

Gene mutation and DNA repair: types of gene mutations, methods for detection of induced mutations, P- element insertional mutagenesis in *Drosophila*, DNA damage and repair; regulation of gene activity in lac and trp operons of *E. coli*, general introduction to gene regulation in eukaryotes at transcriptional and posttranscriptional levels, organization of a typical eukaryotic gene, transcription factors, enhancers and silencers, non coding genes.

Sex determination and dosage compensation: sex determination- in humans, *Drosophila* and other animals; dosage compensation of X-linked genes- hyperactivation of X-linked gene in male *Drosophila*, inactivation of X-linked genes in female mammals; human genetics- karyotype and nomenclature of metaphase chromosome bands; chromosome anomalies and diseases- chromosomal anomalies in malignancy (chronic myeloid leukemia, Burkitt's lymphoma, retinoblastoma and Wilms' tumor); genetic analysis of complex traits - complex pattern of inheritance, quantitative traits, threshold traits; human genome and mapping. Genetics and cancer: oncogenes- tumor inducing retroviruses and viral oncogenes; chromosome rearrangement and cancer; tumor suppressor genes- cellular roles of tumor suppressor genes, pRB, p53, pAPC, genetic pathways to cancer.

Suggested Literature:

1. Principles of Genetics, Snustad and Simmons, (4th Ed. 2005), John Wiley & Sons, USA

2. Modern Genetic Analysis: Integrating Genes and Genomes, Griffiths, J.F., Gelbart, M., Lewontin, C. and Miller, W. H. Freeman and Company, New York, USA
3. Genetics, J. Russell, Benjamin-Cummings Publishing Company, San Francisco, California, USA

Subject Name: PRINCIPLES OF GENE MANIPULATION

Basic recombinant DNA techniques, cutting and joining DNA molecules, restriction modification systems, various enzymes used in recombinant DNA technology, restriction maps and mapping techniques; nucleic acid probes, blotting techniques, DNA fingerprinting, foot printing, methyl interference assay. Polymerase chain reaction– methods and applications.

Basic biology of cloning vectors: plasmids, phages, single stranded DNA vectors, high capacity vectors, retroviral vectors, expression vectors and other advanced vectors in use. Gene cloning strategies: methods of transforming E. coli and other cells with rDNA; methods of selection and screening of transformed cells; construction of genomic and cDNA libraries; strategies of expressing cloned genes; phage display.

Principles of DNA sequencing, automated sequencing methods; synthesis of oligonucleotides, primer design; micro-arrays; confocal microscopy; changing genes- directed evolution, protein engineering in microbes.

Manipulating genes in animals: gene transfer to animal cells, genetic manipulation of animals, transgenic technology, application of recombinant DNA technology; genetically modified organisms: gene knockouts, mouse disease models, gene silencing, gene therapy, somatic and germ- line therapy.

Suggested Literature:

1. Recombinant DNA: Genes and Genomics – a short course, Watson et al., W. H. Freeman and Company, New York, USA
2. Principles of Gene Manipulation and Genomics, Primrose, S. B. And Twyman, R. M., (7th Ed. 2006), Blackwell Publishing, West Sussex, UK
3. Molecular Biotechnology: Principles and application of recombinant DNA, Bernard R. and Jack, ASM Press, Herndon, USA

Subject Name: COMPARATIVE ANIMAL PHYSIOLOGY

Internal Transport and Gas Exchange – Systems of circulation, Peripheral circulation, Regulation of heart beat and blood pressure, Transport and exchange of gases, Neural and chemical regulation of respiration, Gas transfer in air and water, Gas exchangers, Circulatory and respiratory responses to extreme conditions, Acid –base balance, Regulation of body pH.

Osmoregulation Osmoregulation in aquatic and terrestrial environments, Kidney functions and diversity, Extra-renal osmoregulatory organs, Patterns of nitrogen excretion. Thermoregulation - Heat balance in animals, Adaptations to temperature extremes, torpor, Aestivation and hibernation, Counter current heat exchangers. Adaptations to Stress- basic concept of environmental stress, acclimation, acclimatization, avoidance and tolerance, stress and hormones.

Sensing the Environment- photoreception, chemoreception, mechanoreception, echolocation, Endogenous and exogenous biological rhythms, Chromatophores and bioluminescence.

Feeding mechanisms and their control, effect of starvation. Muscle physiology – striated and smooth muscle, Adaptations of muscles for various activities, Neuronal control of muscle contraction, Electric organs.

Suggested Literature:

1. General and Comparative Animal Physiology, Hoar W. S. (ed), Prentice Hall, India.
2. Comparative Physiology (Handbook of Physiology): Vol. 1, 2, Dantzler, W.H. (ed.) Oxford University Press, New York, USA.
3. Animal Physiology: Adaptation and Environmental, Nelson K. S. (ed) Cambridge University Press, Cambridge, UK.

Subject Name: METABOLISM: CONCEPTS AND REGULATION

The living state, metabolism as the defining characteristic of living organisms, molecular approach to understanding life forms and living processes, biomolecule identification, separation and quantization, dynamic state of body constituents, experimental approaches to study metabolism.

A broad outline of metabolic pathways and their linkage, metabolism of primary metabolites – monosaccharides, lipids, amino acids and nucleotides.

Nature of enzymes – kinetics, reaction mechanism of chymotrypsin and lysozyme, purification and physico – chemical characterization, regulation of enzyme activity.

Metabolic basis of nutrition, metabolic basis of specialized tissue function, metabolic disorders, metabolic basis of diagnostics, metabolism and adaptation with one example, regulation of metabolism at molecular, cellular and organismic levels, enzymes and receptors as drug targets.

Suggested Literature:

1. Biochemistry and Molecular Biology, Elliott and Elliott, Oxford University press, New York, USA (Indian edition)
2. Harper's Illustrated Biochemistry, Murray, Granner and Rodwell, (27th Ed.), McGraw Hill, New York, USA
3. Practical Biochemistry – Principles and Techniques, Wilson and Walker, Cambridge University Press, Cambridge, UK

Subject Name: PRACTICAL

1. Study of sex chromatin in buccal smear and hair bud cells (Human)
2. Study of mutant phenotypes of Drosophila. Demonstration of law of segregation using Drosophila mutants
3. Study of law of independent assortment
4. Identification of molecular tools and techniques.
5. Fundamentals of Agarose electrophoresis.
6. Principle and function of Polymerase chain reaction

7. Demonstration of tetany, action current and fatigue in muscle.
8. To study the effect of load on muscle contraction.
9. Concentration / dispersal of pigment in isolated scales of dark / light adapted fish.
10. Preparation of a „Good“ buffer
11. Estimation of a sugar, an amino acid, a vitamin, a nucleotide/nucleic acid by appropriate chemical and biological methods
12. Biomolecules