MASTER OF SCIENCES
ZOOLOGY

SYLLABUS & REGULATIONS

WITH EFFECT FROM 2025-2026

M.Sc. ZOOLOGY

P.G. Degree Programme (CBCS) Regulations-2016
Amended as per NEP-2020

CHOICE BASED CREDIT SYSTEM (CBCS)

CENTRE FOR DISTANCE AND ONLINE EDUCATION(CDOE)
SRI VENKATESWARA UNIVERSITY
Accredited by "NAAC" with A+ Grade
Tirupati, Andhra Pradesh – 517502

CENTRE FOR DISTANCE AND ONLINE EDUCATION (CDOE)
SRI VENKATESWARA UNIVERSITY::TIRUPATI
S.V.U.COLLEGE OF SCIENCES
DEPARTMENT OF ZOOLOGY

(Revised Scheme of Instruction and Examination, Syllabus etc., (with effect from the Academic Years 2025-2026)

M.Sc. ZOOLOGY

Semester – I

Sl. No	Components of Study	Title of the Course	Status of Paper	Title of the Paper	Credit Hrs / Week	Number of Credits	IA Marks	Semester End Marks	Total
1	Core*	ZOO-101	Mandatory	Invertebrata & Chordata	6	4	20	80	100
2		ZOO-102	Mandatory	Metabolic Regulation & Cell Function	6	4	20	80	100
3	Compulsory Foundation	ZOO-103A	Optional - 1	Genetics & Evolution	6	4	20	80	100
		ZOO-103B		Endocrinology					
4	Elective Foundation	ZOO-104A	Optional - 1	Tools & Techniques	6	4	20	80	100
		ZOO-104B		Genetic Engineering					
5	Practical - I	ZOO-105P	Paper 1 & 3	Lab-1	6	4		100	100
6	Practical - II	ZOO-106P	Paper 2 & 4	Lab-2	6	4		100	100

- *All CORE Papers are Mandatory
- Compulsory Foundation - Choose one paper
- Elective Foundation - Choose one paper
- Audit Course – 100 marks (Internal) – Zero Credits under self study
- Interested students may register for MOOC with the approval of the concerned DDC but it will be considered for the award of the
- grade as open elective only giving extra credits.

Semester - II

S.No	Components of Study	Title of the Course	Status of Paper	Title of the Paper	Credit Hrs / Week	Number of Credits	IA Marks	Semester End Marks	Total
1	Core*	ZOO-201	Mandatory	Molecular Biology	6	4	20	80	100
2		ZOO-202	Mandatory	Cell Biology & Immunology	6	4	20	80	100
3	Compulsory Foundation	ZOO-203A	Optional - 1	Neurobiology & Animal Behavior	6	4	20	80	100
		ZOO-203B		Bioinformatics & Biostatistics					
4	Elective Foundation	ZOO-204A	Optional - 1	Enzymology	6	4	20	80	100
		ZOO-204B		Pathobiology					
5	Practical - I	ZOO-205P	Paper 1 & 3	Lab-1	6	4		100	100
6	Practical - II	ZOO-206P	Paper 2 & 4	Lab-2	6	4		100	100
	Total				36	24	80	520	600

- *All CORE Papers are Mandatory
- Compulsory Foundation - Choose one paper
- Elective Foundation - Choose one paper
- Audit Course – 100 marks (internal) – Zero Credits under self study
- Interested students may register for MOOC with the approval of the concerned DDC but it will be considered for the award of the grade as open elective only giving extra credits.

Semester - III

S.No	Components of Study	Title of the Course	Status of Paper	Title of the Paper	Credit Hrs / Week	Number of Credits	IA Marks	Semester End Marks	Total
1	Core*	ZOO-301	Mandatory	Developmental Biology	6	4	20	80	100
2		ZOO-302	Mandatory	Environmental Biology	6	4	20	80	100
3	Generic Elective	ZOO-303A	Optional - 1	Animal Biotechnology	6	4	20	80	100
		ZOO-303B		Microbiology					
4	Practical - I	ZOO-304P	Core & Generic Electives	Lab-1	6	4		100	100
5	Skill Oriented Course	ZOO-305	Mandatory (Theory + Practical)	Economic Zoology	6 (3+3)	4	10	90 (40 + 50)	100
6	Open Elective	ZOO-306A	Optional - 1	Environmental Impact Assessment & Green Auditing	6	4	20	80	100
		ZOO-306B		Human Health and Infectious diseases					
	Total				36	24	90	510	600

- *All CORE Papers are Mandatory
- Generic Elective - Choose two
- Core papers and Generic electives opted paper held Practical-I
- Skill Oriented Course is Mandatory. Relevant to Society along with practical (10 marks Internal, 40 final theory & 50 for practical's)
- Open Electives are for the Students of other Departments. Minimum One paper should be opted. Extra credits may be earned by opting
- for more number of open electives depending on the interest of the student through self study.
- Interested students may register for MOOC with the approval of the concerned DDC.

Semester - IV

S.No	Components of Study	Title of the Course	Status of Paper	Title of the Paper	Credit Hrs / Week	Number of Credits	IA Marks	Semester End Marks	Total
1	Core*	ZOO-401	Mandatory	Toxicology	6	4	20	80	100
2		ZOO-402	Mandatory	Comparative Animal Physiology	6	4	20	80	100
3	Generic Elective	ZOO-403A	Optional -1	Biodiversity and Conservation	6	4	20	80	100
		ZOO-403B		Animal Husbandry and Poultry Farming					
4	Practical - II	ZOO-404P	Core & Generic Electives	Lab-1	6	4		100	100
5	Multi Disciplinary Course / Project Work	ZOO-405	Mandatory (Theory + Practical)	Principles and Practices of Aquaculture	6 (3+3)	4	10	90 (40 + 50)	100
6	Open Elective	ZOO-406A	Optional - 1	Environmental Microbiology	6	4	20	80	100
		ZOO-406B		Medical Biotechnology, IPR, Biosafety and Bioethics					
	Total				36	24	120	480	600

- *All CORE Papers are Mandatory
- Generic Elective - Choose two
- Core papers and Generic elective opted paper held Practical-II
- Project Work – Collaboration with various firms/companies/societies.
- Multi-disciplinary course is Mandatory. Circle formation with other subjects/Dept. of Arts/Commerce
- Open Electives are for the Students of other Departments. Minimum One paper should be opted. Extra credits may be earned by opting for more number of open electives depending on the interest of the student through self study.
- Interested students may register for MOOC with the approval of the concerned DDC.

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M.Sc. ZOOLOGY
SEMESTER – I

CORE ZOO-101: INVERTEBRATA & CHORDATA

General Course Objectives

- While studying the Comparative anatomy of Invertebrates and Chordates i.e. Vertebrata Course, the Student shall be able to:
- This Course develops concepts in animal Taxonomy and systematic modern methods of Taxonomy and systematics and their application General organization, affinities and systematic position of Minor phyla and molecular basis of animal taxonomy.
- Develops concepts regarding various Invertebrate and vertebrate morphology.
- Describe the relationships among animals with their internal developments.
- Analysis the relationships among animals with internal structure.
- Learners gain Knowledge and develop skill over the comparative anatomy of Chordates and Vertebrata.
- Enumerate the origin and classification of Vertebrates.

Invertebrates

Course Objectives

- To describe and explain the basic principles of Animal classification, from and function among Invertebrate Phyla
- Make students to understand how life evolved from simple to complex organization by division of labor & enhancing efficiency in Invertebrates.
- To understand the importance of biodiversity, habitat, adaptations, body organization and taxonomic status of non-chordates.
- To study the fundamental knowledge about pattern of feeding and digestion among Invertebrates.
- To describe the larval forms of Invertebrates and their Phylogenetic significance.

Vertebrates

Course Objectives

- To describe the Comparative and Evolutionary trends in structure and functions of organ systems among vertebrate Phyla.
- To study the basic structure and function of Chordates. To determine the progress and complexity in the development and evolution of different chordate groups for their habitat selection, adaptation and regulation of the life processes.
- Imparts conceptual knowledge of Vertebrates, their adaptations and associations in relation to their environment.
- To describe the characteristic features of larval forms of Crustaceans and Echinodermata relationship among Invertebrates.

UNIT-1

1. Evolutionary time scale, Eras, Periods & Epoch-major events.
2. Species concept, International code of Zoological nomenclature, Taxonomical procedures, New Trends in taxonomy.
3. Patterns of feeding and digestion in lower metazoans: Holozoic nutrition, Pinocytosis, Saprozoic Nutrition, Myxotrophic nutrition, Nutrition of parasites.
4. Feeding in Polychaeta, Mollusca, Echinodermata.

UNIT-2

1. Acoelomata, Pseud acoelomata, Coelomata, Proterostomia and Dueterostomia.
2. Structure of Gill, lungs, trachea and Mechanism of Respiration. Circulatory system in Annelids, Arthropods & Molluscs.
3. Advanced nervous system-Annelida, Arthropoda and Mollusca.
4. Larval forms of Crustaceans: Larval forms: Nauplius, Metanauplius, Protozoea, Zoaea, Cypris, Mysis, Megalopa, Phyllosoma, Alima, Significance of larval forms; Larval forms of Echinodermata: Asteroidea Bipinnaria Larva, Ophiuroidea, Echinoidea, Holothuroidea, Crinoidea Doliolaria Larva, Significance of Echinoderm larval forms.

UNIT-3

1. Vertebrate integument and derivatives: Skin structure and functions-glands, scales, horns, claws, nails, hoofs, feathers and hair.
2. Comparative an atomy of heart: Types-structure-blood circulation-aortic arches and portal system.
3. Comparative an atomy of reproductive system: Organs of male reproductive system– organs of female reproductive system – functions.
4. Comparative account of excretory system.

UNIT-4

1. Comparative an atomy of respiratory organs: Gills, trachea and lungs types
2. Structure-mechanism of respiration.
3. Comparative an atomy of brain and spinal cord: structure, composition and functions
4. Organs of vision: structure of eye in different phyla-mechanism of vision, Photoreceptors-fishes, Amphibians, Reptiles, Birds and Mammals.

5. Organs of Gustatory hearing and tactile responses: Structure of hearing organs in different Phyla-mechanism of hearing-tactile organs.

Invertebrates

Course Outcomes

- Understanding the General Characteristics, Principles of classification, general biology of Invertebrate Communities.
- To understand the various biological functions, the evolutions of life from most primitive to most advanced form with respective to their habit and habitat.
- To understand the various physiological mechanisms among Invertebrates and their significance among Invertebrate Phyla.

Vertebrates

Course Outcomes

- Understanding the comparative aspects of different organs systems among chordate Phyla.
- Explain the similarity and differences in structure and function of organs in different groups of **Chordates.**
- In depth understanding of Anatomical features of Integumentary, Circulatory, Reproductive, Respiratory, Receptor, Nervous systems among Chordate groups.
- The students may apply this knowledge in taxonomy related research and job opportunities.

SUGGESTED READING MATERIAL

1. Alexander, R.M. The Chordata. Cambridge University Press, London.
2. Barnes, R.D. Invertebrate Zoology, III edition. W.b. Saunders Co., Philadelphia, 1980.
3. Barrington, EJ.W. Invertebrate structure and function. Thomas Nelson and Sons Ltd., London.1969.
4. Barrington, EJ.W. The Biology of Hernichor data and Protochor data. Oliver and Boyd, Ed in bourgh.
5. Bourne, GH. The structure and functions of nervous tissue. Academic Press, New York.

6. Carter, GS. Structure and habit invertebrate volution Sedwick and Jackson, London.
7. Eecles, J.C. The understanding of the brain. McGrawHillCo., New York and London.
8. Hyman, L.B. The Invertebrates smaller coelomate groups, Vol.V. Mc.GrawHill, Co., New York.
9. Hyman, L.B. The Invertebrates. Vol.2 McGrawHill Co., New York and London.
10. Hyman, L.B. The invertebrates. Vol.l. Protozoa through Ctenophora, McGrawHillCo., New York.
11. Hyman, L.H. The Invertebrates. Vol.8. McGrawHill Co., New York and London.
12. Jagerstein, G.Evolution of Metazoan life cycle, Academic Press, New York & London.
13. Kingsley, J.S. Outlines of Comparative Anatomy of Vertebrates. Central Book Depot, Allahabad.
14. Parker, TJ., Haswell, W.A. Textbook of Zoology, McMillan Co., London.

CORE ZOO-102: METABOLIC REGULATION AND CELL FUNCTION

Course Objectives

While studying the **Metabolic Regulation & Cell Function** (MRCF) course, the student shall be able to:

- This course is designed to introduce the organic structure of living systems mainly dealing with biomolecules like carbohydrates, lipids, proteins and nucleic acids laying foundation for other advanced courses like Physiology, Cell Biology, Molecular Biology and Immunology.
- To develop understanding of chemistry used in biological processes and to perform wide range of analytical techniques to explore biological activities.
- Physiological and biochemical understanding through scientific enquiry into the nature of mechanical, physical, and biochemical functions of humans, their organs, and the cells of which they are composed
- To understand the Interactions and interdependence of physiological and biochemical processes and thus to help the student to navigate the discipline of Biochemistry that explains how the collection of inanimate molecules.
- Provide a concise and unifying approach of knowledge-sharing of the structure, function and interaction of biomolecules & bioprocesses at molecular and metabolic levels thus pave way for understanding the biochemical integrity of various life processes and the metabolic Pathways
- The Intermediary Metabolism: Concept and Regulation is designed as an advance course for understanding the interaction, network and regulation of certain important metabolic pathways and their roles in health and diseases.
- The course also explains the interplay and energetics, catalysis and design of living systems. It is designed for students who have already taken up the courses and elementary biochemistry and macromolecular structures at the undergraduate level.

UNIT-1

1. Chemical Bonds (Covalent, Ionic and Hydrogen Bonds) and Thermodynamic principles in Biology (Enthalpy, Entropy, Free energy, First law and Second law of thermo-dynamics in relation to Biological system).
2. Carbohydrates: Definition and Classification- Structure and function of important Mono, Oligo and Polysaccharides.
3. Intermediary Metabolism-I: Glycolysis, TCA Cycle and their Bio-medical importance.
4. Intermediary Metabolism-II: Gluconeogenesis, HMP Shunt, Metabolism of Galactose and Fructose and their Bio-medical importance.

UNIT-2

1. Proteins: Definition and Classification- Structure (Primary, Secondary and Tertiary structures, Protein folding and denaturation) and function of important Proteins-Hemoglobin, Myosin and Actin.
2. Bio-synthesis of nutritionally non-essential amino acids and their Bio-medical importance.
3. Catabolism of Proteins and Amino acids-I: Biosynthesis of Urea- Detoxification of Ammonia- Metabolic disorders of Urea cycle.

4. Catabolism of Proteins and Amino acids-II: Phenylalanine, Tryptophan, Biosynthesis and degradation of Polyamines and their Bio-medical importance.

UNIT-3

1. Chemistry of purines, pyrimidines, Nucleosides, Nucleotides, Synthetic derivatives.
2. Biosynthesis of purine nucleotides, Catabolism of purines.
3. Biosynthesis of pyrimidine nucleotides, Catabolism of Pyrimidines,
4. Clinical disorders of purine and pyrimidine metabolism; Hyperurecemia or gout; Hypo-urocemia, Orotic aciduria.

UNIT-4

1. Biomedical importance, Classification of lipids; Saturated and unsaturated fatty acids; Triacylglycerol's (tri-glycerides), Phospholipids, Glycolipids, Steroids, Lipid peroxidation.
2. β- oxidation of fatty acids, Oxidation of unsaturated fatty acids, Ketogenesis.
3. Biosynthesis of long chain fatty acids (Palmitic acid), Clinical aspects.
4. Overview of Metabolism (Carbohydrate, Protein and Lipid): Integrated metabolism at tissue and organ level (Kidney, Liver, Muscle, Adipose tissue and Small intestine);Metabolic interrelationships among Adipose tissue, Liver and Extra hepatic tissues

Course Outcomes

After the completion of the course, a student will be able to achieve these outcomes:

- The students will learn about chemical bonding patterns, chemical structures and classification of carbohydrates and their structural and metabolic role in cellular system i.e. different pathways associated with carbohydrate metabolism.
- The students will learn about definition and classification of Proteins, Carbohydrates, Lipids etc and their importance in metabolism
- Students would gain expertise to develop understanding of biological processes at chemical, biochemical and molecular level to perform vide range of analytical techniques to explore biological activities.
- The student will be able to learn carbohydrate metabolism i.e. catabolism and its association with cellular energy production and carbohydrate anabolism in animal cells.
- The student will learn and understand about the Biosynthesis of Purines and Pyrimidine
- Nucleotides, degradation of Nucleotides, salvage pathways, biosynthesis and biodegradation of Amino acids, inborn errors of metabolism.

SUGGESTED READING MATERIAL

- D. Voet and J.G Voet, Biochemistry, 1. Wiley & Sons.
- David L. Nelson and Michael M. Cox, Lehninger; Principles of Biochemistry, McMillan Lange
- Medical Robert K.Murrey, D.K. Granner, P.A. Mayes and V.W. Rodwell; Harper's Biochemistry, Worth Publishers.

CF ZOO-103A: GENETICS AND EVOLUTION

Course Objectives

While studying the **Genetics** course, the student shall be able to understand:

- To provide fundamental knowledge about different concepts of Genetics includes Concepts of Gene, Mendelian Principles, Gene mapping methods and Mutation types etc.
- To study the basic tools and techniques involved in Cytogenetics, Microbial Genetics, Human Genetics and Quantitative Genetics etc.
- To provide strong foundation in Genetics, Cytogenetics and Molecular biology enables the students to familiarize themselves with Genetic Engineering concepts.
- To provide and introduce some of the most incisive analytical across the spectrum of the biological applications.
- Analysis of structure and functions of human chromosomes and to provide insight in to the human metabolic disorders and diseases

Course Objectives

While studying the Evolution course, the student shall be able to:

- Provide scientific foundation to support the sustainable management of diverse ecosystem services and a deep understanding of interaction of different ecoystem. It will also in depth understanding of inorganic and organic evolution.
- Imparts knowledge to the learner regarding various concepts of evolution i.e Molecular and Gene evolution, fundamentals of Micro & Macro evolution.
- Understand the concepts of Darwinism, Neo-Darwinism, Mechanisms of Isolation, Speciation model, Factors of evolution and their role.
- Acquiring knowledge on Molecular events of Evolution at cellular level.
- Gaining of knowledge about Theories of Evolution and its implications.

UNIT-1

1. Concept of gene: Alleles, Multiple alleles and Pseudo allelesn (ABO blood grouping, Bombay pheno type and Rh factor).
2. Extensions of Mendelian Principles: Pleiotropy, genomicim printing, Penetrance and expressivity, pheno copy, sex linked (color blind ness; Haemophilia), sex limited and sex in fluenced characters.
3. Gene mapping methods: Linkage maps, tetrad analysis, mapping with molecular markers, mapping with somatic cell hybrids.
4. Mutation: Types (Spontaneous, Induced, lethal, conditional, biochemical l) causes, loss off unction, gain of function, Frame shift mutations, insertional mutagenesis.

UNIT-2

1. Microbial genetics: Methods of genetic transfers-Conjugation, Transduction and sexduction, mapping genes by inter rupted mating, Recombination: homologous and non-homologous recombination including Transposition.

2. Human genetics: Pedigree analysis, geneticd is orders (Brachydactyly, Huntington's chorea).
3. Quantitative genetics: Polygenic inheritance, Types of quantitative traits (continous, meristic and threshold); examples (skin color and height in humans), Mapping of Quantitative trait loci (QTL mapping).

UNIT-3

1. Critical reviews of Darwinism.
2. Neo-Darwinism.
3. Isolation and role of isolating mechanisms in evolution.
4. Speciation and models of speciation (Allopatric, sympatric and parapatric).

UNIT-4

1. Factors of evolution (i) Mutations (ii) Natural Selection (iii) Genetic Drift.
2. Basic patterns of evolution; Micro and Macro evolution.
3. Species categories: (i) Morphological species (ii) Biological species (iii) Sibling species (iv) Subspecies Evolution of Proteins- Examples of protein evolution (Hb, insulin, growth hormone).

Course Outcomes

After the completion of the **Genetics** course, the student will be able to:

- Learn how genetic information is passed on in eukaryotes and prokaryotes, how genes work together in a complex manner in biological system and any alteration can lead to major phenotypic change
- Appreciate the concept of epigenetics as a key mechanism of regulation of gene expression steering development and cell fate that can ultimately be affected in disease condition
- Explain the ideas about Mendelian, non-Mendelian inheritance, genetic disorder, gene mutations and sex determination.
- Understood about several concepts pertaining to Microbial, Human and Quantitative genetics, Gene mapping, methods and their applications.

Course Outcomes

After completion of the Evolution, the student will be able to:

- Gained knowledge on the factors influencing the pattern of Evolution including Mutations, Natural Selection, genetic drift.
- Acquired information on the Isolating, Speciation mechanisms and their impact on Speciation.
- Understood the concepts of Micro, Macro evolution speciation categories, Protein evolution etc. to fortify the existing knowledge on Evolutionary patterns.

SUGGESTED READING MATERIAL

- An introduction to Modern genetics by Ch. Waddinsgton
- Basic Human Genetics- EJ. Mange, Arthur P. Mange. Indian Print, 1997.
- Genetic is orders of Man by M.R. Good man.
- Genetics- Monrve W. Strick berger. 3rd Ed., May, 2000.
- Genetics-K.B. Allluwallia-1985.
- Molecular Biology of genes
- Watson, J.D., N.H. Hopkins, J.W. Roberts, J.A. Steitz & A.M. Weiner. The Benjamin Cummings publishing company. Inc.Tokyo.
- Principles of Genetics- EJ. Gardner. MJ. Simmons & D.P. Snustad.
- Genetics- P.S. Verma and V.K.Agarwal-2009, S.Chand Publication.
- An introduction to genetican alysis. Griffiths, A.J.F., J.B. Miller, D.T. Suzuki, R.C. Lewontin & W.M. Gelbar k, W.H. Freeman and Company, New York.
- Dobzhansky, Th. Genetics and origin of species, Columbia University press.
- Dobzhansky, Th., F.J. Ayala, GL. Stebbins and J.M. Valentine Evolution: Surjeet publications, New Delhi latest edition.
- Gould, J.L. The mechanisms and evolution of behavior.
- Hartl, D.L. Aprimer of population genetics, sinauer Associatesm Inc., Massachusetts.
- P.A. Moody Introduction to Evolution IIed/latest: Kalyani publishers, New Delhi.
- Peter Volpe E. Understanding Evolution, University Bookstall, New Delhi.

CF ZOO-103B - ENDOCRINOLOGY

Course Objectives

- To study the concepts of Classification of Hormones, Structural features of Endocrine Glands
- Compare the structure, functions and regulation of the endocrine organs of vertebrates
- Identification of Endocrines glands of the body and their secretions
- To study the Steroid and Peptide hormones and their role
- To study the evolution of Pancreatic and Adrenal gland hormones
- To study the evolution of Thyroid and Parathyroid hormones and their role in the regulation of metabolism
- To study the role of hormones in the growth, development and reproduction.
- To study the aspects concerning Hormones – Human health

Unit 1

1. Classification of hormones. Brief account of structural features of endocrine glands. Hormonal effects and regulation – basic concepts and methods
2. Biosynthesis and secretion of pituitary. Factors influencing secretion. Endocrine disorders - brief description
3. Biosynthesis and secretion of pancreas, adrenal, and thyroid hormones. Factors influencing secretion.
4. Biosynthesis and secretion of sex steroid hormones. Factors influencing secretion.

Unit 2

1. Peptide hormones, Steroid hormones. Hormones as messengers. Cell surface receptors. Cascade of reaction linked to signal transduction.
2. Evolution of pituitary gland; Physiological actions of pituitary hormones. Urophysis and action of its hormone(s). Pancreatic hormones and glucose homeostasis.
3. Evolution of discrete adrenal gland; Synthesis of corticosteroid, structural diversity of glucocorticoids among vertebrates.
4. Sex steroids. Cytoplasmic and nuclear receptors. Mechanism of action of steroid hormones. Prostaglandins. Calcium-magnesium-protein Kinase. Hormones and eukaryotic metabolic regulation

Unit 3

1. Evolution of thyroid gland.
2. Thyroid hormone synthesis and its regulation, paradigms of thyroid hormone action in poikilotherms and homeotherms.
3. A comparative account of parathyroid gland and ultimobranchial body/C cells, synthesis of parathyroid hormone, calcitonin and of vitamin D3;
4. Hormonal regulation of calcium and phosphate homeostasis.

Unit 4:

1. Hormones, growth and development and reproduction
2. Hormones regulating reproduction
3. Hormones and human health
4. Production of hormones as Pharmaceuticals-Insulin, GH and Prolactin.

Course Outcomes

- Understand the structure, function and regulation of endocrine & neuroendocrine glands,
- Develop a deep knowledge of the role of endocrine secretion in regulation of reproductive Cycle
- Understand the pathways associated with Biosynthesis and secretion of Endocrine hormones and their role in the control of metabolism
- Acquring the knowledge of signal transduction mechanisms
- Through understanding of several endocrines including Peptide hormones, Steroid hormones, Pituitary hormones, Sex hormones, Thyroid hormones etc in the control of metabolic pathways
- Understanding the influence of hormones on Growth, Development and Reproduction and their regulatory pattern

SUGGESTED READING MATERIAL

1. Barrington. EJ.W. General and comparative Endocrinology Cambridge Press, Oxford.

2. Bentley, PJ. Comparative Vertebrate Endocrinology, Cambridge Press, Oxford.

3. Martin, C.R. Endocrine Physiology. Oxford Univ. Press, Oxford.

4. Prakash S. Lohar. Endocrionology-Hormones and human health-2005. MJP Publishers-Chennai.

5. Williams, R.H. Text Book of Endocrinology, W.B. Saunders Co., Philadelphia.

EF ZOO-104A : TOOLS & TECHNIQUES

Course Objectives

While studying the Tools & Techniques, the student shall be able to:

- To study the different tools used in biology and research.
- To learn about the operational handling and maintenance of laboratory instruments and glassware.
- To study different types of microscopy used in biology.
- To learn about different molecular and cellular separation techniques and their application in biological research.
- To study principles and methods of micro technique.

UNIT-1

1. Chromatography: Molecular sieve chromatography: Principle, Determination of void volume and molecular mass of native molecules. Ion exchange chromatography: Ion exchange materials – Cation and anion exchange materials. Principle and separation of charged molecules. Principle and application of TLC and HPLC.
2. Centrifugation. Techniques-Density gradient., ultra centrifugation.
3. Electrophoresis: principle, Matrices used in electrophoresis – PAGE for separation of proteins, molecular mass determination. Separation of nucleic acids using agarose gel- electrophoresis. Pulse field electrophoresis and isoelectric focusing.
4. Blotting techniques: western, southern and northern blotting techniques.

UNIT-2

Introduction to cell and tissue culture: Preparatory techniques – cleaning, sterilization, sterile handling tissue culture laboratory requirements, Design of tissue culture laboratory: Equipments and purpose.

Cell types (Primary and secondary) and cell lines, Cell proliferation measurements, Cell viability testing: Dye inclusion and dye exclusion tests.

Culture media: composition, preparation and sterilization, macro and micro nutrients, Importance of serum and limitation with serum media, cell harvesting methods.

The biology of stem cell: overview; different types of stem cells – embryonic stem cells, fetal tissue stem cells, adult stem cells, stem cell nuclear transfer; somatic cell nuclear transfer, Animal cloning.

UNIT-3

1. Electromagnetic spectrum of light- Simple theories of absorption of light by molecules. Beer-Lambert law.
2. Types of detectors: UV-Visible spectrophotometry, Infrared spectrophotometry, Fluorescent spectroscopy. Flame photometry, AAS.
3. Electrophysiological methods: Single neuron recording, patch-clamp recording, ECG
4. Brain activity recording, lesion and stimulation of brain, pharmacological testing, PET, MRI, CAT.

UNIT-4

1. Microscopic techniques: Principles of microscopy Scanning and transmission microscopes. Image processing methods in microscopy.
2. Different fixation and staining techniques for Light microscope and Electron microscope.
3. Microtomy and processing of tissues for Light microscope and Electron microscope. Cryopreservation and cryotechniques for microscopy
4. Freeze-etch and freeze-fracture methods for EM.

Course Outcomes

- Students would be trained in various tools and techniques used to gain insight into biological processes.
- Students would be expertise techniques used for imaging, isolation, purification and characterization of various biological substances.
- Students would gain basic knowledge of the underlying principles and practical strategy of the analytical and preparative techniques that are fundamental to study and understanding of life processes.
- Identify and describe the different equipment and tools used in a biology laboratory.
- Correctly operate different laboratory instruments.
- Correctly operate different types of microscopes.
- Prepare tissue for section cutting and correctly operate a microtome.
- Choose and perform correct staining technique for any given tissue sections.
- Describe cellular separation techniques.
- Properly handle and maintain glassware.
- Properly operate laboratory equipment.

SUGGESTED READING MATERIAL

- A Biologists Guide to Principles and Techniques of Practical Biochemistry, K. Wilson &K.W. Goulding, ELBS Edn.
- Animal Cell Culture – A practical approach, Ed.John. R. W.Masters IRL Press.
- General Zoological Microtechniques - P.M. Weesner.
- Principles and techniques of Biochemistry and molecular biology by Kein Wilson and John Walker, VII volume, Cambridge press Edition.
- Neuro anatomical Techniques, N.J. Stransfed and T.A. Miller Springer Verlag, New York Heidelberg, Berlin.
- Principles of Neuro Phycho pharmacology- Robert S. Feldman, Jerrold S. Meyer and Lind F. Quenzer. Sinauer Associates, Inc. Publishers. Sunderland. Massachusetts.
- Biophysical chemisty by Upadhyay – Upadhyay - Nath.
- Analytical Biochemistry (Biochemical techniques) by Dr P. Asokan. Chinnaa publications.
- Introduction to Instrumental analysis, Robert Braun. McGraw Hill International Edition.
- Vogel's Qantitative Chemical Analysis by Vogel, Arthur I.

EF ZOO-104B : GENETIC ENGINEERING

Course Objectives

- To demonstrate the innovative utilization of manipulating enzymes, various cloning and expression vectors and analysis of genomic sequences.
- To interpret the applications of genetic engineering in biotechnological research.
- To educate the students in strategizing research methodologies employing recombinant DNA techniques

UNIT-1

1. Enzymes used for the synthesis of DNA: DNA Polymerase I, Klenow fragment, Sequenase, Taq Polymerase, Reverse transcriptase, Terminal Transferase
2. Enzymes used for the synthesis of RNA: T3 and T7 RNA polymerases, SP6 RNA polymerase
3. Restriction enzymes - Outlines of bacterial restriction and modification systems – Classification of restriction enzymes - Type II restriction enzyme: Nomenclature, Production of DNA fragments with 3' protruding ends and blunt ends and their significance in molecular cloning - RFLP and its significance.
4. Enzymes used for ligation and modification of DNA: DNA ligase, Methylases, Kinase, Phosphatase

UNIT-2

1. Vectors for construction of genomic libraries - cosmids, bacterial artificial chromosomes (BACs), yeast artificial chromosomes (YACs) - vectors for construction of cDNA libraries - lamda ZAP. Multipurpose vectors - pUC 18/19, Blue script vectors
2. Expression vectors – structure - promoters used in expression vectors - lac, tac, λpL, T7 promoters and their significance in constructing expression vectors.
3. Promoter-probe vectors – Structure promoter probe vector - Reporter genes (lacZ, gfp, gus, luciferase) and strategies used to assay promoter activity.
4. Vectors used for cloning in to mammalian cells - SV40 Vectors

UNIT-3

1. Isolation of gene/DNA fragments. Mechanical shearing, restriction digestion, cDNA synthesis, PCR amplification and chemical synthesis of gene.
2. cDNA synthesis - Mechanism of cDNA synthesis, Strategies used to obtain full length cDNA. 5' and 3' RACE.
3. PCR - Concept and technology- Properties of primers - Inverse, multiplex PCR, RAPD and its significance. Real time PCR.
4. Chemical synthesis - Designing gene from amino acid sequence, solid phase synthesis of oligonulceotides - In vitro synthesis of gene.

UNIT-4

1. Ligation between cohesive and blunt end DNA fragments - T4 DNA ligase - Conversion of blunt end DNA fragment into cohesive ended DNA - linkers, adapters, homopolymer tailing.
2. Introduction of cloned genes into host - Transformation, conjugation, transduction, electroporation, particle bombardment, microinjection, liposome mediated DNA delivery.
3. Identification and characterization of cloned genes - Screening of genomic/cDNA libraries - genetic, molecular hybridization - immunochemical techniques
4. Expression of cloned genes – detection of expressed proteins – biological and molecular methods

Course Outcomes

- Students will become familiar with the tools and techniques of genetic engineering DNA manipulation enzymes, genome and transcriptome analysis and manipulation tools, gene expression regulation, production and characterization of recombinant proteins.
- This course exposes students to the applications of genetic engineering in biological research.
- Students will be able to perform basic genetic engineering experiments at the end of course.
- Students will acquire knowledge of advances in biotechnology- healthcare, agriculture and environment cleanup via recombinant DNA technology.

SUGGESTED READING MATERIAL

- Biotech's Dictionary of Genetic Engineering by Dinesh Arora.
- D. Green; Philip Hilter Richard M. Myers Sue. Klapholz; Harold Riethman Jane Roskams.
- DNA cloning: Mammalian systems - A Practical Approach by D.M. Glover, B. D. Hames.
- From Genes to clones Introduction to Gene technology by Ernst-L- Winnacker.
- Genetic disorders of Man by M.R. Goodman.
- Genetic Engineering and its Applications by P. Joshi
- Genetics - Monrve W. Strickberger. 3rd Ed., May, 2000.
- Genetics-K.B.Allluwallia-1985.
- Genome Alalysis - A laboratory Manual Volume-2 Detecting Genes by Bruce. Birren; Eric D.
- Genome analysis - A laboratory manual volume-3 cloning systems by Bruce. Birren; Eric D. Green; Sue. Klapholz; Richard M. Myers & Harold Riethman Jane Roskams.
- Genome Analysis - A laoboratory manual Voulume-4 Mapping Genomes by Bruce. Birren; Eric.
- Green; Sue. Klapholz; Richard M. Myers Jane Roskam.
- Molecular Biology of genes- Watson, J.D., N.H. Hopkins, J.W. Roberts, J.A. Steitz&A.M. Weiner. The Benjamin Cummings publishing company. Inc. Tokyo.
- Molecular cloning by Sambrook.

ZOO 105P : ZOO-101 (Core) & ZOO-103A or ZOO-103B (CF)

ZOO 106P : ZOO-102 (Core) & ZOO-104A or ZOO-104B (EF)

CENTRE FOR DISTANCE AND ONLINE EDUCATION (CDOE)
SRI VENKATESWARA UNIVERSITY::TIRUPATI
S.V.U.COLLEGE OF SCIENCES
DEPARTMENT OF ZOOLOGY

M.Sc. ZOOLOGY
SEMESTER – II

CORE ZOO-201: MOLECULAR BIOLOGY

Course Objectives

While studying the Molecular Biology Course, the student shall be able to:

- This course provides concept in molecular understanding of structural and functional properties of cell and various processes associated which have potential applications in Molecular, Biochemical and Biomedical research.
- To provide Knowledge about the complex organization in the Eukaryotics Cell and the molecular mechanisms of the cellular processes that exist in all the cell types.
- To gain knowledge on DNA models, structure and functions of mitochondrial DNA, DNA repair mechanisms, Transcription, translation, Replication, Gene regulation mechanisms with emphasis on Eukaryotics.

UNIT-1

1. Watson and Crick Model: Types of DNA; Properties of DNA(C-value paradox, Cot value)
2. Nuclear and mitochondrial genome, mitochondrial and maternal Inheritance
3. Structure of gene (Cistron, Muton, Recon, Cis-trans test)
4. DNA damage and repair: Biological indication of repair, photo reactivation, Excision repair, Recombination repair, SOS repair, and Mismatch repair.

UNIT-2

1. Replication in Prokaryotes: Geometry of DNA replication, semi conservative replication.
2. Enzymology of DNA replication: DNA polymerase I, II and III; Replication of Eukaryotic Chromosomes; Eukaryotic DNA polymerases; Multiple fork; Replication of Chromatin.
3. Discontinuous Replication: Fragments in Replication fork and detection of fragments; Events in the Replication fork; De novo initiation and covalent extension.
4. Bidirectional replication, Termination of replication.

UNIT-3. Transcription and Translation

1. Synthesis of RNA:- RNA Polymerase, Promoter, Auxiliary Proteins, RNA chain initiation, elongation, termination and Splicing mechanism
2. Types of RNA, Processing of mRNA, rRNA and tRNA, Ribozyme.
3. Genetic code, Identification of start and stop codon, Universality of genetic code Degeneracy, Wobbles Hypothesis. Codon usage, Genetic code of Mitochondria.
4. Ribosome structure (Prokaryotic and Eukaryotic), Protein synthesis: Initiation, Elongation and Termination of polypeptide chain, Signal peptide hypothesis, Post translational modification, Polyproteins, Inhibitors of translation.

UNIT-4

1. Temporal response, Induction, Repression, Lac Operon, Galactose Operon, Lambda Operon, Tryptophan Operon
2. Gene regulation in Eukaryotes- I: Gene families, Gene alteration (Gene loss, Gene amplification, gene rearrangement), Regulation of synthesis of primary transcripts (gene organization that affects regulation-Activator gene; Transcriptional control by hormones, Methylation).
3. Gene regulation in Eukaryotes-II: Brief description of Chromatin remodeling, Enhanceosome, Reporter or Chimeric genes, Role of binding motifs in gene expression (Helix-Turn-Helix motif, Zinc finger and Leucine Zipper), miRNA.

Course Outcomes

After Completion of the Molecular Biology course the student will be able to:

- The study of molecular biology provides the necessary information about the Chemistry of life to allow the students to understand the basis of life.
- The study of Molecular Biology stands as a tribute to human curiosity for seeking to discover, and to human creative intelligence for devising the complex instruments and elaborate techniques by which these discoveries can be made.
- Comparative analysis of Prokaryotic and Eukaryotic cells.
- Gain insight into the most significant Molecular and cell- based methods used today to expand our understanding of Biology.
- Students world gain expertise in understanding the complex molecular mechanisms occurring in cell and the applications of molecular technologies for betterment of life.
- Understand and our apply the Principles and techniques of Molecular Biology which prepares students for further education employment in teaching, basic research or the health Professions.
- Students will acquire knowledge about replication, transcription, translation, post transcriptional and post translational modifications, gene regulation, DNA repair mechanisms and various molecular tools and techniques like PCR, southern and western blotting, recombinant DNA technology etc. they will also know the various tools and techniques related to bacterial microbiology.

SUGGESTED READING MATERIAL

- Biochemistry by A.L. Lehniger
- Cell and Molecular Biology-E.D.P. De Robertis and E.M.F.
- Concepts in Molecular Biology-S.C. Rastogi, VN. Sharma and AnandaTandon (1993) Genes VII by Benjamin Lewin.
- Harper's review of Biochemistry by D.W. Martin et al1990
- Molecular Biology by David Freifelder, 1993

CORE ZOO-202:CELLBIOLOGYANDIMMUNOLOGY

While studying the **Cell Biology and Immunology** course, the student shall be able to:

Cell Biology Objectives

While studying the **Cell Biology** course, the student shall be able to:

- Develop deeper understanding of what life is and how it functions at cellular level.
- To study the structure and function of the basic unit of living organisms
- Describe cellular membrane structure and function, fine structure and function of cell organelles.
- To study stages in cell cycle (including cell death and cancer), cell differentiation, and organelles and other cellular structures in the growth and functioning of the cell (including membrane transport and signaling).
- Perform a variety of molecular and cellular biology techniques Students will understand the structures, positions and functions of plasma membrane and all cellular organelles in details. Examine the structure and functions of cellular organelles.
- Gather basic concepts of Cell Biology along with various cellular functions. Comparative analysis of cellular organelles.

Immunology Course Objectives

While studying the **Immunology** course, the student shall be able to:

- The students will have to understand how the immune system can fight with infection and other diseases, the strategies to improve existing vaccines and how to approach these, Cellular and molecular basis of inflammatory response, mechanisms involved in control of immune response
- The objective of the course is to apprise the students about components associated with immune system and molecular mechanism of their working.
- The course also deals with implications of deregulation of basic regulatory networks that lead to immune system related disorders.
- The students will be able to describe the roles of the immune system in both maintaining health and contributing to disease.
- To provide knowledge of fundamentals of immune system and immunological basis for treatment of some common diseases.
- Study the organs of immune system and the innate and adaptive immunity
- To gain knowledge on antigens, antibodies and their production mechanism
- To study the antigen antibody reactions and immunological disorders

CELL BIOLOGY

UNIT-1

1. Organization of Prokaryotic and Eukaryotic cell.
2. Membrane structure – Lipid bilayer and two dimensional structure – Fluidity of lipid bilayer–Assembly of lipid bilayer – Membrane proteins.
3. Membrane transport: Active transport – Passive transport – Diffusion – Osmosis – Ion channels-Membrane pumps.
4. Vesicular traffic and Protein sorting: Trans location of proteins in to mitochondria– Endoplasmic reticulum and Golgi-Endocytosis – exocytosis.

UNIT-2

1. Models of cell-cell signaling (steroid receptors, Nitric oxide and Carbon monoxide).
2. Functions of cell surface receptors (G-protein coupled receptors, Tyrosine kinases, cytokine receptors, receptors liked to other enzymatic activities).
3. Path ways of intracellular signaling transduction (c-AMP path ways, cyclicc-GMP, phospholipids and Ca2+, Ras, Raf and MAP kinases).
4. Signaling in development and differentiation (the receptors tyro sine kinase, Ras, MAP kinase path way in Drosophila, notch signaling).

IMMUNOLOGY

UNIT-3

1. Cells of the immune system: Lymphoid cells, Mononuclear cells, granulocytic cells, Mast Cells
2. Organs of the immune system – primary and secondary lymphoid organs, lymphatic system
3. Antigens: Antigenic determinants or Epitopes, Immunogenicity, Haptens, Adjuvants
4. Innate (Non-specific): Anatomical barriers, Phagocytosis, Physiological barriers, inflammatory barriers.

UNIT-4

1. Humoral immunity: Immunoglobulins (fine structure of immunoglobulins and Classes); the complement system, Classical and alternate path way, Inflammation.
2. Cell mediated immunity: Mechanism of cell mediated immunity; brief account on Antigen Presentation, Major Histocompatability complex
3. Antigen- anti body interactions: Affinity, Avidity, Cross-reactivity, precipitation reactions and Agglutination reactions and ELISA.
4. Brief account on immunological disorders:

a) To lerance to autoimmunity
b) Transplantation
c) Immuno deficiency diseases
d) Immunization (active and passive immunity)

Cell Biology - Course Outcomes

- This course develops concepts in molecular understanding of structural and functional properties of cells and various processes associated which have potential applications in molecular and biochemical research
- Students will understand the structures, positions and functions of plasma membrane and all cellular organelles in details. They will acquire knowledge about chromosomes and cell divisions, both mitosis and meiosis. They will also know about cell signaling and cancers. They will know how to measure and stain different cell types.
- Students would gain expertise in the ultra structural information of animal cell besides the detailed views of the cell interior revealing the various events and actions of cell at the molecular level.
- The study will help the students to understand the new discoveries about the structure and internal functioning of the cell due to technological improvements.
- The study will help the students to increase powerful means of visualization in the field of cell biology.

Immunology - Outcomes

After completion of the course, a student will be able to achieve these outcomes.

- Learn the fundamental principles of immune response including molecular, biochemical and cellular basis of immune homeostasis.
- The course will aid in understanding various aspects of immunological response and how its triggered and regulated.
- The student will learn and understand the rationale behind various assays used in immunodiagnosis of diseases and will be able to transfer knowledge of immunology in clinical perspective.
- The course will aid in understanding the principles of Graft rejection, Auto immunity and Antibody based therapy.

SUGGESTED READING MATERIAL

- An introduction to Immunology by C.Y. Rao, Narosa publishing house, 2002.
- Cell and Molecular Biology by EDRDe Robertis and EMRDe Robert is Jr, Indian Edition, B.I. Publications, Pvt .Ltd.
- Cell Biology (Fundamentals and Applications) By Gupta/Jangir, 2001; Agrobios, India.
- HarpersReviewofBiochemistry,Murray,Granier,MayesandRodwell,LangeMedicalPublications,25thEd.
- Human Physiology by Stuart Era Fox, W.M.C. Brown Publishers, USA 1984 or Recent Edition.
- Immunology introductory textbook by Nandini Shetty, Wiley Eastern Ltd.
- Kuby, J. (1998) Immunology, W.H. Freeman and Company, New York.
- Roitt, I., Brost off, J. Male, D. (1999/2000) Immunology, 4th Edition. Harcourt Brace and Company Asia, Pvt. Ltd., Singapore.
- The Cell (A Molecular Approach) by Geoffrey M. Cooper, 2ndEdn. 2000, ISBN.

CF : ZOO-203A :NEUROBIOLOGYAND ANIMALBEHAVIOUR

Neurobiology

Course Objectives

While studying the Neurobiology course, the student shall be able to:

- To study the micro anatomical structure of neuron
- To describe the different types of Neurons and their organization
- To understand the Molecular mechanism of transmission
- To study the chemical composition of Nervous system
- To understand the principles of different types of neurotransmitters

Animal Behavior

Course Objectives

While studying the Animal Behavior course, the student shall be able to:

- To study the types of perception in animal behaviour
- To study the patterns of social organization of Primates and Insects
- To know about the Animal aggressive behaviour and homing teritoriality
- To study in depth the patterns of Learning and Memory

UNIT-1

1. Micro anatomy of neurons and types of nerve cells.
2. Autonomic nervous system – Sympathetic Division, Parasympathetic Division.
3. Bioelectrical properties of neurons (Resting membrane potential – Nearnst equation; Sodium and potassium pump; Propagation of nerveim pulse.
4. Synapses: Structure and Integration (Types of synapses; Ultra structure of synapse Chemical transmission; Electrical transmission)

UNIT-2

1. Chemical composition of the nervous system-cerebrospinal fluid – CNS barriers
2. Synthesis – storage-release and in activation mechanisms and functions of the following neuro transmitters; Acetylcholine & Catecholamine's (Norepinephrine, Epinephrine, Dopamine)
3. Amino acid Neuro transmitters- Glutamate and GABA
4. Neuropeptides (Oxytocin and Vasopressin)

UNIT-3

1. General introduction: An over view of concept of Animal behaviour
2. Visual Perception, Auditory perception and Olfactory Perception
3. Animal aggression and Homing territoriality
4. Social organization, Advantages, Social organization in insects, primates

UNIT-4

1. Conditioning Learning (Classical and Operant conditioning and, Multiple-response learning) Cognitive Learning (In sight Learning, Sign Learning, Latent Learning)
2. Kinds of remembering (Red integrative memory – Recall – Recognition-Relearning-Retrieval process- Theories of Memory).

3. The nature off or getting (Decay through disuse-Interference effects, motivated forgetting, improving memory)

Neurobiology
Course Outcomes

- Learnt about structure, function and organization of Neurons in the Central nervous system Understanding Electrophysiological techniques and Molecular mechanisms associated with action potentials
- Students leant and gain knowledge on structure and function of different types of Synapses
- Gained information on different types of Neurotransmitters i.e. Amino acids and Peptides.

Animal Behavior
Course Outcomes

- Acquired knowledge on types of perception in different Animals and their importance
- Understand the overview of Animal Behavior and prominence of social organization in insects and primates
- Gained lot of information on different types of Learning phenomenon and their mechanisms.

SUGGESTED READING MATERIAL

- Basic Neurochemistry-G.J. Siegal, RW. Albers, B.W. Agran off, R Katzman (1981) Little, Brown and company. Boston.
- Introduction to Nervous system- T.H. Bullock, R Cork, A. Granner (1977); W.H Free-man & Co.
- Mechanism of Drug Action on the Nervous System M.A.B. Brazil, RW. Ryall. (1979), Cambridge University Press. Cambridge, London and New York.
- Neuro anatomical Techniques, N.J. Stransfed and T.A. Miller Springer Verlag, New
- Neurobiology. Shepherd, G.M. Oxford University press, London.
- Principles of Neural Science -E.R Kandel and J.H. Schwertz. (1981); Elsevierl North Holland. NY. Oxford.
- Principles of Neuro Phycho pharmacology- Robert S. Feldman, Jerrold S. Meyer and Lind F. Quenzer. Sinauer Associates, Inc. Publishers. Sunderland. Massachusetts.
- The Bio Chemical basis of Neuropharmacology-J.R Cooper, F.E. Bloom, &RH. Roth. (1982); Oxford University Press, NY and London. York Heidelberg, Berlin, 1980.
- Alcock, J. Animal behaviour: An evolutionary approach. Sinauer Assoc., Sunderland, Mass. USA.
- An introduction to genetic analysis. Griffiths, A.J .F., J.B. Miller, D.T. Suzuki, R.C. Lewontin & W.M. Gelbark, W.H. Freeman and Company, New York.
- Bradbury, lW. and S.L. Vehrencamp. Principles of animal communication. Sinauer Assoc. Sunderland, Mass. USA.

CF : ZOO-203B : BIOINFORMATICS AND BIO STATISTICS

Bioinformatics

Course objectives

While studying the Bioinformatics course, the student shall be able to:

- The main objective of the course is learning and understanding the detailed developments and applications of the field of Bioinformatics in varied area of biological research.
- This course generally focuses on Genomics, Proteomics and Computational biology studies and their relevance on research platform.
- To learn the fundamentals of Computational Biology.
- The course is designed in such a way that the students get the confidence to use computer programs for the daily design of experiments, data collection and analysis of results.
- It involves the integration of Computers, Software tools and Databases in an effort to address biological questions. It involves different tools to unwrap different biological functions arise during study.
- To study different methods of data processing.
- To develop skills of data handling using computer.
- To study the different outline databases of biological information.
- To learn about different data representation methods.
- To study the different DNA and Protein analysis software.

Biostatistics

Course objectives

- This course will be helpful in the learning and understanding the applications of various biostatistical methods and tools in research.
- Students studying this course will be able to perform the data analysis using Statistical tools available on any computer such as Excel as well as the programmes for big and complex data.
- Students gain knowledge on scope and importance of biostatistics.
- Students learn and practice various statistical methods used in Zoological studies and research.

UNIT-1

1. Scope, importance and status of Bioinformatics.
2. Internet basics, Tools for web search, Data retrieval tools,.
3. Sources of websites.
4. Data base types-primary, secondary and specific annotation databases

UNIT-2

1. Database types, Prediction of protein structure and protein folding, Protein sequence databases.
2. Prediction of gene structure, Functional genomics, Genomic databases
3. Submission of sequence to the database, Homology, BLAST- Types of BLAST
4. Phylogenetic analysis, Human genome project

UNIT-3

1. Definition of statistics: Biostatistics, classification, variables and attributes, Diagramatic distribution of biological data.
2. Measures of location and dispersion: Arithmetic mean, median and mode. Mean deviation, quartile deviation, Standard deviation and co-efficient of variation.
3. Curve fitting: Fitting strait line, parabola exponential curve and geometric curve to the data. Fitting of straight line using Ms-Excel.
4. Correlation and regression: Scatter diagram, types of relationship. Positive and negative correlation, computation of correlation coefficient, Interpretation of correlation coefficient. Simple regression lines and its interpretation.

UNIT-4.

1. Normal probability distribution & its applications.
2. Tests of significance: level of significance, null and alternative hypothesis, power of test and p-value of a test.
3. Student t- test for one a sample and two samples means-paired t-tests.
4. F-test, chi square test and their application, concept of ANOVA.

Bioinformatics

Course Outcomes

- It provides information to the students about database and Computer science into the area of Biology for the purpose of studying and processing genomic information as well as other forms of biological information.
- Familiar with various Applications of Bioinformatics by exploring the fundamentals of computer applications in Biology.
- Describe different methods of data handling using computers.
- Feed and tabulate raw data using computer.
- Explain and perform data representation using digital methods.
- Access and download relevant information from different online databases of biological information.
- Perform basic operations of gene sequence retrieval and compare them using different software.
- Perform basic operations of protein structure retrieval and comparison using different software.
- The student will learn about the Computer basics like Operating systems, Programming, Data Access, Internet and Nucleic acid Sequence and Protein Data Banks.
- The course will help to understand the Database similarity searches like BLAST, FASTA etc. Multiple sequencing alignments, Primer designing, Homology modeling, Phylogenetic analysis & Drug designing and Determination of Secondary and Tertiary structure of proteins.

Biostatistics

Course Outcomes

- Came to know the data collection, tabulation and presentation.
- Described the mean, median, mode and SD.
- Understood the Analysis of Variance.
- Described student 't' test and probability.
- Understood the Correlation and Regression.
- The student will learn the basics of handling of data, measures of Central tendency like Mean, Median and Mode, Measures of dispersion like Mean deviation and Standard deviation and Co-efficient of Variation.
- The course will aid in learning Test of significance like Null hypothesis and Alternative hypothesis, t-test, F-test, Chi-square test, Correlation and Regression analysis.

SUGGESTED READING MATERIAL

- Basic Bioinformatics by S. Ignacimuthu, s. j. Narosa publications, 2005.
- Bioinformatics by Andreas D. Baxevanis and B.P. Francis Ouellette, 2nd Ed., 2002.
- Bioinformatics, Methods and Applications, Genomics proteomics and drug discovery, S.C. Rastogi, N. Mendiratla and P. Rastogi, prentice-Hall ofIndia, 2004.
- Bioinformatics. Murthy, C.S.V. Himalaya Publishing House, Hyderabad.
- Computers to-day by Suresh K. Basandra (1999), Published by Galagotia publications, Pvt.Ltd., New Delhi.
- Database processing by D.M. Kroenke, Galgotia publications, 1990.
- Introduction to Bioinformatics, S. SundaraRajan and R. Balaji, Himalaya Publishing House, 2003.
- Microsoft Office, by Setultz, 1997.
- Bio-Statistics- An introductory text-Goldstein, A The Macmillan Co., New York, 1971.
- Biostatistics by Lewis Alvin (1971) Affiliated East West Press pvt., Ltd., New Delhi.
- Bio-Statistics- By Lewis Alvin E. Affiliated East-West press (P) Ltd., 1971.
- Interpretation and uses of Medical Statistics – G.J. Bourke & J.Mc. Gilvaray, Blovk well Science Publication, London, 1969.
- Introduction to Biostatistics – By Sokal – Rohlf (2nd Edn) Freeman International Editor (1973).
- Introduction to Biostatistics by Holdan Bancroft (1962) Pual B.Hoebar Inc., New York.
- Introduction to Instrumental analysis, Ronert Braun. McGraw Hill Intemational edition.
- Principles and techniques of Biochemistry and molecular biology by Kein Wilson and John Walker, VII volume, Cambridge press Edition.
- Probit Analysis by Finney, D.J.S. Chand & Co., Ltd., New Delhi.
- Statistical analysis in Biology by Mather, K Chapman and Hall, London, 1972.
- Statistical methods in Biology by Bailey Norman T.J.(1965) The English Language Book Society & The English University press Ltd.,

EF ZOO-204A: ENZYMOLOGY

Course Objectives

While studying the Enzymology, the student shall be able to:

To study the Nomenclature and Classification, Enzyme specificity, Enzyme Catalysis and Enzyme purification mechanisms

To study the Enzyme Kinetics mechanisms and impact of several parameters

To study the different mechanisms of Inhibitions and their implications at cellular level

To study the Enzyme Regulatory mechanisms

To study the Clinical aspects of Enzymology and diagnosis

To study the Enzyme Engineering Principles

To understand the Enzymes in industrial use – Biotechnological implications

UNIT-1

1. Historical Background, overview and specific examples, nomenclature and classification of enzymes–IUB system, chemical nature and properties of enzymes.
2. Enzyme specificity (Absolute specificity, Group specificity, Broad specificity).
3. Enzyme catalysis, Quantitative measurement of enzyme activity, Assay of enzyme activity-units of enzyme activity.
4. Isolation and purification of enzymes, intracellular distribution of enzymes.

UNIT-2

1. Theories of enzyme kinetics - kinetic theory and collision theory.
2. Enzyme kinetics and its importance, derivation of Michaelis-Menton equation, Methods of Vmax and Km determination, construction of Line weaver burk plots.
3. Effect of reactant concentrations (Rate constant, First order, Second order and Zero order kinetic reactions, Ramachandran plot, determination of slope).
4. Effect of Temperature, pH and enzyme concentration on reaction rate.

UNIT-3

1. Inhibition of enzyme activity (competitive, non-competitive, uncompetitive and mixed inhibition).
2. Kinetics of allosteric enzymes.
3. Regulation of enzyme activity (Metabolic regulation), Catalytic efficiency of enzymes (feed back inhibition, covalent modification).
4. Mechanism of enzyme action (Lock and Key, Induced fit model), catalytic site, role of metal ions.

UNIT-4

1. Clinical Aspects of enzymology, Medical and Therapeutic applications of enzymes; Enzymes-Clinical diagnosis.

2. Immobilized enzymes, various methods of immobilization-ionic bonding, absorption, covalent bonding (based on R groups of amino acids).
3. Iso enzymes and multiple forms of enzymes.
4. Enzyme engineering–economic importance of enzyme production. Enzymes in industries- food, biotechnology and other industries.

Enzymology

Course Outcomes

- Students learn about enzymes. Their classification and nomenclature
- Students learn about specificity of enzymes
- Students learn about measurement of enzymatic activity
- Students learn about isolation, purification of enzymes and intercellular distribution enzymes
- Students learn about kinetic and collision theories
- Students learn about mechanisms of enzyme action
- Students learn about effect of reactant concentration
- Students learn about effect of enzyme concentration, pH and temperature
- Students learn about kinetic constant and determination of kinetic constants
- Students learn about types of inhibitory mechanisms of enzymes
- Students learn about kinetics of Allosteric enzymes
- Students gain knowledge about regulation of enzyme activity with respective mechanisms
- Students learn about mechanism of enzymes in clinical diagnosis and their applications
- Students gain knowledge about immobilization of enzymes, applications of immobilized enzymes
- Students gain knowledge about isoenzymes and their applications
- Students learn about enzyme engineering, process of enzyme engineering and their applications

SUGGESTED READING MATERIAL

- Biochemical calculations. I.H. Segel, 2nd Ed., John Wiley & Sons.
- Biochemistry. D. Voet& J.G. Voet, J.Wiley& Sons.
- Enzyme Kinetics. I.W. Segil.
- Enzyme Kinetics. D.V. Roberties, Cambridge University Press.
- Harper's Biochemistry. Robert K. Murrey, Peter A. Mayer, D.K. Granner, V.W. Rodwell, Lange Medical.

EF ZOO-204 B: PATHOBIOLOGY

Course Objectives

While studying the Pathobiology course, the student shall be able to:

- To learn about communicable and non-communicable diseases in humans.
- To learn about pathological agents causing disease in man.
- To study parasitic diseases in man and farm animals.
- To understand biology of disease carrying vectors and their mode of transmission of
- pathogens.
- To learn about changes taking place in human body upon infection by pathogens.
- To study the major types of parasites of medical & veterinary importance.
- To understand the basics of identification of common parasites of humans and animals.
- To design and evaluate an intervention to control food and waterborne diseases.
- To understand and evaluate epidemiological studies in different disease.

UNIT-1

1. Disease and injury (communicable and non-communicable)
2. Local and systematic reactions of injury
3. Cellular reactions to injury
4. Inflammation and Immunological reactions

UNIT-2

1. Important human and veterinary parasites (Protozoan and helminthes)
2. Life cycle and biology of plasmodium, Trypanosoma, Ascaris, Schistosoma and Leishmania
3. Symptoms of the disease caused parasites
4. Host - Parasite interactions

UNIT-3

1. Biology of house flies (Muscadomastica) and mosquitoes (Culex, Anaphiles)
2. Arthropods as vectors of human diseases (Mosquitoes, Lice, Flies and Ticks)
3. Mode of transmission of pathogens by vectors
4. Vector Control methods- Chemical-, Physical-, Biological and Environmental control.

UNIT-4

1. Biochemical and micro chemicals studies.
2. Changes in the blood during infection & disease
3. Types of anaemia, Biochemical and Microscopic changes.
4. Molecular basis of Hemophilia.

Course Outcomes

- Explain about the different pathogens causing disease in man.
- Describe the different parasites causing disease and disability in man and animals.
- Ability to elaborate about the life cycle and biology of disease carrying vectors;
- suggest preventive and control measures for the said diseases.
- An understanding of the relationship between changes in physiology of host and
- Progress of pathogenesis in human beings and animals.
- The students after completion of the course based on the Expertise he/she may join as
- Parasitological Scientist.
- May join as Parasitologist in the State and Central Government Public Health
- Programmes as Officer

SUGGESTED READING MATERIAL

- Animal parasites, their life cycles and ecology - O. W. Oslsen.
- Clinical Haematology - Dy. L. Aksencu&A. Dranaikota, 1972.
- Principles of Pathobiology - Lavia, Mariano F.Hill, Rolla B. Oxford University Press, London, 1975.
- Text book of Pathology - an introduction to medicine 6th edition Philadelphia. Lea & Febiger, 1953.
- Veterinary clinical pathology, E.H. Coles D 1967.

ZOO- 205P : ZOO-201 (Core)& ZOO-203A or ZOO-203B (CF)

ZOO- 206P: ZOO-202 (Core) & ZOO-204A or ZOO-204B (EF)

CENTRE FOR DISTANCE AND ONLINE EDUCATION (CDOE)
SRI VENKATESWARA UNIVERSITY::TIRUPATI
S.V.U.COLLEGE OF SCIENCES
DEPARTMENT OF ZOOLOGY

M.Sc. ZOOLOGY
SEMESTER – III

CORE ZOO-301: DEVELOPMENTAL BIOLOGY

Course Objectives

While studying the Developmental Biology course, the student shall be able to:

- The main objective of Developmental Biology course is to provide four-dimensional thinking of students to truly understand the patterns and process of embryonic development, body plan, fate map, induction, competence, regulative and mosaic development, molecular and genetic approach for the study of developing embryo which is not necessarily shared with any other disciplines in the biological sciences. The relevance of Developmental Biology to the study of human disease will be exemplified throughout using different model organisms.
- Acquire knowledge on the fertilization and morphogenetic movements in the developing embryo.
- To understand the embryo organizer, inductions and differentiation.
- To study gametogenesis, fertilization, cleavage and gastrulation, stages in developing embryo.
- To acquaint students with basic knowledge of experimental embryology.

UNIT-1

1. Potency, commitment, specification, Induction, Competence, Determination and differentiation of embryonic cells.
2. Embryonic stem cells, origin and mechanism of Cell lineage, Fate maps.
3. Imprinting; Mutants and transgenics in analysis of development.
4. Genomic equivalence, cytoplasmic determinants and Nuclear transplantation experiments.

UNIT-2

1. Origin and migration of germ cells; production of gametes and establishment of polarity.
2. Fertilization; Cell surface molecules in sperm egg recognition in animals; Molecular events of post fertilization.
3. Cleavage types, Blastula formation, Gastrulation and Molecular mechanism in germ layers formation.
4. Environmental regulation of normal development.

UNIT-3

1. Axis and pattern formation in Drosophila, Amphibia and Chick.
2. Cell aggeregation and differentiation in dictyostelium.
3. Organogenesis- vulva formation in caenorhabditiselegans, eye lens induction.
4. Development in tetrapod Limb (Amphibians) and Neural fold formation.

UNIT-4

1. Sex determination in animals (mechanism of primary and secondary sex determination) Hormonal regulation of sexual phenotypes.
2. Regeneration - types of Regeneration; Axial patterning during Regeneration. Metamorphosis- hormonal regulation of metamorphosis in insects and amphibians.
3. Ageing and senescence- Reactive oxygen species and cell senescence; dietary restriction and anti aging action: genetic control of longevity; Age related diseases.
4. Programmed cell death- Incidence of Apoptosis; Apoptosis during animal development; Apoptosis in metamorphosis and morphogenesis; Apoptosis during limb development: Biochemical and molecular mechanisms involved in Apoptosis.

Course Outcomes

- Developmental Biology displays a rich array of material and conceptual practices that can be analyzed to better understand the scientific reasoning exhibited in experimental life sciences. Based on learning contents of embryology, students can have a systematic and organized learning about the knowledge and concepts of growth and development.
- Students would gain expertise in explaining how a variety of interacting processes generate an organism's heterogenous shapes, size and structural features that arise on the trajectory from embryo to adult or more generally throughout a life cycle.
- Gains knowledge about gametogenesis, cleavage mechanisms, gastrulation and role of hormones in metamorphosis and regeneration.
- After learning the development of life from cell to multicellularity complex and coordinated systems in organisms the students can apply this knowledge for research, and education, to solve the problems related to development in animals through research.
- Developmental Biology enquires about the fundamental processes that underpin the fertilization of an egg cell and its step-by-step transformation into the fascinating complexity of a whole organism.
- Students will also understand that cells only express a proportion of their genome, and that differential gene expression underlies cell differentiation and any alteration in the entire process of development leads to devastating diseases.
- Students would have a systematic and organized learning about the knowledge and concepts of growth and development of organisms. Developmental Biology displays a rich array of material and conceptual practices that could be analysed to better understand the scientific reasoning exhibited in experimental life sciences.
- To understand the overall chronology of the development and the role of various morphogens (protein/mRNA) in specification and determination of various organs and body axis formation.

SUGGESTED READINGMATERIAL

- Austen, C.R. and Short, R.V. Reproduction in Animals
- Ethan Bier The Coiled Spring Harlsor Laboratory Press, NewYork
- F.T. Longo, Fertilization, Chapman & Hall
- Molecular Developmental Biology –2008, T. Subramonian, Narosa Publishing House
- R.G. Edwards, Human Reproduction
- S.F. Gillbert, Developmental Biology, Sinauer Associates Inc., Massachusetts
- Schatten and Schatten. Molecular Biology of Fertilization.

CORE ZOO-302: ENVIRONMENTAL BIOLOGY

Course Objectives

While studying the Environmental Biology, the student shall be able to:

- The objectives of the course are to develop the ability to solve the problems related to the environment, to make them aware of various eco-friendly techniques and modern techniques to solve various environment-related problems.
- The objective of this course is to make awareness among the young students about the surrounding environment, the impact of climate change and its mitigation and biodiversity.
- The aim of the contents of this course is to introduce and explain about various conservation issues of the ecosystem and animals.
- Man himself is a part of ecosystem. The ecosystems in the world are continuously under the pressure of anthropogenic activities and human mediated ecological changes. Several animal species are under the survival threats. To introduce the students about wildlife and wild habitats, about depleting wild life and human wildlife conflict.
- Generate an interest in Ethology in order to understand the complexities of both animal and human behavior.
- To understand the basic theories and Principles of Ecology.
- To learn about current environmental issues based on Ecological principles.
- To study Environmental pollution and their management.

UNIT-1

1. A general account on Biomes and their environments.
2. Fresh Water: Classification and Characteristics, eutrophication, seasonal changes.
3. Marine: Classification and Characteristics.
4. Terrestrial: Forests – Grass lands – Tundra – Desert.

UNIT-2

1. Trophic dynamic view of ecosystem and energy flow.
2. Ecological Energetics and productivity of ecosystems.
3. Impact of environmental factors on Energy flow.
4. Bioaccumulation and Biological magnification.

UNIT-3

1. Air Pollution: Criteria and standards in India, health hazards and Toxicology – Green house gases and Green House Effect.
2. Water Pollution: Criteria and standards in India, health hazards and toxicology.
3. Role of environmental epidemiological studies and health indices in evaluation of environmental health hazards: environmental epidemiological episodes in India and Abroad.
4. Environmental Laws; Environmental Laws in India – legislation and Execution.

UNIT-4

1. Biomonitoring,.

2. Bio indicators and environmental monitoring, Environmental impact assessment.
3. Bioremediation: Need and scope of bioremediation, Environmental applications of bioremediation. Future outlook of Bioremediation: Phytoremediation, Biotechnological cleaning up of the environment by plants.

SUGGESTED READING MATERIAL

- Animal Physiology - Adaptation & Environment. 4th EditionKnut Schmidt - Nielsen - Cambridge University Press.
- Biochemical ecology and water pollution - PR Dugan, plenum press, London, 1972.
- Biodegradation & Bioremediation - 2nd editon, Martein Alexander - Academic Press, 1999 USA.
- Chemical and biological methods for water pollution studiesR.K. Trivedy and P.K. Goel, 1984.
- Current pollution researches in India - RK. Trivedy and P.K. Goel. Karad.
- Ecology & Environment - P.D. Sharma, 1991.
- Ecotechnology for pollution control and environmental management, enviromedia, Karad, RK. Trivedi.
- Encyclopedia of environmental pollution and control, enviromedia, Karad, Vol. 1 &2, R.K Trivedi.
- Environmental Biology and Toxicology-P.D. Sharma, Rastogi Publications, Meerut (India), 1998.
- Environmental Physiology of desert organism. Ed.by N.F. Hadley - Dowden Huchinson and Ross, Inc.Penn. USA.
- Environmental Science Research Volumes: Vol.1. Indicators of environmental quality - W.A. Thomas, 1972. Vol.3. Environmental pollution by pesticides - C.A. Edwards, 1974.
- Field Biology & Ecology - Allen H Benton & E. Werner, JR, 1980.
- Health hazards and human environment, World Health Organization (WHO) 1972.
- Industrial Pollution - VP. Kudesia, 1990.
- Methods in Environmental Analysis - Water soil and air by P.K. Gupta - Agrobios (India), Jodhpur, 2001
- Pesticides in the environment - R White Stevenns, MarcelDekker Inc. New York, 1971.
- Practical methods in Ecology & Environmental Science, RK. Trivedy, Goel, Trisal, 1997.
- The Ecology of waste water treatment - H.A. Hawkes pergoman press, 1963a. Vol.5 Environmental dynamics of pesticides - R. Hague and V.H. Preed, 1975.
- Water Treatment and purification technology - W.J. Ryan, Agrobios (India), Jodhpur, 2002.

GENERIC ELECTIVE ZOO-303A ANIMAL BIOTECHNOLOGY

Course objectives

While studying the Animal Biotechnology course, the student shall be able to:

- To introduce a detailed achievements of Biotechnology, Genetic Engineering and r-DNA technology principles.
- To gain knowledge on cloning vectors and their uses in gene cloning technologies.
- Principles of Cloning strategies and screening analysis of Re-combinations.
- To apply principles of Biotechnology concepts in veterinary sciences i.e. production of Transgenic animals, Artificial insemination, Invitro fertilization, Embryo transfer technology.
- Application of Biotechnological principles in Medicine and Gene transfer techniques.
- To understand the uses of Fresh and marine pearl culture technology, IPR, Patents and Copyrights.

UNIT-1

1. General Introduction and Achievements of Biotechnology
2. Enzymes used in gene cloning – Restriction end on ucleases, DNA ligases, Kinase, Phosphatase, Nucleases, Polymerases, Reverse transcriptase
3. Cloning vectors (Plasmids, Phages, cosmids, yeasts Shuttle vectors), viral vectors (SV40, Adenovirus and Baculo virus) used in Gene cloning.
4. Cloning and selection strategies of recombinants (antibiotic selection, blue white screening, colony hybridization, Fluorescence in – Situ Hybridization (FISH) and immune logical test.

UNIT-2

1. Preparation of cell lines, types of cell lines. Types of Stem Cells, Stem Cell Therapy
2. ApplicationsofcellcultureinVeterinary–Diseasediagnosis,virusvaccines,hormones
3. Application of Biotechnology in Medicine- Production of monoclonal antibodies (Hybridoma technology), Production of vaccines and Production of Growth Hormone
4. Genetherapy: Introduction, principle of gene transfer and examples (Adenosine deaminase deficiency disease, Duchenne Musculardy strophy disease and Cystic fibrosis)

UNIT-3

1. Live stock improvement: Mani pulation of reproduction in animals (Artificial in semi nation, multiple ovulations, *invitro* fertilization, Embryo transfer technology)
2. Methodsofgenetransfer–Microinjection,electroporation,lipofectionandviralmediated genetransfer techniques
3. Generation of chimeric, transgenic and knockout mice and other animals and their characterization. Gene editing- Gene silencing-CRISPR-associated protein-9 nuclease(Cas9)technology
4. Potential application of transgenic animals: models for various diseases/ disorders, production of peptides and proteins of biopharma aceutical interest (molecular farming)

UNIT-4

1. Growth hormone transgenics and stem cell technology for betterment of aquaculture. Sex reversal in fishes and their applications, Production of mono sex populations. Aquaculture and fish seed production: Hypophysiation, hCG injections
2. Marine bio / fisher sources and its applications in pharmaceutical and Nutraceutical Industries
3. Fresh water and marine (oyster) pearl culture technology, pearl culture in India, uses of pearl culture
4. Intellectual Property Rights: Introduction; Types of IP; Patents and its types, Trademark Copy right & Related Rights, Protection of GMOs; ethical and legal issues in biotechnology.

Course Outcomes

- Imparts the knowledge to cells lines and stem cells in culture media.
- It gives insight into various cell/ tissues culture techniques and their applications
- Understanding of in vitro culturing of organisms and production of transgenic animals.
- Understanding of cloning of mammals, large scale culture and production from recombinant microorganisms and cloning vectors.
- This insight allows students to take into consideration about ethical issues involved in production of transgenic animals and BT products.
- Use in gene transfer technology, genetic manipulations and in a variety of Industrial processes and prominence of IVF, Artificial insemination and embryo transfer techniques.
- Gives knowledge to culture of animal cells and its culture medium.
- Learn basic concepts and principles of recombinant DNA technology, Gene manipulation for transgenic animal production and therapeutics/ vaccine production.
- Provides knowledge on Livestock, improvement aquaculture and pearl culture
- Provides knowledge on Intellectual property rights and genetically modified organisms

SUGGESTED READING MATERIAL

- A text book of Biotechnology-RC. Dubey. S. Chand & Company Ltd., New Delhi - 1996.
- A text book on Biotechnology-(n Ed.) H.D. Kumar. EWP - Private Ltd., New Delhi - 1998.
- Animal Biotechnology-M.M. Ranga, Agrobios (India), 2000.
- Biotechnology-Fundamentals & Applications-S.S .Purohit & S.K. Mathur, Agro Botonics-1999.
- Biotechnology-V. Kumaresan. Saras Publication-1994.

GENERIC ELECTIVE ZOO-303B: MICROBIOLOGY

Course Objectives

This course enables the students to:

- Establish an understanding of the basic techniques (concept of aseptic work, cultivation and identification) in microbiology
- Describe different aspects of microbial nutrition and growth
- Describe microbial interactions and their significance in environment
- Describe microbial interactions and their significance in agriculture, food and pharmaceuticals
- Describe nonspecific body defenses and the immune responses and apply this understanding to the infectious disease process as well as the prevention and control of infectious diseases
- Develop and execute oral and writing skills necessary for effective communication of the course, the ability to think critically regarding a topic and the delivery of scientific principles to both scientists and non-scientists community

UNIT-1

Techniques in Microbiology & Microbial Diversity: Microscopy, Staining in Microbiology, sterilization, Pure culture Methods, Culture Media and its types, Micrometry, Air Sampling, Waste water analysis, Measurement of Microbial Growth, Types of microorganisms, Methods of identification of microorganisms

UNIT-2

Microbial Nutrition and Growth: Nutritional and Growth Factors requirement of microorganisms, Nutritional Types of Microorganisms, Uptake of Nutrition, Microbial Growth, Influence of Environmental Factors of Growth, Batch Culture, Continuous Culture, Synchronous Growth, Fed-batch Culture. Control of microbial growth by physical and chemical agents

UNIT-3

Environmental Microbiology: Distribution of Microbes in Air and water, Allergic disorders by air microflora, air sampling, Water treatment, Bacteriological analysis of water, Bioleaching, Bioremediation, Agricultural Microbiology and Industrial Microbiology: Plant-microbes interactions, Microbial Biodeterioration of agricultural products, control of microbes and safe storage of agricultural products, Biofertilizers, industrially important micro-organisms, secondary metabolites from micro-organisms, Microbiology of foods, Single cell Protein

UNIT-4

Medical Microbiology: Diseases caused bacteria, virus, fungi, and protozoans; Fungal diseases, Host parasite interaction-recognition and entry process of different pathogens in plants and animals, Toxins produced, Vaccines, Anti-microbial agents, Antibiotics and disinfectants, National Immunization Programme.

Course Outcomes: At the end of the course, a student should be able to:

- Identify microbiological techniques, the defining characteristics of the major groups of microorganisms and apply to study microbial phylogeny
- Classify the nutritional types of microorganisms and measure microbial growth
- Evaluate how microorganisms interact with the environment in beneficial or detrimental ways
- Assess impact of plant- microbe interaction on agriculture in both beneficial and detrimental ways. Identify industrially important microbes
- Determine ways in which microorganisms play an integral role in disease, and the microbial and immunological methodologies are used in disease treatment and prevention
- Apply the scientific method by stating a question; researching the topic; determining appropriate tests; performing tests; collecting, analyzing, and presenting data and effective communicate with both specialist and non-specialist audiences/community

SUGGESTED READING MATERIAL

- Willey, Sherwood, Woolvertan, Prescott/Harley/Klein's Microbiology, 7th Ed., TMH, 2007
- Tortora, Microbiology: an Introduction, 12th Ed., Pearson, 2016
- Frazier and Westhoff, Food Microbiology, 4th Ed., TMH, 1995
- Pelczar, Chan and Krieg, Microbiology, 5th Ed., McGraw Hill, 1985
- Stanier, General Microbiology, 1st Ed., MacMillan, 1958
- Alexander, M. (1977). Introduction to Soil Microbiology .New York: John Wiley & Sons. Atlas, R. M. (1984).
- Microbiology, Fundamentals and Applications. Macmillan. Atlas, R. M. &Bartha, R. (1997). Microbial Ecology: Fundamentals and Applications, 4th ed. Benjamin/ Cummings. Black, J. G. (2001).
- Microbiology: Principles and Explorations, 5th ed. John Wiley & Sons, New York. Campbell, R. (1983). Microbial Ecology. 2nd ed. Oxford, Blackwell.

SKILL ORIENTED COURSE ZOO-305: ECONOMIC ZOOLOGY

Course objectives

- While studying the Economic Zoology course, the student shall be able to:
- To identify various Methodologies and Perspectives of applied branches of Zoology for the possibilities of Self-employment.
- To study the economic importance of Animal husbandries, Vermicompost technology, Sericulture, Apiculture etc.
- To know the technical practices of Aquaculture, Sericulture, Apiculture, Animal husbandries, Vermicompost technologies.
- To gain disease management technologies their adaptation in the Fisheries, Apiculture, Sericulture, Poultry etc.

UNIT-1

1. Introduction to Aquarium Fish Keeping The potential scope of Aquarium Fish Industry as a Cottage Industry, Exotic and Endemic species of Aquarium Fishes
2. Biology of Aquarium Fishes Common characters and sexual dimorphism of Fresh water and Marine Aquarium fishes such as Guppy, Molly, Sword tail, Gold fish, Angel fish, Blue morph, Anemone fish and Butterfly fish, Use of live fish feed organisms. Preparation and composition of formulated fish feeds
3. Fish Transportation and Aquarium Maintenance Live fish transport - Fish handling, packing and forwarding techniques.
4. General Aquarium maintenance–budget for setting up an Aquarium Fish Farm as a Cottage Industry

UNIT-2

1. History, scope and status of Sericulture Industry in India.
2. Species of silkworm, life history of mulberry silkworm and tasar silkworm(Eri0.
3. Silk worm diseases-.
4. Brief idea of cocoon processing for silk fabric - cocoon boiling, reeling, rereeling, winding, doubling, twisting and weaving

UNIT-3

1. Types of honey bees.
2. Life cycle, culture of honey bees using movable frame hive.
3. Methods of bee keeping, enemies of bees.
4. Bye products of Honey bees and its economic importance.

UNIT-4

1. Lac culture – Lac insect, Lacciferalacca - Life cycle, Lac processing, Lac products and Economic Importance.
2. Pearl culture and Pearl Industry. Vermi culture and Composting technologies
3. Economics of Poultry keeping: Morphology of different breeds of Chicken-Brooding and Rearing of Chicks-Processing of Egg, Meat and By-Products of Poultry.
4. Dairy farm management, Milch breeds. Draught breeds, Dual purpose breeds and New Cross breeds of Cows and Buffaloes in India.

Course Outcomes

After the completion of the Economic Zoology, the student will be able to:

- Exploring of various concepts and the importance of Economic Zoology.
- Creating the self-employment opportunities to rural students through Animal husbandry, Aquaculture, Vermiculture and Sericulture.
- To understand the significance of Economically important animals including cultivable Fishes, Prawns and their culture practices.
- Identification of Animal pathogenic diseases in Fisheries, Sericulture, Apiculture, Aquaculture and their management strategies.
- Introducing technologies pertaining to Pearl culture, Vermicomposting, Poultry keeping, Dairy farm management.

SUGGESTED READING MATERIAL

- Sukla, G.S. and Upadhyay, V.B., 2000 Economic Zoology – ISBN – 81-7133-137-8 Rastogi Publications, Meerut, India.
- Jawaid Ahsan and Subhas Prasad Sinha, 2000 A Handbook on Economic Zoology-ISBN-81-219-0876-O S. Chand & Co., Ltd., New Delhi.
- Ashok Kumar and Premmohan Nigam, 1991 Economic and Applied Entomology Emkay Publications, New Delhi.
- Shammi, Q.J. and Bhatnagar, S., 2002 Applied Fisheries: ISBN-81-7754-114-5 Agrobios (India), Jodhpur – India.
- Major Hall, C.B. 2005 Ponds and Fish culture - ISBN-81-7754-146-3 Agrobios (India), Jodhpur – India.
- Keith Wilson, N.D.P., 2005 A Handbook of Poultry Practice – ISBN-81-7754-O-69-6 Agrobios (India), Jodhpur – India.
- Banerjee, G.C. 1992 Poultry – III- Edition – ISBN-81-204-008-4 Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi. B.Sc. Zoology: Syllabus (CBCS) 45
- Banerjee, 1988 A Text Book of Animal husbandry-VIII-Edition-ISBN-81-204-1260-5 Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
- Kaushish, S.K., 2001 Trends in Livestock Research – ISBN-81-7754-112-9 Agrobios (India), Jodhpur – India.
- Ismail, S.A. 1997. Vermicology the Biology of Earth worm Orient Longman, India 11. A. Mary violet Christy 2008 vermy technology MJP Publ. Chennai

OPEN ELECTIVE ZOO-306A ENVIRONMENTAL IMPACT ASSESSMENT AND GREEN AUDITING

Course Objectives

While studying the Environmental Impact Assessment and Green Auditing course, the student shall be able to:

- Introduce students to the concept of Environmental Management
- Develop skills in identifying and solving environmental problems
- Teach the principles and practices of effective environmental management system audits

Unit-1

EIA Objectives: Basis for Environmental Impact Assessment– Screening of Projects – Environmental Assessment Procedures –Significant Impact–Project Alternatives. Environmental Impact Statement Process – Environmental Management Plan (EMP).Guidelines for environmental audit, EIA Notification – 2006 and amendments. Public Participation, Regional and Sectoral Impact Assessment, Major limitations of Environmental Impact Assessment. Status of EIA in India -Current trends and strategies.

Unit-2

EIA Methodologies: Adhoc Method – Checklist Methods – Matrix Methods – Network Methods, Uniqueness ratio, habitat evaluation system. Prediction and Assessment of Impacts on Natural Resources–Biota, Surface Waters, Ground Water, Air, Noise, Hazards, Historic and Cultural Resources, Transportation, Socio-economic relationships.

Unit-3

EIA Case Studies: Land Clearing Projects – Dam sites –Aquaculture– Mines–Steel–Hydel–Thermal–Nuclear–Oil and Gas based Power Plants – Highways projects – Industrial Projects. Inter linking of Rivers and River Basin Management.

Unit-4

Green Auditing: Introduction, Necessity, Procedure for Environmental Auditing, Case Study. Environmental Management System- ISO 14000 series of standards. Green Entrepreneurship- Green Consumerism, Green Technology. Certification Process – Different Phases of Audit, Certification Audit. Various Certifying Agencies in Operation. Carbon Sequestration: Sources and Sinks, Biological Processes, Physical Processes, Chemical Processes. Greenhouse Gas Emissions, Kyoto Protocol, Carbon Footprint, Carbon Trading, Carbon Diet, Carbon Credits, Role of Trees and Forest in Reducing Atmospheric Carbon.

Course Outcomes

- Explain the concepts about Environmental Impact Assessment, develop skills in identifying and solving problems
- Locate, analyse and evaluate informations from various environmental matrices Systematically
- Be able to access and analyse different case studies/examples of EIA in practice for evaluation/ assessment
- Explain the importance of environmental audits and other management tools in business for social benefit by improving environmental performance

- Calculate the carbon footprint of any organization and identify suitable mitigation strategies for carbon reduction solutions.

SUGGESTED READING MATERIAL

- Environmental Impact Statements, Bregman, J. I. (1999), Lewis Publishers, London
- Environmental Assessment, Singleton R, Castle, P and Sort, D. (1999), Thomas Telford
- Publishing, London.
- Effective Environmental Assessment, Eccleston, C. H. (2000), Lewis Publishers, London.
- Environmental Auditing, Humphery, N. and Hadley. M. (2000), Boca Raton, USA.
- Green Accounting, Bartelmus, P. and Seifert, E. K. (2017), Taylor & Francis Limited.
- Perspectives in Environmental Studies, Kaushik, A. and Kaushik C. P. (2014). 4th Edition,
- New Age International Publishers, New Delhi.
- Carbon Sequestration for Climate Change Mitigation and Adaptation, Ussiri, D. A. N. Lal, R. (2017), Springer International Publishing.

OPEN ELECTIVE: ZOO-306B: HUMAN HEALTH AND INFECTIOUS DISEASES

Course objectives

While studying the Human Health and Infectious Diseases course, the student shall be able to:

- To introduce the basic concepts of pathophysiology of infectious diseases
- To study the major infectious diseases transmission to humans and response of immunity
- To understand the Pathogenesis, mechanisms of pathogenesis; transmission and epidemiology of various bacterial, viral, fungal and protozoan diseases.
- To study the Sexually transmitted diseases.
- To study the prevention and control measures of infectious diseases

Unit-1

Introduction to Infectious Diseases: Basic concepts in pathophysiology of infectious diseases, Outline of physiological mechanisms leading to diseased state, Infectious disease transmission, Infection and immunity, Acute and Chronic Infections, Major infectious diseases of humans.

Unit-2

Bacterial Infections: Pathogenesis, mechanisms of pathogenesis; transmission, epidemiology, public health implications, diagnosis, prophylaxis and treatment of major human infections (Tuberculosis, Cholera, Typhoid).

Unit-3

Viral Diseases: Pathogenesis, mechanisms of pathogenesis; transmission, life cycle, epidemiology, public health implications, diagnosis, prophylaxis and anti-retroviral therapy of Human immunodeficiency virus (HIV/AIDS); Sexually transmitted diseases.

Unit-4

Fungal and Protozoan Diseases: Pathogenesis, mechanisms of pathogenesis; transmission, life cycle, epidemiology, public health implications, diagnosis, prophylaxis and treatment of major Fungal human pathogens: (Dermatophytes, Candida, Aspergillus); Protozoal human pathogens (Plasmodia and Trypanosoma).

Course Outcomes

- Learn the basic concepts of Infectious diseases and the role of immunity to control infections
- Provides knowledge on the physiological mechanisms leading to diseased conditions.
- Students gains knowledge on the pathogenesis and transmission of infectious diseases.
- This insight allows the students to learn the treatment methods to control the growth and control of microbes.

SUGGESTED READING MATERIAL

- A text book of Biotechnology-RC. Dubey. S. Chand& Company Ltd., New Delhi - 1996.
- A text book on Biotechnology-(n Ed.) H.D. Kumar. EWP - Private Ltd., New Delhi - 1998.
- Biotechnology-V. Kumaresan. Saras Publication-1994.
- Environmental Microbiology, Pepper, I. L., Gerba, C. P. and Gentry, T. J. (2015), 3rd edition, Academia Press, Elsevier
- Textbook of Environmental Microbiology, Mohapatra, P. K. (2008), I.K. International (P)Ltd.
- Basic Biotechnology, Ratledge, C. and Kristiansen, B. (2003), 2nd edition, Cambridge University Press
- Pocket Guide to Bacterial Infections – K. Balamurugan and Prithika Udaya kumar (2019). CRC Press.
- Infections and Infectious diseases (2001). WHO &International Federation of Red Cross and Red Crescent Societies

ZOO 304 P : ZOO-301 (Core), ZOO-302 (Core) & ZOO-303 A& B (GE)

ZOO Lab 2: ZOO-305 (Skill Oriented course)

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M.Sc. ZOOLOGY
SEMESTER – IV

CORE ZOO-401: TOXICOLOGY

Course objectives

While studying the Toxicology course, the student shall be able to:

- Provides broad theoretical knowledge within toxicology and development of a general working knowledge of the principles and practice of clinical toxicology.
- Basic toxicology concepts including: mechanisms of toxicology, absorption, distribution and excretion of toxicants, xenobiotic metabolism, toxi cokinetics, chemical carcinogenesis, hepato toxicology. Based on student interest some of the following areas may be included: genetic toxicology, developmental toxicology, renal toxicology, toxic effects of pesticides, toxic effects of metals, toxic effects of radiation, venoms and animal poisons, air pollution, ecotoxicology, food toxicology, forensic toxicology, occupational toxicology, regulatory toxicology, other.
- This course includes the study of Pesticides that are agrochemicals and used for preventing, repelling, mitigating or destroying any pests. It includes insecticides, fungicides, rodenticides and herbicides etc. These insecticides are of chemical or biological origin that control the insect. The course indicates the mechanism of Pest control that may result in the form of killing the insects or otherwise preventing it from its destructive behaviors. Insecticides are either natural or man-made synthesized and are applied to target pests in a myriad of formulations (EC, WP, SP, FP, G etc.) and delivery systems (sprays, baits, slow-release diffusion, dust, etc.). In recent years, the bacterial genes coding for insecticidal proteins have been incorporated into various crops that deal with the mortality of the pests feeding on them.
- The course highlights various categories of insecticides and their relative efficacy in relation to other control methods in a particular ecosystem. Use of bio-pesticides and other plant derived pesticides form an important part of IPM (Integrated Pest Management).
- The course indicates the biodiversity of insects in different ecosystems and the impact of global climatic changes on insects diversity and their behaviour. Insects are important for the survival of different biota on the earth. Effect of various anthropogenic activities and pollutants on insects is correlated with maintenance of different ecosystems.
- To apprise the students about the toxicants along with their application and their effects on biosphere as well as human health.

Unit-1

1. Introduction and scope of toxicology and classification of xenobiotics.
2. Principles of toxicology- Dose response relationship- Toxicity tests {acute ($LD_{50,}$ $LC_{50,}$ ED_{50}) and chronic toxicity tests on aquatic and terrestrial animals}, Variations in toxic response.
3. Mechanism of toxic action of pesticides (Receptor concept, nature of receptors, Theory of toxicants- receptors interactions and mechanism of action of some pesticides)
4. Toxico kinetics- Classic toxic okinetics
   ii) Physiologic toxico kinetics

Unit-2

1. Translocation of toxicants; Absorption of Toxicants, Distribution of Toxicants, Excretion of Toxicants
2. Biotransformation of Xenobiotics; Biotransformation sites, Biotransformation enzymes, Biotransformation reaction and bioactivation
3. Bioaccumulation of Xenobiotics; Bio concentration, Bioaccumulation and Bio magnification;
4. Toxic effect of metals - Mercury, Lead, Cadmium and Arsenic

Unit-3

1. Toxic Response of Blood: Toxicology of erythron, leukon, platelets and homeostasis
2. Toxic Response of Liver; Mechanism and types of toxin – induced liver injury; critical factors in toxicant induced liver injury; detoxification mechanisms by liver.
3. Toxic Response of Kidney; Susceptibility of the kidney to toxic injury; Biochemical mechanisms / mediators of renal cell injury.
4. Toxic Response of Reproductive system; Endocrine disruption (including screening and puberty) in humans and mammals. Testicular and ovarian dysfunction. Deterioration in fertility by toxicants.

Unit-4

1. Xenobiotic effect on basic metabolism (Carbohydrates, Proteins, Lipids)
2. Teratogens and Teratology (Relationships between maternal and developmental toxicity)
3. Antidotal therapy; Types of antidotes and antidotal procedures.
4. Risk assessment-Hazard identification; Risk characterization and Safety evaluation of Chemicals.

Course outcomes

- The awareness about toxic agents, their effects and knowledge about mode of transformation of toxicants will help in creating skilled personnel in the field of environment protection and research.
- It is a discipline overlapping with biology, chemistry, medicine that involves the study of toxicants, their mechanism of action.
- It involves the study of the adverse effects of chemical substances on living organisms.
- Skill development in environmental and occupational Toxicology.

- It provides opportunities for students research projects, internships in assessing the effects of toxic pollutants on the environment and in the food chain.
- Identification of different routes of exposure of environmental toxins.
- Understanding of the physiological and genotoxic effects of drugs and environmental toxins.
- Knowledge of various techniques for Toxicity evaluation.
- The students having this course will study various types of insecticides and understand their mode of action to kill/control the insects. Also, the students will learn about novel categories of insecticides that may be compatible with other control strategies.
- The students will learn handling of the pesticides in crop protection and understand the therapy and antidotes at the time of poisoning.
- Further, Insects being the important component of various food chains/ food webs, the students will be understand their crucial role in homeostatic maintenance of ecosystems and their biota.
- The students will learn about the impact of anthropogenic pollutants and climatic changes on the survival and propagation of insects, and may appreciate the insects as bio-indicators of ecological changes/disturbances.

SUGGESTED READING MATERIAL

- Casarett & Doul's- Toxicology- The basic science of poisons- C.D. Klassen, Mary, O.D & John Doull.
- Concepts of Toxicology Dr. Omkar, Vishal Publishing C.2003.
- Environmental toxicology of pesticides- F. Mastimura, G.M. Boush and T. Misato.
- Introduction of Biochemical Toxicology- E.Hodgson & F.E. Gutherie.
- Pesticides action and metabolism- O'Brrien.
- Pesticides and Human Welfare- D.L. Gunn and J.G.R. Stevens. Oxford University Press-1978.
- The Encyclopedia of Americana- Vol.15.

CORE ZOO-402: COMPARATIVE ANIMAL PHYSIOLOGY

Course Objectives

While studying the Comparative Animal Physiology course, the student shall be able to:

- Comparative Animal Physiology is a comprehensive subject that gives in depth knowledge of various physiological processes in the animal kingdom.
- This course provides knowledge of animal body system functions across levels of organization, from subcellular through organismal, in order to reveal physiological homologies, patterns of physiological adaptation to various environments and general physiological principles in a wide range of organisms to understand how organisms evolved their functional characteristics and how they stay alive in the face of constantly changing internal and external environments.
- Course provides students comprehensive understanding of about Feeding mechanisms & Nutrition, Digestion in comparative basis, Respiration & Metabolism, Circulation of Body fluids, Patterns of Nitrogen excretion, Osmoregulation, Thermoregulation etc.
- To provide Structure and Functional components of Muscle
- To provide Physiological and Biochemical basis of Bioluminiscence in animal world.
- To provide information on Biological Rhythms and their occurrence in Animals.

UNIT-1

1. Aim and scope of physiology; General physiological functions and principles. Validity of comparative approach of physiology.
2. Feeding mechanisms and regulation: Nutrition, Autotrophs, Heterotrophs, Feeding Mechanisms, Digestion, Digestion in mouth, swallowing, Peristalsis, Digestion in the Stomach, Gastric secretion, Gastric juice, Regulation of Gastric secretion, Activities of Gastric Secretion, Digestion in small intestine.
3. Comparative physiology of digestion: Mechanical treatment, Movement of gut contents, Chemical Action: intracellular digestion, extracellular digestion, The digestive tract and its Enzyme chain; Digestive enzymes: Carbohydrases, Lipases and Esterases, Proteinases, Other Digestive enzymes, Absorption.
4. Coordination of Digestive activities: Visceral Autonomic system, Gastro intestinal Hormones.

UNIT-2

1. Respiration and Metabolism: Types of respiration, Respiratory organs, Mechanism of Respiration.
2. Circulation of body fluids: Major types of body fluids, Blood, General properties of blood, Composition of blood, Blood groups and Transfusions.
3. Patterns on nitrogen excretion among different animal groups: Introduction, Nitrogenous Waste Products, Morphology of the excretory system in different groups of animals, Mechanism of urine formation.

4. Osmoregulation in different animal groups: Biological significance of water, Body compartmentation, Nature of the problem of osmoregulations in different environments, Invertebrate body fluid regulation, Vertebrate body fluid regulation.

UNIT-3

1. Thermoregulation: Temperature as an environmental factor, Thermoregulation in
2. Invertebrates, Thermoregulation in vertebrates.
3. Poikilothermic animals: Temperature relation in poikilotherms, Aquatic poikilotherms, Terrestrial poikilotherms, Homoeothermic animals: Temperature relations of homeotherms, Physical heat regulation, Chemical heat regulation.
4. Hibernation & Aestivation.
5. Biological Rhythms.

UNIT-4

1. Bioluminescence: Occurrence of bioluminescence among different animals, Mechanism of light production, Control of bioluminescence, Functions of luminescence.
2. Chromatophores and regulation of their function: Colour production, Chromatophore pigments, Mechanism of action of chromatophore, Movement of pigment, Control of Chromatophores, Factors influencing on chromatophore system.
3. Contractile elements in animals.
4. Muscle structure and function-correlation.

Course Outcomes

- After going through this course of Comparative Animal Physiology, the students have a good understanding of:
- How Invertebrates and Vertebrate animals work and how these animals biology is influenced by the different environments of their niches.
- The students will be able to explore an original query in Animal Physiology. The students will appreciate evolutionary changes and environmental adaptations in different taxa of Invertebrates and Vertebrates.
- An appropriate understanding of functioning of each system of different groups of animals with their comparison will be acquainted.
- Understanding of the basic concepts of Physiological regulation, from cellular to organ to organismal.
- Understanding of how different groups of animals have different Physiological adaptations appropriate to carry out the required function to the fullet.
- Appreciation of the gorgeous diversity of Physiological possibilities that animals have developed through natural selection.

SUGGESTED READINGMATERIAL

- C.L. Prosser. Comparative Animal7 Physiology. W.B. Saunders & Company.
- C.L. Prosser. Environment and Metabolic Physiology. Wiley-Liss, New York.
- R. Eckert. Animal physiology, Mechanism and Adaptation. W.H. Freeman & Company.
- Schiemdt-Nielsen. Animal Physiology, Adaptation and Environment. Cambridge.
- W.S. Hoar. General Comparative Animal Physiology.

GENERIC ELECTIVE ZOO: 403A - BIODIVERSITY AND CONSERVATION

Course Objectives

The main objectives of this course are to: To impart understanding on the occurrence and distribution of various flora and fauna, their existence, interaction, Importance of biodiversity conservation and understand about Legislation related to conservation.

UNIT-1

1. Scope and Constraints of Biodiversity Science
2. Biological Diversity: Species – Origin of new species, Description of new species, Community and ecosystem diversity, Genetic diversity- The Hardy-Weinberg law; genetically effective populations size, Gene flow-Genetic pollution and gene erosion, Systematics in Diversity – Environment and Genetic Variations – Biological Classification – Phylogenetic Relationship – Ecological Biodiversity
3. Species Concept – Biological and Phylogenic Concepts; Species Inventory – Biodiversity hot spots. IUCN categories– Red data book. Case Studies – Deciduous Forests - Desert Lizard communities – Marine and Coral Reef - Fish Communities - Island species– Western and Eastern Ghats – Himalayas.
4. Species Diversity: Global Distribution of Species - Tropical species diversity – Diversity in terrestrial, marine and freshwater –Micro-organisms-lower and higher plants – lower and higher invertebrates and vertebrates; Species extinction and Endangered species;
5. Monitoring indicator species and habitats; Threats to biodiversity: Extinction – Past rate of Extinction – Human Caused Extinctions – Endemic species - Extinction rates - Man and animal conflicts.

UNIT-2

1. Habitats and Ecosystem:
2. History of ecosystem ecology, Human induced Ecosystem change, Urban Ecosystem Classification – Ecosystem mapping, tropical forests, grasslands, wetlands, coral reefs, mangroves
3. Habitat lass: Habitat destruction – Fragmentation and degradation – desertification – Habitat restoration;
4. Invasive Species: their introduction pathways, biological impacts of invasive species on terrestrial and aquatic systems;
5. Pollution: Impacts of Pesticide pollution, Water pollution and Air Pollution on biodiversity; Overexploitation: Impacts of Exploitation on Target and Non-target Terrestrial and Aquatic species and Ecosystems.

UNIT-3

1. Values of Biodiversity: Instrumental/Utilitarian value and their categories, Direct use value; Indirect/ Non-consumptive use value
2. Introduction to Ecological Economics; Monetizing the value of Biodiversity
3. Intrinsic Value; Ethical and aesthetic values, Anthropocentrism, Biocentrism, Ecocentrism and Religions; Intellectual Value
4. Economics of Ecosystem, Green Revolution, Food Plants, medicinal and ornamental plants, animal uses – livestock and fisheries

UNIT-4

1. Conservation and Management: National Legislation – Protection of Wild flora and Fauna -Protection of National Habitats - National and International Protected Areas
2. Current Practices in Conservation - in situ Conservation and ex situ Conservation of Threatened
3. Species
4. Biodiversity Act 2002 – Patent Act – Agenda 21 – Forest protection Act-Forest conservation Act 1980-Multilateral Treaties – Biodiversity Conventions.
5. Environmental ethics – Biodiversity – a Socio – Political Perspective; Community conserved Areas (CCAs) - Range sand significance of CCAs.

Course Outcomes

- Student will gain knowledge about the diversity distribution pattern of the enormous number of species and different kind of ecosystems in the natural world.
- The interaction between the various species and environment and the impact of social development on biodiversity
- The importance of conservation of biodiversity which serving to the mankind and the ecosystem, and the major threats to biodiversity due to human developmental activities. The loss of biodiversity and the impact to the humankind.
- Will gain knowledge about legislations regarding the conservation of biodiversity.
- Will gain knowledge on Conservation and Management of biodiversity.

SUGGESTED READINGMATERIAL

- Global Biodiversity – Status of the Earths Living Resources, Groombridge, B. (1992), Chapman & Hall, London.
- Ecology of Natural Resources, Ramade, F. (1991), John Wiley and Sons Ltd.
- Global Biodiversity and Strategy, WRI, IUCN, UNEP (1992).
- Biodiversity, Science and Development, Younes, T and Castri, F. (1996), CAB International, UK.
- The Biology of Biodiversity, Kato, M. (1999), Springer Verlag, Tokyo.
- Biodiversity Conservation – In Managed forest and Protected areas, Kotwal, P.C. and Banerjee, S. (2002), Agrobios, India.
- Global Biodiversity, Sinha, R. K. (1997), INA Shree Publishers, Jaipur.
- Mega diversity Conservation, flora, Fauna and Medicinal Plants of India's hot spots, Chaudhuri, A. B. and Sarkar, D. D. (2003), Daya Publishing House, New Delhi.
- Conservation of Biodiversity and Natural Resources. Singh, M.P., Singh B.S. and Dey, S.S. (2004), Daya Publishing House, New Delhi.
- Biodiversity –Strategies for Conservation, Dadhich L. K. and Sharma, A.P. (2002), APH Publishing Corporation, New Delhi
- Global Biodiversity – Conservation Measure, Khan, T. I and Al-Ajmi, D. N. (1999), Pointer Publishers, Jaipur.
- An Advanced Textbook on Biodiversity – Principles and Practice, Krishnamurthy, K.V. (2003), Oxford and IBH Publishing, New Delhi.

- An advanced Text book on biodiversity, Krishnamurthy, K. V.(2003), Oxford and IBH Book Publishing Co Pvt Ltd., New Delhi.
- Evolution, Hall, B. K. and Hallgrimsson, B. (2014), 5th Edition, Johnes and Bartlett India Pvt. Ltd. New Delhi.
- Ridley, M.(2004), Evolution, 3rd Edition, Blackwell Science Ltd a Blackwell Publishing company, USA.
- Curry, G.B. and. Humphries C. J. (2007), Biodiversity Databases Techniques, Politics, and Applications, CRC Press, Taylor & Francis Group.
- The conservation of Plant Biodiversity, Frankel, O. H., Brown, A.H.D. and Burdon, J.J. (1995), 1st edition, Cambridge University Press.
- Encyclopedia of Biodiversity, Levin, S.A. (2000), Volume 1, Academic Press.
- Manual of patent Practice and procedure Patent office, India, 2005.
- Evolution Understanding Evolution http:// evolution. berkeley.edu /evolibrary/ article/ evo_01 accessed on 28.12.2014.

GENERIC ELECTIVE: ZOO-403B: ANIMAL HUSBANDRY AND POULTRY FARMING

Course Objectives

- To acquire the knowledge related to animal husbandry importance and applications to the farmers and industries
- To learn primary construction of dairy and poultry form establishment.
- To gain knowledge in how to maintain the cattle and poultry forms.
- To become proficient in disease management strategies and control measures of cattle and poultry forms.

Unit-1

1. Breeds of Dairy Cattle and Buffaloes – Definition of breed; Classification of Indian Cattle breeds, exotic breeds and Indian buffalo breeds. Systems of inbreeding and crossbreeding.
2. Housing of dairy animals – Selection of site for dairy farm; systems of housing – loose, housing system.
3. Conventional dairy barn. Cleaning and sanitation of dairy farm. Weaning of calf. Castration and dehorning.
4. Deworming and Vaccination programme. Records to be maintained in a dairy farm.

Unit-2

1. Livestock census; Breeds of Dairy cattle, Buffaloes and Goats. Indigenous, Exotic and Crossbred Cattle breeds.
2. Anatomy of Udder; Development of udder; Lacto genesis and Galactopoises; Letdown of milk.
3. Artificial insemination; Oestrous cycle; Symptoms of heat in cows and buffaloes. Conception, Pregnancy diagnosis in cattle. Multi ovulation and embryo transfer technique. Cloning. Economic traits of Dairy cattle. Methods of selection of dairy animals.
4. Systems of Dairy cattle breeding. Inbreeding, out breeding, Cross breeding, Grading up. Breeding systems (Cross breeding of cattle and Grading up of buffaloes).

Unit-3

1. General introduction to poultry farming. Principles of poultry housing. Poultry houses.
2. Systems of poultry farming.
3. Management of chicks, growers and layers. Management of Broilers. Poultry feed management – Principles of feeding.
4. Nutrient requirements for different stages of layers and broilers. Methods of feeding.
5. Egg testing. Methods of hatching. Brooding and rearing. Sexing of chicks.

Unit-4

1. Poultry diseases- Viral, Bacterial, Fungal and Protozoan- their prevention and control.
2. Management of egg layers and Broilers in large scale farms.
3. Poultry feed. Importance and adverse effects on excessive use of Antibiotics and Growth promoters.
4. Progressive plans to promote poultry as a self-employment venture.

Course Outcomes

Students at the successful completion of the course will be able to.

- Select the suitable breeds of livestock for rearing.
- Relate the anatomy of udder with letdown of milk.
- Identify and manipulate the reproductive behaviour of cattle.
- Inspect the economics of dairy farming.
- Apprise the various breeding techniques employed in live stock.

SUGGESTED READING MATERIAL

- Banerjee, G.C. A text book of Animal Husbandry.
- Jagdish Prasad, Animal Husbandry & dairy science.
- Panda, A. K. Rural Poultry production.
- Ibne Ali & Singh, D. K. Handbook of poultry husbandry.
- Anand, B. Handbook of poultry disease diagnosis & treatment.
- Viyas, M. K. Glimpse of Indian Poultry Industry

MULTI DISCIPLINARY COURSE / PROJECT WORK

ZOO: 405 PRINCIPLES AND PRACTICES OF AQUACULTURE

Course Objectives

The course explains the basic concepts about the principles and practices of aquaculture. The objective of this course is to impart knowledge among the students about the culture practices of various aquatic organisms from different aquatic habitats such as freshwater, brackish water and marine water, and to help develop skills in students necessary for contemporary advanced culture techniques for higher and profitable yields in aquaculture. This course will open up several avenues for students in terms of research and employability in hatcheries, culture farms and marketing in aquaculture.

UNIT-1

1. Basics of Aquaculture: Definition, significance and classification; History of aquaculture; Cultivable species – freshwater, brackish water and marine; A knowledge of inland water bodies suitable for culture in India.
2. Criteria for the selection of a species for culture.
3. Culture practices of fish and shrimp: Traditional, extensive, modified extensive, semi-intensive and intensive cultures.
4. Concept of monoculture, polyculture and integrated fish farming.

UNIT-2

1. Bundh breeding and Induced breeding of carp by hypophysation and use of synthetic hormones.
2. Culture of Indian major carps – nursery, rearing and production ponds.
3. Culture of air-breathing fishes in India.
4. Culture of giant fresh water prawn, *Macro brachiumrosenbergii*

UNIT-3.

1. Culture of milk fish, *Chanoschanos*.
2. Culture of Asian sea bass, *Latescalcarifer*.
3. Culture of shrimp, *Penaeusmonodon.*
4. Culture of crab, *Scylla serrata.*

UNIT-4.

1. Sewage-fed fish culture.
2. Culture of ornamental fishes.
3. Culture of pearl oysters.
4. Culture of sea weeds: Major seaweed species of commercial importance; methods of culture.

Course Outcomes
Students would acquire the knowledge and understanding of the

- Significance, classification, history and cultivable species of aquaculture, and the inland water bodies suitable for culture in India
- Criteria for the selection of species for culture
- Various practices followed for the culture of fish and shrimp, and
- Concepts of different types of culture.
- Feasibility of using sewage water for aquaculture
- Maintenance of aquaria and breeding of ornamental fishes
- Culture of marine organisms like pearl oysters and sea weeds.
- Culture of brackish water species such as milk fish, seas bass, shrimp and crab.
- Conceptualize the induced breeding techniques of carp in bundhs and in hatcheries
- Get acquainted with the management of nursery, rearing and production ponds.
- Appreciate the culture of air-breathing fishes and freshwater prawn.

SUGGESTED READING MATERIAL

1. Bardach, JE *et al*. 1972. *Aquaculture – The farming and husbandry of freshwater and marine organisms*, John Wiley & Sons, New York.
2. Chakraborty C & Sadhu AK. 2000. *Biology Hatchery and Culture Technology of Tiger Prawn and Giant Freshwater Prawn.*Daya Publ. House.
3. FAO. 2007. *Manual on Freshwater Prawn Farming*.
4. Huet J. 1986. *A text Book of Fish Culture*. Fishing News Books Ltd.
5. ICAR. 2006. *Hand Book of Fisheries and Aquaculture*. ICAR.
6. Jhingran V.G. 1991. *Fish and Fisheries of India*. Hindustan Publ. Corporation, India.
7. Landau M. 1992. *Introduction to Aquaculture*. John Wiley & Sons.
8. Mcvey JP. 1983. *Handbook of Mariculture*. CRC Press.
9. MPEDA: *Handbooks on culture of carp, shrimp, etc*.
10. New MB. 2000. *Freshwater Prawn Farming*. CRC Publ.
11. Pillay TVR. 1990. *Aquaculture- Principles and Practices*, Fishing News Books Ltd., London.
12. Pillay TVR &Kutty MN. 2005. *Aquaculture- Principles and Practices*. 2nd Ed. Blackwell
13. Rath RK. 2000. *Freshwater Aquaculture*. Scientific Publ.
14. Stickney RR. 1979. *Principles of Warmwater Fish Culture*, John Wiley & Sons.

OE: ZOO-406 A ENVIRONMENTAL MICROBIOLOGY

Course Objectives

The main objective of this course are to

- Impart knowledge on microbial diversity and recent advancement methods in the analysis of microbial diversity.
- Provide in-depth knowledge of role of beneficial and pathogenic microorganisms in environment.
- Understand the application of microbes for production of different eco-friendly products
- Impart knowledge in molecular biotechnology and its applications in Environmental management and conservation of biodiversity
- Make students aware about Bioethics, Biosafety and IPR

UNIT-1

Distribution / Diversity of Microorganisms: Microflora in different aquatic and terrestrial environment; Adaptation of microorganisms to the air environment; Extreme Environment – archae bacteria, acidophilic, alkalophilic, thermophilic, barophilic, osmophilic and radiodurant microbes. Role of Microorganism in Biogeochemical cycles - Nitrogen, Carbon, Phosphorus, Sulphur Cycle, Microbial corrosions.

UNIT-2

Ecological Relationships Among the Microorganisms: Relationship among microbial population, microbial interactions in a biofilm, Host - Microbe interaction (Beneficial and pathogenic), Microbial pathogens and Parasites and their effects on Human, Animal and Plant health, Transmission of pathogens – Bacterial, Viral, Protozoan, and Helminths, Control of microorganisms. Indicator microorganisms in air, water and soil Environment Standard criteria of indication; Bio-indication of water quality.

UNIT-3

Microbes-Molecular Approaches and Applications: Understanding microbial diversity in the environment by culture-dependent approaches and their limitations, and by culture-independent molecular approaches (BIOLOG microtitre plates, analysis of FAME profiles, quantitative PCR (qPCR), and fluorescent in situ hybridization, pyro sequencing). Role of microbes in production of Biofuel, Bio surfactants, enzymes, biopolymers and biodegradable plastics.

UNIT-4

Role of Biotechnology in Environmental Protection: Development of genetically engineered microorganisms (GEMs), Role of GMOs in bioremediation, Advantages of Genetically engineered plants; Bt insecticide; Conservation of bio-diversity by gene banks, Reforestation through micro-propagation. Microbial enhanced oil recovery (MEOR), Biomining, biosensors, Nano technology in pollution control.

Course Outcomes

- Understand and describe the type of microorganisms in the environment and the role of microorganisms in the cycling of nutrients in an ecosystem.
- Relate the role of microorganisms in spread of human diseases and select the type of physical and chemical agents for microbial control.
- Understand the importance of plants and microbes in environmental remediation
- Know the ethical guidelines in the use of GMOs, different biosafety levels an IPR
- Know the importance of microbes and biotechnology for the synthesis of eco-friendly products.

SUGGESTED READING MATERIAL

- Textbook of Environmental Microbiology, Mohapatra, PK. (2008), I.K. International (P)Ltd.
- Environmental Microbiology, Pepper, I. L., Gerba, C. P. and Gentry, T. J. (2015), 3rd edition, Academia Press, Elsevier
- Basic Biotechnology, Ratledge, C. and Kristiansen, B. (2003), 2nd edition, Cambridge University Press
- Bioethics and Biosafety in Biotechnology, SreeKrishna.V. (2007), New Age International Publishers.
- Topics in Ecological and Environmental Microbiology, Schmidt, T. M. and Schaechter, M.(2012), 3rd edition, Academia Press, Elsevier.
- Environmental Microbiology: Fundamentals and Applications: Microbial Ecology, Bertrand, J. C., Caumette, P. and Lebaron, P. (2015), Springer
- Environmental Microbiology – Theory and Application, Jjemba, P.K. (2004), Science Pub. Inc., USA
- Environmental Biotechnology-Theory and Application, Evano, G.H. and Furlong, J.C. (2004), John Wiley and Sons, USA
- Environmental Biotechnology and Cleaner Bioprocesses, Olguin, C. J., Sanchez, G., Hernandez. E. (2000), Taylor & Francis.

GENERIC ELECTIVE : ZOO-406 B MEDICAL BIOTECHNOLOGY, IPR, BIO-SAFETY AND BIO-ETHICS

Course objectives

While studying the **Medical Biotechnology, IPR, Bio-safety and Bio-ethics** course, the student shall be able to

- Study the types of Gene therapy and its uses in Medical Biotechnology
- This course is designed to develop the knowledge on PCR, Immunological assays, cloning and animal cell culture techniques.
- To study the fertilization, organogenesis, potency and differentiation, Morphogenesis in the developmental biology.
- To gain knowledge on bacterial, plant and animal viruses.
- This course helps to adhere to the ethical practices appropriate to the discipline at all times.
- Adopt to the safe working practices, relevant to the bio industries and research field.

UNIT-1

Disease diagnosis-probe: PCR, LCR immunological assay. Detection of genetic, Neuro genetic disorders involving Metabolic and Movement disorders. Treatment products from recombinant and non-recombinant organisms, Interferons, Antisense therapy, cell penetrating peptides, Gene therapy, Types of gene therapy, somatic virus germline gene therapy, mechanism of gene therapy, Immunotherapy, Detection of mutations in neoplastic diseases MCC, SSCP, DGGE, PTTC.

UNIT-2

Animal Biotechnology: Development Biology; fertilization and organogenesis, Stem cells; potency and differentiation, different signaling for development, Morphogenesis in different model systems, Cloning; Transgenic and knockout systems. Animal cell Culture methods.

UNIT-3

Virology: Classification and modes of propagation; bacterial, plant and animal viruses: morphology and ultrastructure; assay of viral particles, cell culture; viral enzymes, nucliec acids, DNA viruses: Herpes, Hepatitis B, Adeno virus; RNA viruses: Polio, VSV, Influenza, Retroviruses: Structure, life cycle, transformation; TMV, Baculoviruses,; Response to viral infections: slow and persistent infections, Antiviral agents, Interferons.
Economics, Biosafety. Patent rights and Special Topics Biotechnology R & D and industry: Business aspects of biotechnology, research and market place, Finance and human resources: Intellectual property right: patents, R & D partnership, license agreement and joint venture.

UNIT-4

Innovation Management: Technology transfer tools, Industry-Academia collaborations, Bio-incubators, Bio-accelerators, Finishing school; Bioethics: Role of bioethics in research. Prevention and management of plagiarism, fabrication/manipulation of data, conflict of interest, socio-cultural and behaviourial conflicts during the conduct of research. Authorship & patenting/commercial rights and conflicts. Bioethical norms governing research related to animals and humans.

Biosafety: Prevention and management of chemical and biological hazards associated with research. Evaluation and interpretation of data sheets, labels etc. for pre-assessment of biological and chemical hazard.

Course Outcomes

- Student comes familiar with the Application of Biotechnological techniques in control of Neuro genetic diseases and neoplastic diseases.
- Students will gain awareness about Intellectual Property Rights (IPR) to take measures for protecting their ideas.
- Gains knowledge on the Developmental stages of organism in Animal Biotechnology.
- They will be able to devise business strategies by taking account of IPRs.
- Students will develop awareness about bioethics and biosafety, Authorship and patenting / Commercial rights and conflicts.
- Students will develop the knowledge on bacterial, plant and animal viruses.

SUGGESTED READING MATERIAL

- Sasson A, Biotechnologies and Development, UNESCO Publications, 1988.
- Mike Martin and Roland Schinzinger, "Ethics in Engineering", Mc Graw-Hill, New York, 1996.
- Sasson A. Biotechnologies in developing Countries present and future, UNESCO Publishers, 1993.
- Biosafety: Principles and Practices (Biological safety: Principles and Practices) by Diane O., Ph.D. Fleming and Dbra Long Hunt (Aug 30, 2006).
- S.F. Gillbert, Developmental Biology, Sinauer Associates Inc., Massachusetts
- Schatten and Schatten. Molecular Biology of Fertilization.
- Bioethics and Biosafety in Biotechnology, Sree Krishna.V. (2007), New Age International Publishers.

ZOO 404 P : ZOO-401 (Core), ZOO-402 (Core) & ZOO-403 A& B (GE)

ZOO Lab 2: ZOO-405 (Multi-Disciplinary Course / Project Work)

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