SRI VENKATESWARA UNIVERSITY: TIRUPATI
S.V.U COLLEGE OF SCIENCES
DEPARTMENT OF ZOOLOGY

Course
M.Sc. ZOOLOGY

Choice Based Credit System (CBCS)
Academic Year 2019 – 20

Vision

1. Provide a sound education in basic science
2. Transform society through the empowerment of women
3. Provide inexpensive educational services to the weaker sections of society
4. Inculcate respect for nature and concern for ethical values among students through good and scientific educational practices.
5. Recognizing the essential roles of science and biology in the lives of citizens today and tomorrow, we emphasize biological literacy in our teaching and outreach programs.

Mission

1. To impart to the students the contemporary advancements in life sciences.
2. To impart a global perspective and such skills among students that benefit humanity.
3. To promote the discovery and broad communication of knowledge about the biology of animals including their Taxonomy, Evolution, Physiology, Cell, Molecular and Biochemical make up, interaction with their environments and its Zoogeographical realms.
4. To develop research aptitude and a scientific advancement.
5. Reinvent ourselves in response to the changing demands of society with high moral values as a good citizen

Program Educational Objectives:

1. Exposure of students to animal diversity and to provide them systematic tools of traditional and modern types to acquire this knowledge and skill.
2. To update the syllabus essential for appearing in NET, SET, GATE, ASRB and other competitive exams of UPSC and APPSC.
3. To make aware the students to know the natural resources of country, to utilize by sustainable methods and conservation of living resources.
4. To develop trained and knowledgeable human resource for educational and research institutions and industries; to use this human resource for self reliant India.
5. To develop self employable ability and to apply knowledge for several agro-based industries like Sericulture, Goat farming and Apiculture; it will also provide employment to other dependents.

The M.Sc. degree in Zoology being offered by this University provides its students with a course of study that integrates a range of learning and teaching techniques relevant to their educational development and career ambitions. This Masters programme covers the latest developments in Zoology and its specializations, viz., Applied Parasitology, Animal Physiology, Fishery Science and Entomology. It provides theoretical knowledge as well as training in the practical and intellectual skills to enable students to better understand and then solve some of the problems in this subject. Graduates in this programme will be induced into critical thinking, and would be able to solve complex problems in Zoology. The students would also be inculcated with personal and problem-solving skills that will enhance their employability prospects. Enhanced competence of students has been the key concern in designing and developing this syllabus. Careful thought has gone into selection of topics and setting their scope. Major areas of Zoology like Genetics, Evolution, Physiology, Biochemistry, Ecology, Immunology, Cytology, Developmental Biology, and Taxonomy have been included in the syllabus only after multiple rounds of thorough discussions and intensive study. Special attention has been paid to subjects like Bioinformatics, Molecular Biology and Genetics to incorporate the latest developments in these fields.

DEPARTMENT OBJECTIVES :

The Department is having the following objectives:

1. To expose students to updated curricula and to recent advances in the subject and enable the students to face NET, SET and other competitive examinations successfully.
2. To create awareness among students about the latest streams of Zoology including advanced subjects like Biotechnology, Tissue culture, Genetic Engineering and Bioinformatics.
3. To improve the quality of laboratory and field work for which zoological study tours and excursions have been made compulsory so that the students can become familiar with field status of ecosystem and surrounding study.
4. To prepare students to attract and develop interest in applied Parasitology, Animal Physiology, Genetics, Cell Biology, Fisheries science, Toxicology so that the students can select Zoology as their career.
5. The BOS in Zoology expects that this new framework of curriculum caters the need of enabling students of subject to accept new challenges of dynamically changing modern era.

OBJECTIVES OF THE PROGRAMME :

The primary objective of the program is to impart quality education in the subject of Zoology as a basic science and its applied branches to the students

1. To meet the academic to applied aspects in Zoology suited to real problems of regional and National needs
2. To expose learners to frontier and thrust areas of Zoology
3. To train learners for better performance in various competitive examination and in research careers.
4. To enable the learners to acquire and develop self- study habits
5. To facilitate Higher education & research in Zoology.
6. To provide quality education offering skill based programs and motivate the students for self employment in applied branches of Zoology.
7. To Inculcate the spirit of resource conservation and love for nature
8. To conduct field studies and different projects of local and global interests.
9. To provides opportunities for professional and personal development through curricular and co- curricular activities.
10. Provide consultancy and organize extension activities.
11. To shape the learners to become worthy citizens of the Nation in the field of Zoology and interrelated fields.

PROGRAMME OUTCOMES :

1. The student should acquired the knowledge with facts and figures related to various aspects in life sciences
2. When you graduate with a Master of Science (Zoology) you will have learned how to work at a high level of academic achievement.
3. The student to understanding the basic concepts, fundamental principles, and the scientific theories related to various scientific phenomena and their relevancies in the day-to-day life and the applications of Zoology in Aquaculture, Vermiculture, Sericulture, Poultry Science and Fundamentals of Clinical Science and Immunology and to create new industry in their relevant area.
4. The student could apply the skills to handling scientific instruments, planning and performing in laboratory experiments and also drawing logical inferences from the scientific experiments.
5. The students analyzed and realized how developments in any science subject helps in the development of other science subjects and vice-versa and how interdisciplinary

approach helps in providing better solutions and new ideas for the sustainable developments.

6. Understand the applications of Biological techniques to various fields of biology.
7. Attained the knowledge relating to invertebrate & chordate, developmental biology, animal physiology, Cell & Molecular biology, genetics and clinical science, Progression to PG education in Zoology, Aquaculture, Environmental science, Biotechnology, Bioinformatics, Biochemistry, Microbiology and Human genetics, The Students get employment by industries/self employment in Poultry, Veterinary and Aquaculture industries.
8. Perform, Assess and implement practical techniques and procedure to solve biological problems and analyse and quantify data collected during any project.

CHOICE BASED CREDIT SYSTEM (CBCS):

The Choice Based Credit System (CBCS) provides an opportunity for the students to choose courses from the prescribed courses comprising core, elective/minor or skill based courses. The courses can be evaluated following the grading system, which is considered to be better than the conventional marks system. Therefore, it has been found necessary to introduce uniform grading system in the entire higher education in India. This will benefit the students to move across institutions to begin with. The uniform grading system will also enable potential employers in assessing the performance of the candidates. In order to bring uniformity in evaluation system and computation of the Cumulative Grade Point Average (CGPA) based on students' performance in examinations, the UGC has formulated the guidelines to be followed.

Students of this course would be expected to :

1. Be able to play leading role in industry, research and the public services;
2. Understand and appreciate major public concerns and issues associated with Zoology;
3. Have an understanding and grasp of international research environment where the frontiers of knowledge in Zoology are under research;
4. Be able to adapt and respond positively and flexibly to changing circumstances;
5. Develop the professional skills and personal attributes to deal with complex issues, both systematically and creatively;
6. Have the capacity for individual work and teamwork;
7. Be lifelong learners with intellectual and practical skills.

Semester - I

S.No	Components of Study	Title of the Course	Title of the Paper	Credit Hrs / Week	Number of Credits	IA Marks	Semester End Marks	Total
1	Core	ZOO-101	Invertebrata & Chordata	4	4	20	80	100
2	Core	ZOO-102	Genetics & Evolution	4	4	20	80	100
3		ZOO-103P	Practical - I	8	4		100	100
4		ZOO-104P	Practical - II	8	4		100	100
5	Compulsory Foundation	ZOO-105	Metabolic Regulation & Cell Function	4	4	20	80	100
6	Elective Foundation	ZOO-106	HVPE-I	4	4	20	80	100
Total				32	24	80	520	600

Semester - II

S.No	Components of Study	Title of the Course	Title of the Paper	Credit Hrs / Week	Number of Credits	IA Marks	Semester End Marks	Total
1	Core	ZOO-201	Cell Biology & Immunology	4	4	20	80	100
2	Core	ZOO-202	Molecular Biology	4	4	20	80	100
3		ZOO-203P	Practical - I	8	4		100	100
4		ZOO-204P	Practical - II	8	4		100	100
5	Compulsory Foundation	ZOO-205	Comparative Animal Physiology	4	4	20	80	100
6	Elective Foundation	ZOO-206	HVPE-II	4	4	20	80	100
Total				32	24	80	520	600

Semester - III

S.No	Components of Study	Title of the Course	Title of the Paper	Credit Hrs / Week	Number of Credits	IA Marks	Semester End Marks	Total
1	Core	ZOO-301	Developmental Biology	4	4	20	80	100
2	Core	ZOO-302	Environmental Biology	4	4	20	80	100
3		ZOO-303P	Practical - I	8	4		100	100
4		ZOO-304P	Practical - II	8	4		100	100
5	Generic Elective	ZOO-305A	Tools & techniques	4	4	20	80	100
		ZOO-305B	Enzymology	4	4	20	80	100
		ZOO-305C	Environmental Microbiology	4	4	20	80	100
6	Open Elective	ZOO-306A	Economic Zoology	4	4	20	80	100
		ZOO-306B	Structural Biology	4	4	20	80	100
		ZOO-306C	Human Health and Infectious diseases	4	4	20	80	100
Total				32	24	80	520	600

Semester - IV

S.No	Components of Study	Title of the Course	Title of the Paper	Credit Hrs / Week	Number of Credits	IA Marks	Semester End Marks	Total
1	Core	ZOO-401	Neurobiology	4	4	20	80	100
2	Core	ZOO-402	Toxicology	4	4	20	80	100
3		ZOO-403P	Practical -I	8	4		100	100
4		ZOO-404P	Practical - II	8	4		100	100
5	Generic Elective	ZOO-405A	Animal Biotechnology & Microbiology	4	4	20	80	100
		ZOO-405B	Animal Behaviour & Wild Life	4	4	20	80	100
		ZOO-405C	Endocrinology	4	4	20	80	100
6	Open Elective	ZOO-406A	Genetic Engineering	4	4	20	80	100
		ZOO-406B	Environmental Impact Assessment & Green Auditing	4	4	20	80	100
		ZOO-406C	Medical Biotechnology, IPR, Biosafety Methods	4	4	20	80	100
Total				32	24	80	520	600

SEMESTER-I

ZOO-101: INVERTEBRATA & CHORDATA

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:

1. 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.
2. Develops concepts regarding various Invertebrate and vertebrate morphology.
3. Describe the relationships among animals with their internal developments.
4. Analysis the relationships among animals with internal structure.
5. Learners gain Knowledge and develop skill over the comparative anatomy of Chordates and Vertebrata.
6. Enumerate the origin and classification of Vertebrates.

Invertebrates:

Course Objectives:

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

Vertebrates:

Course Objectives :

1. To describe the Comparative and Evolutionary trends in structure and functions of organ systems among vertebrate Phyla.
2. 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.

3. Imparts conceptual knowledge of Vertebrates, their adaptations and associations in relation to their environment.
4. To describe the characteristic features of larval forms of Crustaceans and Echinodermata relationship among Invertebrates.

UNIT-1

Evolutionary time scale, Eras, Periods & Epoch - major events.

Species concept, International code of Zoological nomenclature, Taxonomical procedures, New Trends in taxonomy.

Patterns of feeding and digestion in lower metazoans: Holozoic nutrition , Pinocytosis, Saprozoic Nutrition, Myxotrophic nutrition, Nutrition of parasites. Feeding in Polychaeta, Mollusca,Echinodermata.

UNIT-2

2.1. Acoelomata, Pseudocoelomata, Coelomata,Proterostomia and Dueterostomia.

Structure of Gill, lungs, trachea and Mechanism of Respiration.Circulatory system in Annelids, Arthropods & Molluscs.

Advanced nervous system- Annelida, Arthropoda and Mollusca.

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

Vertebrate integument and derivatives: - Skin structure and functions - glands, scales, horns, claws, nails, hoofs, feathers and hair.

Comparative anatomy of heart: - Types - structure- blood circulation-aortic arches and portal system.

Comparative anatomy of reproductive system: - Organs of male reproductive system – organs of female reproductive system –functions.

Comparative account of excretory system.

UNIT- 4

4.1. Comparative anatomy of respiratory organs: - Gills, trachea and lungs – types structure-mechanism of respiration.

Comparative anatomy of brain and spinal cord: - structure, composition and functions

Organs of vision: structure of eye in different phyla - mechanism of vision, Photoreceptors-fishes, Amphibians, Reptiles, Birds and Mammals.

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

Invertebrates

Course Outcomes:

1. Understanding the General Characteristics, Principles of classification, general biology of Invertebrate Communities.

2. To understand the various biological functions, the evolutions of life from most primitive to most advanced form with respective to their habit and habitat.
3. To understand the various physiological mechanisms among Invertebrates and their significance among Invertebrate Phyla.

Vertebrates

Course Outcomes:

1. Understanding the comparative aspects of different organs systems among chordate Phyla.
2. Explain the similarity and differences in structure and function of organs in different groups of Chordates.
3. In depth understanding of Anatomical features of Integumentary, Circulatory, Reproductive, Respiratory, Receptor, Nervous systems among Chordate groups.
4. 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 Hernichordata and Protochordata. Oliver and Boyd, Edinbourgh.
5. Bourne, GH. The structure and functions of nervous tissue. Academic Press, New York.
6. Carter, GS. Structure and habit invertebrate evolution Sedwick and Jackson, London.
7. Eecles, J. C. The understanding of the brain. McGraw Hill Co., 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 Mc Graw Hill Co., New York and London.
10. Hyman, L.B. The invertebrates. Vol.l. Protozoa through Ctenophora, Mc Graw Hill Co., New York.
11. Hyman, L.H. The Invertebrates. Vol. 8. Mc Graw Hill 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. Text Book of Zoology, Mc Millan Co., London.
15. Read, C.P.Animal Parasitism. Prentice Hall Inc., New Jersey.
16. Russel-Hunter, W.D. Biology of higher invertebrates, the Mc Millan Co. Ltd., London.1969.
17. Sedwick, A. A student text book of Zoology, Vol.I1 and III. Central Book Depot, Allahabad.1972.

CO-PO Mapping

Cour	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	-	-	1	2	1	1	1	-	1
CO2	3	3	2	2	2	2	2	2	1	2	-	2
CO3	3	3	3	2	2	3	1	2	2	1	2	2
CO4	1	-	-	-	-	-	1	3	-	1	-	2

3-High, 2- Medium, 1- Low

ZOO-102: GENETICS AND EVOLUTION

Course Objectives :

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

1. To provide fundamental knowledge about different concepts of Genetics includes Concepts of Gene, Mendelian Principles, Gene mapping methods and Mutation types etc.
2. To study the basic tools and techniques involved in Cytogenetics, Microbial Genetics, Human Genetics and Quantitative Genetics etc.
3. To provide strong foundation in Genetics, Cytogenetics and Molecular biology enables the students to familiarize themselves with Genetic Engineering concepts.
4. To provide and introduce some of the most incisive analytical across the spectrum of the biological applications.
5. 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:

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

UNIT-1

Concept of gene: Alleles, Multiple alleles and Pseudoallelesn(ABO blood grouping, Bombay phenotype and Rh factor).

Extensions of Mendelian Principles: Pleiotropy, genomic imprinting, Penetrance and expressivity, phenocopy, sex linked (color blindness; Haemophilia), sex limited and sex influenced characters.

Gene mapping methods: Linkage maps, tetrad analysis, mapping with molecular markers, mapping with somatic cell hybrids.

Mutation: Types (Spontaneous, Induced, lethal, conditional, biochemical) causes, loss of function, gain of function, Frame shift mutations, insertional mutagenesis.

UNIT-2

Microbial genetics: Methods of genetic transfers -Conjugation, Transduction and sexduction, mapping genes by interrupted mating,
Recombination: homologous and non homologous recombination including Transposition.
Human genetics: Pedigree analysis, genetic disorders (Brachydactyly, Huntington's chorea).
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

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

UNIT- 4

Factors of evolution (i) Mutations (ii) Natural Selection (iii) Genetic Drift.
Basic patterns of evolution; Micro and Macro evolution.
Species categories: (i) Morphological species (ii) Biological species (iii) Sibling species (iv) Sub species
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 :

1. Students will 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
2. Students will 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
3. Explain the ideas about Mendelian, non-Mendelian inheritance, genetic disorder, gene mutations and sex determination.
4. 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:

1. Understood that the four propositions underlying Darwin's theory of evolution through natural selection are:

    (1) more individuals are produced than can survive;

(2) There is therefore, a struggle for existence

(3) Individuals within a species show variation

(4) Offspring tend to inherit their parental characters

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

SUGGESTED READING MATERIAL:

1. An introduction to Modern genetics by Ch. Waddinsgton
2. Basic Human Genetics- EJ. Mange, Arthur P. Mange. Indian Print, 1997.
3. Genetic disorders of Man by M.R. Goodman.
4. Genetics - Monrve W. Strickberger. 3rd Ed., May, 2000.
5. Genetics-K.B.Allluwallia-1985.
6. 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.
7. Principles of Genetics - EJ. Gardner. MJ. Simmons & D.P. Snustad.
8. Genetics-P.S.Verma and V.K.Agarwal-2009, S.Chand Publication.
9. 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.
10. Dobzhansky, Th. Genetics and origin of species, Columbia University press.
11. Dobzhansky, Th., F.J. Ayala, GL. Stebbins and J .M. Valentine Evolution: Surjeet publications, New Delhi latest edition.
12. Gould, J.L. The mechanisms and evolution of behavior.
13. Hartl, D.L. A primer of population genetics, sinauer Associatesm Inc., Massachusetts.
14. P.A. Moody Introduction to Evolution II ed/latest: Kalyani publishers, New Delhi.
15. Peter Volpe E. Understanding Evolution, University Book stall, New Delhi.

CO-PO Mapping

Cour	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	2	2	2	2	1	2	-	2
CO2	3	3	2	2	2	2	2	2	1	2	-	2
CO3	3	3	2	2	2	2	2	2	1	2	-	2
CO4	3	3	2	2	2	2	2	2	1	2	-	2
CO5	2	3	3	3	-	-	2	-	3	-	-	2

ZOO 103P : Invertebrata, Chordate and Genetics.

ZOO 104P: Evolution and Metablic Regulation and Cell Function

ZOO-105: METABOLIC REGULATION AND CELL FUNCTION

Course Objectives:

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

1. 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.
2. To develop understanding of chemistry used in biological processes and to perform wide range of analytical techniques to explore biological activities.
3. 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
4. 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.
5. 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

6. 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.
7. 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.:

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).

Carbohydrates: Definition and Classification- Structure and function of important Mono, Oligo and Polysaccharides.

Intermediary Metabolism-I: Glycolysis, TCA Cycle and their Bio-medical importance. Intermediary Metabolism-II: Gluconeogenesis, HMP Shunt, Metabolism of Galactose and Fructose and their Bio-medical importance.

UNIT-2:

Proteins: Definition and Classification- Structure (Primary, Secondary and Tertiary structures, Protein folding and denaturation) and function of important Proteins- Haemoglobin, Myosin and Actin.

Bio-synthesis of nutritionally non-essential amino acids and their Bio-medical importance. Catabolism of Proteins and Amino acids-I: Biosynthesis of Urea- Detoxification of Ammonia- Metabolic disorders of Urea cycle.

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

UNIT-3:

Chemistry of purines, pyrimidines, Nucleosides, Nucleotides, Synthetic derivatives.

Biosynthesis of purine nucleotides, Catabolism of purines.

Biosynthesis of pyrimidine nucleotides, Catabolism of Pyrimidines,

Clinical disorders of purine and pyrimidine metabolism; Hyperurecemia or gout; Hypo-urocemia, Orotic aciduria.

UNIT-4

Biomedical importance, Classification of lipids; Saturated and unsaturated fatty acids; Triacylglycerols (tri-glycerides), Phospholipids, Glycolipids, Steroids, Lipid peroxidation.

β- oxidation of fatty acids, Oxidation of unsaturated fatty acids, Ketogenesis.

Biosynthesis of long chain fatty acids (Palmitic acid), Clinical aspects.

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:

1. 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.
2. The students will learn about definition and classification of Proteins, Carbohydrates, Lipids etc and their importance in metabolism
3. 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.
4. 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.
5. 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:

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

CO-PO Mapping

Cour	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	2	2	2	2	1	2	2	1	2	2
CO2	3	2	1	2	1	3	1	1	1	1	2	2
CO3	3	1	2	1	2	2	2	2	2	1	2	2
CO4	3	2	3	2	2	3	1	2	2	1	2	2
CO5	3	2	1	2	1	3	2	-	2	-	-	3

ZOO 106: HUMAN VALUES AND PROFESSIONAL ETHICS – I
(With effect from 2019-2020)

Definition and Nature of Ethics- Its relation to Religion, Politics, Business, Law, Medicine and Environment. Need and Importance of Professional Ethics- Goals – Ethical Values in various Professions.

Nature of Values- Good and Bad, Ends and Means, Actual and potential Values, Objective and Subjective Values, Analysis of basic moral concepts- right, ought, duty, obligation, justice, responsibility and freedom, Good behavior and respect for elders, Character and Conduct.

Individual and society:

Ahimsa (Non-Violence), Satya (Truth), Brahmacharya (Celibacy), Asteya (Non possession) and Aparigraha (Non-stealing). Purusharthas (Cardinal virtues)- Dharma (Righteousness), Artha (Wealth), Kama (Fulfillment Bodily Desires), Moksha (Liberation).

Bhagavad Gita – (a) Niskama karma. (b) Buddhism – The Four Noble Truths – Arya astanga marga, (c) Jainism – mahavratas and anuvratas. Values Embedded in Various Religions, Relirious Tolerance, Gandhian Ethics.

Crime and Theories of punishment – (a) Reformative, Retributive and Deterrent. (b) Views on manu and Yajnavalkya.

Books for study:

1. John S Mackenjie: A manual of ethics.
2. **"**The Ethics of Management**"** by Larue Tone Hosmer, Richard D. Irwin Inc.
3. **"**Management Ethics – integrity at work**"** by Joseph A. Petrick and John F. Quinn, Response Books: New Delhi.
4. **"**Ethics in Management**"** by S.A. Sherlekar, Himalaya Publishing House.
5. Harold H. Titus: Ethics for Today
6. Maitra, S.K: Hindu Ethics
7. William Lilly: Introduction to Ethics
8. Sinha: A Manual of Ethics
9. Manu: Manu Dharma Sastra or the Institute of Manu: Comprising the
10. Susruta Samhita: Tr. Kaviraj Kunjanlal, Kunjalal Brishagratha, Chowkamba Sanskrit series, Vol. I, II and III, Varnasi, Vol I OO, 16-20, 21-32 and 74-77 only.
11. Caraka Samhita: Tr. Dr. Ram Karan Sarma and Vaidya Bhagavan Dash, Chowkambha Sanskrit Series office, Varanasi I,II,III Vol I PP 183-191.
12. Ethics, Theory and Contemporary Issues, Barbara Mackinnon, Wadsworth/Thomson Learning, 2001.
13. Analyzing Moral Issues, Judith A. Boss, Mayfield Publishing Company, 1999.
14. An Introduction to Applied Ethics (Ed.) John H. Piet and Ayodhya Prasad, Cosmo Publications.
15. Text book for Intermediate logic, Ethics and Human Values, board of Intermediate Education & Telugu Academic Hyderabad.
16. I.C. Sharma Ethical Philosophy of India. Nagin & co Julundhar.

CO-PO Mapping

Cour	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	-	-	-	-	-	1	3	-	1	-	2
CO2	2	-	-	2	-	-	-	-	-	1	1	2
CO3	1	1	-	1	1	1	1	2	2	-	-	2
CO4	1	1	1	-	-	-	1	1	1	1	-	-

SEMESTER-II

ZOO-201: CELL BIOLOGY AND IMMUNOLOGY

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:

1. Develop deeper understanding of what life is and how it functions at cellular level.
2. To study the structure and function of the basic unit of living organisms
3. Describe cellular membrane structure and function, fine structure and function of cell organelles.
4. 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).
5. 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.
6. 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:

1. 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
2. The objective of the course is to apprise the students about components associated with immune system and molecular mechanism of their working.
3. The course also deals with implications of deregulation of basic regulatory networks that lead to immune system related disorders.
4. The students will be able to describe the roles of the immune system in both maintaining health and contributing to disease.
5. To provide knowledge of fundamentals of immune system and immunological basis for treatment of some common diseases.
6. Study the organs of immune system and the innate and adaptive immunity
7. To gain knowledge on antigens, antibodies and their production mechanism
8. To study the antigen antibody reactions and immunological disorders

UNIT-1.

Organization of Prokaryotic and Eukaryotic cell.

Membrane structure – Lipid bi layer and two dimensional structure – Fluidity of lipid bilayer – Assembly of lipid bi layer – Membrane proteins.
Membrane transport: Active transport – Passive transport – Diffusion – Osmosis – Ion channels - Membrane pumps.
Vesicular traffic and Protein sorting: Translocation of proteins in to mitochondria – Endoplasmic reticulum and Golgi - Endocytosis – exocytosis.

UNIT-2.

Models of cell-cell signaling (steroid receptors, Nitric oxide and Carbon monoxide).
Functions of cell surface receptors (G-protein coupled receptors, Tyrosine kinases, cytokine receptors, receptors liked to other enzymatic activities).
Pathways of intracellular signaling transduction (c-AMP pathways, cyclic c-GMP, phospholipids and Ca2+, Ras, Raf and MAP kinases).
Signaling in development and differentiation (the receptors tyrosine kinase, Ras, MAP kinase pathway in Drosophila, notch signaling).

UNIT-3.

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

UNIT-4.

Humoral immunity: Immunoglobulins (fine structure of immunoglobulins and Classes); the complement system, Classical and alternate pathway, Inflammation.
Cell mediated immunity: Mechanism of cell mediated immunity; brief account on Antigen Presentation, Major Histocompatability complex
Antigen-antibody interactions: Affinity, Avidity, Cross-reactivity, precipitation reactions and Agglutination reactions and ELISA.
Brief account on immunological disorders:
a) Tolerance to autoimmunity
b) Transplantation
c) Immunodeficiency diseases
d) Immunization (active and passive immunity)

Cell Biology - Course Outcomes :

1. 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
2. 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.

3. 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.
4. The study will help the students to understand the new discoveries about the structure and internal functioning of the cell due to technological improvements.
5. 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.

1. Learn the fundamental principles of immune response including molecular, biochemical and cellular basis of immune homeostasis.
2. The course will aid in understanding various aspects of immunological response and how its triggered and regulated.
3. 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.
4. The course will aid in understanding the principles of Graft rejection, Auto immunity and Antibody based therapy.

SUGGESTED READING MATERIAL:

1. An introduction to Immunology by C.Y. Rao, Narosa publishing house, 2002.
2. Cell and Molecular Biology by EDR De Robertis and EMR De Robertis Jr, Indian Edition, B.I. Publicaitons, Pvt. Ltd.
3. Cell Biology (Fundamentals and Applications) By Gupta/ Jangir, 2001; Agrobios, India.
4. Harpers Review of Biochemistry, Murray, Granier, Mayes and Rodwell, Lange Medical Publications, 25th Ed.
5. Human Physiology by Stuart Era Fox, W.M.C. Brown Publishers, USA 1984 or Recent Edition.
6. Immunology introductory textbook by Nandini Shetty, Wiley Eastern Ltd.
7. Kuby, J. (1998) Immunology, W.H. Freeman and Company, New York.
8. Roitt, I.,Brostoff, J. Male, D. (1999/2000) Immunology, 4th Edition. Harcourt Brace and Company Asia, Pvt. Ltd., Singapore.
9. The Cell (A Molecular Approach) by Geoffrey M. Cooper, 2nd Edn. 2000, ISBN.

CO-PO Mapping

Cour	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	-	1	1	-	1	-	2	2	-	2
CO2	3	2	1	3	2	2	2	1	-	3	1	2
CO3	3	3	3	1	1	3	2	2	2	-	2	2
CO4	2	-	2	-	3	-	1	3	1	1	1	2

ZOO-202: MOLECULAR BIOLOGY

Course Objectives:

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

1. 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.
2. 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.
3. 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.

Watson and Crick Model: Types of DNA; Properties of DNA(C-value paradox, Cot value) Nuclear and mitochondrial genome, mitochondrial and maternal Inheritance Structure of gene (Cistron, Muton, Recon, Cis-trans test)

DNA damage and repair: Biological indication of repair, photo reactivation, Excision repair, Recombination repair, SOS repair, and Mismatch repair.

UNIT-2.

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

UNIT-3.

Transcription and Translation:

Synthesis of RNA:- RNA Polymerase, Promoter, Auxiliary Proteins, RNA chain initiation, elongation, termination and Splicing mechanism

Types of RNA, Processing of mRNA, rRNA and tRNA, Ribozyme.

Genetic code, Identification of start and stop codon, Universality of genetic code Degeneracy,Wobbles Hypothesis. Codon usage, Genetic code of Mitochondria.

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.

Temporal response, Induction, Repression, Lac Operon, Galactose Operon Lambda Operon, Tryptophan Operon

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).

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:

1. The study of molecular biology provides the necessary information about the Chemistry of life to allow the students to understand the basis of life.
2. 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.
3. Comparative analysis of Prokaryotic and Eukaryotic cells.
4. Gain insight into the most significant Molecular and cell- based methods used today to expand our understanding of Biology.
5. Students world gain expertise in understanding the complex molecular mechanisms occurring in cell and the applications of molecular technologies for betterment of life.
6. 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.
7. 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:

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

CO-PO mapping

Cour	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	2	2	-	1	2	-	-	1	1	2

CO2	2	2	2	2	1	2	2	1	1	2	1	2
CO3	3	3	3	1	1	1	1	1	2	-	-	2
CO4	3	2	1	1	2	1	1	1	1	1	1	2
CO5	3	-	1	-	1	2	1	3	1	-	2	

ZOO 203P : Cell Biology and Molecular Biology
ZOO 204P: Immunology and Comparative Animal Physiology

ZOO-205: COMPARATIVE ANIMAL PHYSIOLOGY

Course Objectives :

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

1. Comparative Animal Physiology is a comprehensive subject that gives in depth knowledge of various physiological processes in the animal kingdom.
2. 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.
3. 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.
4. To provide Structure and Functional components of Muscle
5. To provide Physiological and Biochemical basis of Bioluminiscence in animal world.
6. To provide information on Biological Rhythms and their occurrence in Animals.

UNIT-1:

Aim and scope of physiology; General physiological functions and principles. Validity of comparative approach of physiology.

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.

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.

Coordination of Digestive activities: Visceral Autonomic system, Gastro intestinal Hormones.

UNIT-2:

Respiration and Metabolism: Types of respiration, Respiratory organs, Mechanism of Respiration.

Circulation of body fluids: Major types of body fluids, Blood, General properties of blood, Composition of blood, Blood groups and Transfusions.

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.

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.

Thermoregulation: Temperature as an environmental factor, Thermoregulation in Invertebrates, Thermoregulation in vertebrates.

Poikilothermic animals: Temperature relation in poikilotherms, Aquatic poikilotherms, Terrestrial poikilotherms, Homoeothermic animals: Temperature relations of homeotherms, Physical heat regulation, Chemical heat regulation. Hibernation & Aestivation.

Biological Rhythms.

UNIT-4:

Bioluminescence: Occurrence of bioluminescence among different animals, Mechanism of light production, Control of bioluminescence, Functions of luminescence. 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. Contractile elements in animals.

Muscle structure and function-correlation.

Course Outcomes:

After going through this course of **Comparative Animal Physiology**, the students have a good understanding of:

1. How Invertebrates and Vertebrate animals work and how these animals biology is influenced by the different environments of their niches.
2. 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.
3. An appropriate understanding of functioning of each system of different groups of animals with their comparison will be acquainted.
4. Understanding of the basic concepts of Physiological regulation, from cellular to organ to organismal.

5. Understanding of how different groups of animals have different Physiological adaptations appropriate to carry out the required function to the fullet.
6. Appreciation of the gorgeous diversity of Physiological possibilities that animals have developed through natural selection.

SUGGESTED READING MATERIAL:

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

CO-PO Mapping

Cour	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	1	2	-	-	-	-	-	-	-	2
CO2	3	-	2	1	2	2	2	1	1	1	1	2
CO3	3	2	1	1	1	1	1	1	1	-	-	2
CO4	3	-	-	1	1	2	2	1	1	1	1	2
CO5	3	1	1	-	1	1	1	2	1	-	1	2

ZOO 206: HUMAN VALUES AND PROFESSIONAL ETHICS – II
COMMON SYLLABUS FOR ALL P.G. COURSES (CBCS & NON-CBCS)
(With effect from 2019-20)

Value Education- Definition – relevance to present day - Concept of Human Values – Self introspection – Self esteem. Family values - Components, structure and responsibilities of family Neutralization of anger – Adjustability – Threats of family life – Status of women in family and society – Caring for needy and elderly – Time allotment for sharing ideas and concerns.

Medical ethics- Views of Charaka, Sushruta and Hippocratus on moral responsibility of medical practitioners. Code of ethics for medical and healthcare professionals. Euthanasia, Ethical obligation to animals, Ethical issues in relation to health care professionals and patients. Social justice in health care, human cloning, problems of abortion. Ethical issues in genetic engineering and Ethical issues raised by new biological technology or knowledge. Business ethics- Ethical standards of business-Immoral and illegal practices and their solutions. Characterics of ethical problems in management, ethical theories, causes of unethical behavior, ethical abuses and work ethics.

Environmental ethics- Ethical theory, man and nature – Ecological crisis, Pest control, Pollution and waste, Climate change, Energy and population, Justice and environmental health.

Social ethics- Organ trade, Human trafficking, Human rights violation and social disparities Feminist ethics, surrogacy/pregnancy. Ethics of media- Impact of Newspapers, Television Movies and Internet.

Books for study:

1. John S Mackenjie: A manual of ethics.
2. **"**The Ethics of Management**"** by Larue Tone Hosmer, Richard D. Irwin Inc.
3. **"**Management Ethics – integrity at work**'** by Joseph A. Petrick and John F. Quinn, Response Books: New Delhi.
4. **"**Ethics in management**"** by S.A. Sherlekar, Himalaya Publishing House.
5. Harold H. Titus: Ethics for Today
6. Maitra, S.K: Hindu Ethics
7. William Lilly: Introduction to Ethics
8. Sinha: A Manual of Ethics
9. Manu: Manu Dharma Sastra or the Institute of Manu: Comprising the
10. Susruta Samhita: Tr. Kaviraj Kunjanlal, Kunjalal Brishagratha, Chowkamba Sanskrit series, Vol. I, II and III, Varnasi, Vol I OO, 16-20, 21-32 and 74-77 only.
11. Caraka Samhita: Tr. Dr. Ram Kraran Sarma and Vaidya Bhagavan Dash, Chowkambha Sanskrit Series office, Varanasi I,II,III Vol I PP 183-191.
12. Ethics, Theory and Contemporary Issues, Barbara Mackinnon, Wadsworth/Thomson Learning, 2001.
13. Analyzing Moral Issues, Judith A. Boss, Mayfield Publishing Company, 1999.
14. An Introduction to Applied Ethics (Ed.) John H. Piet and Ayodhya Prasad, Cosmo Publications.
15. Text book for Intermediate logic, Ethics and Human Values, board ofIntermediate Education & Telugu Academic Hyderabad.
16. I.C. Sharma Ethical Philosophy of India. Nagin & co Julundhar.

CO-PO Mapping

Cour	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	-	-	1	-	1	3	-	-	-	2
CO2	3	1	1	-	-	1	-	2	-	1	1	2
CO3	2	1	-	-	-	2	1	1	1	-	-	2
CO4	3	1	1	1	1	-	-	2	-	1	1	2

SEMESTER-III

ZOO-301: DEVELOPMENTAL BIOLOGY

Course Objectives:

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

1. 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.
2. Acquire knowledge on the fertilization and morphogenetic movements in the developing embryo.
3. To understand the embryo organizer, inductions and differentiation.
4. To study gametogenesis, fertilization, cleavage and gastrulation, stages in developing embryo.
5. To acquaint students with basic knowledge of experimental embryology.

UNIT-1:

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

UNIT-2:

Origin and migration of germ cells; production of gametes and establishment of polarity. Fertilization; Cell surface molecules in sperm egg recognition in animals; Molecular events of post fertilization.

Cleavage types, Blastula formation, Gastrulation and Molecular mechanism in germ layers formation.

Environmental regulation of normal development.

UNIT-3:

Axis and pattern formation in Drosophila, Amphibia and Chick.

Cell aggeregation and differentiation in dictyostelium.

Organogenesis- vulva formation in caenorhabditis elegans, eye lens induction.

Development in tetrapod Limb (Amphibians) and Neural fold formation.

UNIT-4:

Sex determination in animals (mechanism of primary and secondary sex determination) Hormonal regulation of sexual phenotypes.

Regeneration - types of Regeneration; Axial patterning during Regeneration. Metamorphosis-hormonal regulation of metamorphosis in insects and amphibians.

Ageing and senescence- Reactive oxygen species and cell senescence; dietary restriction and anti aging action: genetic control of longevity; Age related diseases.

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:

1. 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.
2. 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.
3. Gains knowledge about gametogenesis, cleavage mechanisms, gastrulation and role of hormones in metamorphosis and regeneration.
4. 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.
5. 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.

6. 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.
7. 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.
8. 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 READING MATERIAL:

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

CO-PO Mapping

Cour	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	1	-	-	2	1	-	-	-	-	1
CO2	3	1	1	-	-	1	-	2	-	1	1	1
CO3	3	1	-	-	-	2	1	-	1	-	-	2
CO4	3	1	1	1	1	2	-	2	-	1	1	2

ZOO-302: ENVIRONMENTAL BIOLOGY

Course Objectives:

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

1. 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.
2. 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.
3. The aim of the contents of this course is to introduce and explain about various conservation issues of the ecosystem and animals.
4. 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.
5. Generate an interest in Ethology in order to understand the complexities of both animal and human behavior.
6. To understand the basic theories and Principles of Ecology.
7. To learn about current environmental issues based on Ecological principles.
8. To study Environmental pollution and their management.

UNIT-1:

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

UNIT-2.

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

UNIT-3.

Air Pollution: Criteria and standards in India, health hazards and Toxicology – Green house gases and Green House Effect.

Water Pollution: Criteria and standards in India, health hazards and toxicology. Role of environmental epidemiological studies and health indices in evaluation of environmental health hazards: environmental epidemiological episodes in India and Abroad.
Environmental Laws; Environmental Laws in India – legislation and Execution.

UNIT-4.

Biomonitoring,.
Bio indicators and environmental monitoring, Environmental impact assessment.
Bioremediation: Need and scope of bioremediation, Environmental applications of bioremediation. Future outlook of Bioremediation: Phytoremediation, Biotechnological cleaning up of the environment by plants.
Natural calamities and disaster management.

Course Outcomes:

1. The student will get idea about the ecological process in its surrounding and at National and Global level and the use of student knowledge on Ecology, Behaviour can be applied to Education, Research and Extension programmes in his further career.
2. Students will be understanding the various features and aspects of population ecology, community ecology and ecosystem ecology. They might have the knowledge about environmental biology in details. They will acquire knowledge about various tools and techniques of field ecology.
3. Students will be able to apply the scientific method and quantitative techniques to describe, monitor and understand environmental systems.
4. Students will be able to use interdisciplinary approaches such as ecology, economics, ethics and policy to devise solutions to environmental problems.
5. Students will be able to be proficient in ecological field methods such as wildlife survey, biodiversity assessment, mathematical modeling and monitoring of ecological systems.
6. Students will be able to use technology, such as geographical information systems and computer programming, to assist in problem solving.
7. This paper will help in creating skilled personnel in the field of environment protection and research.
8. Demonstrated an understanding of Ecological relationships between organisms and their environment.

SUGGESTED READING MATERIAL:

1. Animal Physiology - Adaptation & Environment. 4th EditionKnut Schmidt - Nielsen - Cambridge University Press.
2. Biochemical ecology and water pollution - PR Dugan, plenum press, London, 1972.

3. Biodegradation & Bioremediation - 2nd editon, Martein Alexander - Academic Press, 1999 USA.
4. Chemical and biological methods for water pollution studiesR.K. Trivedy and P.K. Goel, 1984.
5. Current pollution researches in India - RK. Trivedy and P.K. Goel. Karad.
6. Ecology & Environment - P.D. Sharma, 1991.
7. Ecotechnology for pollution control and environmental management, enviromedia, Karad, RK. Trivedi.
8. Encyclopedia of environmental pollution and control, enviromedia, Karad, Vol. 1 &2, R.K Trivedi.
9. Environmental Biology and Toxicology-P.D. Sharma, Rastogi Publications, Meerut (India), 1998.
10. Environmental Physiology of desert organism. Ed.by N.F. Hadley - Dowden Huchinson and Ross, Inc.Penn.USA.
11. Environmental Science Research Volumes: Vol.1. Indicators of environmental quality - W.A. Thomas, 1972. Vol.3. Environmental pollution by pesticides - C.A. Edwards, 1974.
12. Field Biology & Ecology - Allen H Benton & E. Werner, JR, 1980.
13. Health hazards and human environment, World Health Organization (WHO) 1972.
14. Industrial Pollution - VP. Kudesia, 1990.
15. Methods in Environmental Analysis - Water soil and air by P.K. Gupta - Agrobios (India), Jodhpur, 2001
16. Pesticides in the environment - R White Stevenns, MarcelDekker Inc. New York, 1971.
17. Practical methods in Ecology & Environmental Science, RK. Trivedy, Goel, Trisal, 1997.
18. The Ecology of waste water treatment - H.A. Hawkes pergoman press, 1963.
19. 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.

CO-PO Mapping

Cour	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	2	-	-	2	-	-	-	-	-	2
CO2	3	2	-	1	-	2	1	3	2	2	1	1
CO3	3	2	-	1	-	2	-	-	1	-	2	2
CO4	3	-	1	2	1	2	-	1	-	2	1	2
CO5	3	-	1	-	-	1	2	1	-	2	2	2

ZOO 303 P : Developmental Biology and Environmental Biology

ZOO 304 P : Any Two Generic Electives

Generic Electives: ZOO-305 A : TOOLS & TECHNIQUES

Course Objectives:

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

1. To study the different tools used in biology and research.
2. To learn about the operational handling and maintenance of laboratory instruments and glassware.
3. To study different types of microscopy used in biology.
4. To learn about different molecular and cellular separation techniques and their application in biological research.
5. To study principles and methods of microtechnique.

UNIT-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. Centrifugation. Techniques-Density gradient., ultra centrifugation.

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.

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.

Electromagnetic spectrum of light- Simple theories of absorption of light by molecules. Beer-Lambert law.

Types of detectors: UV-Visible spectrophotometry, Infra red spectrophotometry, Fluorescent spectroscopy. Flame photometry, AAS.

Electrophysiological methods: Single neuron recording, patch-clamp recording, ECG

Brain activity recording, lesion and stimulation of brain, pharmacological testing, PET, MRI, CAT.

UNIT-4.

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

Course Outcomes:

1. Students would be trained in various tools and techniques used to gain insight into biological processes.
2. Students would be expertise techniques used for imaging, isolation, purification and characterization of various biological substances.
3. 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.
4. Identify and describe the different equipment and tools used in a biology laboratory.
5. Correctly operate different laboratory instruments.
6. Correctly operate different types of microscopes.
7. Prepare tissue for section cutting and correctly operate a microtome.
8. Choose and perform correct staining technique for any given tissue sections.
9. Describe cellular separation techniques.
10. Properly handle and maintain glassware.
11. Properly operate laboratory equipment.

SUGGESTED READING MATERIAL:

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

CO-PO mapping

Cour	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	2	-	-	2	-	-	-	-	-	2
CO2	3	2	-	1	-	2	1	3	2	2	1	1
CO3	3	2	-	1	-	2	-	-	1	-	2	2
CO4	3	-	1	2	1	2	-	1	-	2	1	2

Generic Electives: ZOO-305 B : ENZYMOLOGY

Course Objectives:

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

1. To study the Nomenclature and Classification, Enzyme specificity, Enzyme Catalysis and Enzyme purification mechanisms
2. To study the Enzyme Kinetics mechanisms and impact of several parameters
3. To study the different mechanisms of Inhibitions and their implications at cellular level
4. To study the Enzyme Regulatory mechanisms
5. To study the Clinical aspects of Enzymology and diagnosis
6. To study the Enzyme Engineering Principles
7. To understand the Enzymes in industrial use – Biotechnological implications

UNIT-1.

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

UNIT-2:

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

UNIT-3:

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

UNIT-4:

Clinical Aspects of enzymology, Medical and Therapeutic applications of enzymes; Enzymes-Clinical diagnosis.
Immobilized enzymes, various methods of immobilization-ionic bonding, absorption, covalent bonding (based on R groups of amino acids). Iso enzymes and multiple forms of enzymes.
Enzyme engineering–economic importance of enzyme production. Enzymes in industries-food, biotechnology and other industries.

Enzymology:

Course Outcomes :

1. Students learn about enzymes. Their classification and nomenclature
2. Students learn about specificity of enzymes
3. Students learn about measurement of enzymatic activity
4. Students learn about isolation, purification of enzymes and intercellular distribution enzymes
5. Students learn about kinetic and collision theories
6. Students learn about mechanisms of enzyme action
7. Students learn about effect of reactant concentration
8. Students learn about effect of enzyme concentration, pH and temperature
9. Students learn about kinetic constant and determination of kinetic constants
10. Students learn about types of inhibitory mechanisms of enzymes
11. Students learn about kinetics of Allosteric enzymes
12. Students gain knowledge about regulation of enzyme activity with respective mechanisms
13. Students learn about mechanism of enzymes in clinical diagnosis and their applications
14. Students gain knowledge about immobilization of enzymes, applications of immobilized enzymes
15. Students gain knowledge about isoenzymes and their applications
16. Students learn about enzyme engineering, process of enzyme engineering and their applications

SUGGESTED READING MATERIAL:

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

CO-PO mapping

Cour	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	-	1	2	-	-	-	-	-	2
CO2	3	1	1	-	-	2	1	3	2	2	1	1
CO3	3	2	-	2	2	2	-	-	1	-	2	2
CO4	3	1	2	2	1	2	-	1	-	2	1	2
CO5	3	1	2	-	-	1	-	1	-	2	2	2

Generic Electives: ZOO-305 C: ENVIRONMENTAL MICROBIOLOGY

Course Objectives:

The main objective of this course are to:

1. Impart knowledge on microbial diversity and recent advancement methods in the analysis of microbial diversity.
2. Provide in-depth knowledge of role of beneficial and pathogenic microorganisms in environment.
3. Understand the application of microbes for production of different eco-friendly products
4. Impart knowledge in molecular biotechnology and its applications in Environmental management and conservation of biodiversity
5. 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 EnvironmentStandard 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, Biosurfactants, 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:

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

SUGGESTED READING MATERIAL:

1. Textbook of Environmental Microbiology, Mohapatra, P. K. (2008), I.K. International (P)Ltd.
2. Environmental Microbiology, Pepper, I. L., Gerba, C. P. and Gentry, T. J. (2015), 3rd edition, Academia Press, Elsevier

3. Basic Biotechnology, Ratledge, C. and Kristiansen, B. (2003), 2nd edition, Cambridge University Press
4. Bioethics and Biosafety in Biotechnology, Sree Krishna.V. (2007), New Age International Publishers.
5. Topics in Ecological and Environmental Microbiology, Schmidt, T. M. and Schaechter, M.(2012), 3rdedition, Academia Press, Elsevier.
6. Environmental Microbiology: Fundamentals and Applications: Microbial Ecology, Bertrand, J. C., Caumette, P. and Lebaron, P. (2015), Springer
7. Environmental Microbiology – Theory and Application, Jjemba, P.K. (2004), Science Pub. Inc., USA
8. Environmental Biotechnology-Theory and Application, Evano, G.H. and Furlong, J.C. (2004), John Wiley and Sons, USA
9. Environmental Biotechnology and Cleaner Bioprocesses, Olguin, C. J., Sanchez, G., Hernandez. E. (2000), Taylor & Francis.

CO-PO mapping

Cour	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	-	1	-	-	-	1	1	-	-
CO2	3	3	2	-	-	-	1	1	2	2	1	1
CO3	3	2	-	1	2	1	-	-	1	-	-	1
CO4	3	1	1	1	1	1	-	1	-	2	-	1

Open Electives: ZOO: 306 A : ECONOMIC ZOOLOGY

Course objectives:

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

1. To identify various Methodologies and Perspectives of applied branches of Zoology for the possibilities of Self-employment.
2. To study the economic importance of Animal husbandries, Vermicompost technology, Sericulture, Apiculture etc.
3. To know the technical practices of Aquaculture, Sericulture, Apiculture, Animal husbandries, Vermicompost technologies.
4. To gain disease management technologies their adaptation in the Fisheries, Apiculture, Sericulture, Poultry etc.

UNIT-1.

Definition and scope of aquaculture.
Culture of prawns-fresh post harvesting processing.
General account of Edible fresh water fishes. • Carp culture: management of ponds, processing and preservation.
Plankton as a live feed for **Fisheries. • Poly culture practices.**

UNIT-2.

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

UNIT-3:

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

UNIT-4:

Lac culture – Lac insect,Laccifera lacca - Life cycle, Lac processing, Lac products and Economic Importance.
Pearl culture and Pearl Industry. Vermiculture and Composting
Economics of Poultry keeping: Morphology of different breeds of Chicken-Brooding and Rearing of Chicks-Processing of Egg, Meat and By-Products of Poultry.
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:

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

SUGGESTED READING MATERIAL:

1. Sukla, G.S. and Upadhyay, V.B., 2000 Economic Zoology – ISBN – 81-7133-137-8 Rastogi Publications, Meerut, India.

2. Jawaid Ahsan and Subhas Prasad Sinha, 2000 A Handbook on Economic Zoology-ISBN-81-219-0876-O S. Chand & Co., Ltd., New Delhi.
3. Ashok Kumar and Prem mohan Nigam, 1991 Economic and Applied Entomology Emkay Publications, New Delhi.
4. Shammi, Q.J. and Bhatnagar, S., 2002 Applied Fisheries: ISBN-81-7754-114-5 Agrobios (India), Jodhpur – India.
5. Major Hall, C.B. 2005 Ponds and Fish culture - ISBN-81-7754-146-3 Agrobios (India), Jodhpur – India.
6. Keith Wilson, N.D.P., 2005 A Handbook of Poultry Practice – ISBN-81-7754-O-69-6 Agrobios (India), Jodhpur – India.
7. 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
8. Banerjee, 1988 A Text Book of Animal husbandry-VIII-Edition-ISBN-81-204-1260-5 Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
9. Kaushish, S.K., 2001 Trends in Livestock Research – ISBN-81-7754-112-9 Agrobios (India), Jodhpur – India.
10. Ismail, S.A. 1997. Vermicology the Biology of Earth worm Orient Longman, India 11. A. Mary violet Christy 2008 vermy technology MJP Publ. Chennai

CO-PO mapping

Cour	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	2	1	2	1	1	1	-	1	-	2
CO2	3	1	1	-	-	2	1	3	1	2	2	2
CO3	3	2	-	1	-	-	1	-	1	-	2	2
CO4	3	-	1	2	2	2	-	2	2	1	-	2

Open Elective ZOO-306B: STRUCTURAL BIOLOGY

COURSE OBJECTIVES:

1. Allows the students to gain basic knowledge about various bio molecules and their role in metabolism
2. Classification of enzymes, enzyme kinetics
3. Metabolism of carbohydrates, nucleic acids and metabolic disorders
4. Gains understanding of cellular organization and functional biology nucleic acids

UNIT-1.

Interaction in biology systems.
Structure of Biomolecules and confirmations of protein and nucleic acids.
Secondary, tertiary and quaternary structure of protein.

Primary and secondary structure of RNA and DNA

UNIT-2.

Conformational analysis and prediction of conformation.
Thermodynamics and kinetics of conformational transition of Proteins.
Protein folding, techniques for studying Macromolecular Structure.
Ultra centrifugation Sedimentation velocity and equilibrium- determination of molecular weights.

UNIT- 3.

Structural implications of the peptide bond; rigid planar peptide UNIT; cis and trans configuration; conformations of a pair of linked peptide UNITs;
Torsion angles phi and psi - steric hindrance; hardsphere approximation; allowed and disallowed conformations; Ramachandran Diagram; conformational maps for glycine and other natural amino acids; conformationally constrained amino acids and their importance.
Symmetry, space group crystal lattices, brag's law in real & reciprocal space.
Nuclear Magnetic Resonance

UNIT-4.

Crystallography: External features and symmetry – UNIT-cell and Miller indices –
Detection and properties of X-rays-choice of radiation, synchrotron radiation
Powder photographs – interpretation of powder photograph – ASTM index.
Theory of diffraction by helical structures and application to alpha-helix and DNA.
Structure Determination of Proteins by X-ray Crystallography: phasing: molecular replacement, MIR SAD/MAD. Light scattering studies of Globular macromolecules

COURSE OUTCOMES :

1. Post NGS (Next Generation Sequencing) era has completely changed the way of understanding research, especially in the field of biomedical science.
2. Today the complete genome sequencing of an organism is done in a few days providing the researchers with thousands of genes hence thousands of protein sequences. But to proceed further we need to understand the three-dimensional architecture of the protein molecules.

3. The current course would take an initiative to educate the students in gathering knowledge about the structural units forming biological macromolecules, their architectural hierarchies, the basics of the structural biology techniques, their pros and cons, how to read and visualize 3D structure files, etc.

4. The course also include introduction to molecular dynamics and case studies explaining the probable application of the acquired knowledge. But most importantly this course is an attempt to help linking the biological events to understand how biological macromolecules are generated, folded and get functional. Understanding

those fundamentals would help students towards studying follow up advanced courses like Advanced structural biology, Macromolecular crystallography, Cryo-Electron Microscopy, Nuclear Magnetic Resonance, Structure-based drug designing, protein engineering, etc.

5. In summary, this course would open up the gate of modern research-related courses in the field of Drug Designing and macromolecule based engineering.

SUGGESTED READING MATERIAL:

1. Biophysical Chemistry by Cantor & P. Schimmel. Vol. I & II
2. Physical Biochemistry by David Freifelder
3. Protein: Structure 7 molecular Properties by TE Creighton
4. Crystallography made crystal clear, Author: Gale Rhodes; Publisher: Academic Press
5. Introduction to Protein Structure By Carl Branden & John Tooze
6. Protein Structure New approaches to disease and therapy By Max Perutz

CO-PO mapping

Cour	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	2	1	2	1	1	1	-	1	-	2
CO2	3	1	1	-	-	2	1	3	1	2	2	2
CO3	3	2	-	1	-	-	1	-	1	-	2	2
CO4	3	-	1	2	2	2	-	2	2	1	-	2

OE: ZOO-306 C: HUMAN HEALTH AND INFECTIOUS DISEASES

Course objectives:

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

1. To introduce the basic concepts of pathophysiology of infectious diseases

2. To study the major infectious diseases transmission to humans and response of immunity

3. To understand the Pathogenesis, mechanisms of pathogenesis; transmission and epidemiology of various bacterial, viral, fungal and protozoan diseases.

4. To study the Sexually transmitted diseases.

5. 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:

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

SUGGESTED READING MATERIAL:

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

CO-PO mapping

Cour	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	-	1	2	-	-	-	-	-	2
CO2	3	1	1	-	-	2	1	3	2	2	1	1
CO3	3	2	-	2	2	2	-	-	1	-	2	2
CO4	3	1	2	2	1	2	-	1	-	2	1	2

SEMESTER-IV

ZOO-401: NEUROBIOLOGY

Neurobiology :

Course Objectives :

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

1. To study the microanatomical structure of neuron
2. To describe the different types of Neurons and their organization
3. To understand the Molecular mechanism of transmission
4. To study the chemical composition of Nervous system
5. To understand the principles of different types of neurotransmitters

UNIT-1.

Anatomical techniques: Golgi Silver stain; Cobalt chloride Back-filling; HRP method; Procion yellow staining.

Neurons and associated structures; Micro anatomy of neurons; Types of neurons and Glial cells.

Organization of the Central Nervous System (Spinal cord; Brain stem; Cerebral cortex). Organization of the Peripheral nervous System (Sympathetic and Parasympathetic nervous system).

UNIT-2.

Electrophysiological techniques (Voltage-clamp and Patch-clamp); Bioelectrical properties of Neurons-Neuronal excitability; The resting potential membrane potential; Nearnst equation; Sodium and Potassium pump; Generation of the action potential; Propagation of nerve Impulse.

Molecular mechanism of Excitation Carrier protein; Ion channels; Gating mechanisms. Synapses: Structure and Integration; Morphology and Ultra structure of synapse; Types of Synapses; Chemical transmission; Electrical transmission.

Second messenger systems: Cyclic AMP and GMP; G-protein; IP3; Calcium and Calmodulin.

UNIT-3.

Chemical composition of the nervous system-Cerebro Spinal Fluid-CNS Barriers-Nerve Growth Factor.

Synthesis-storage-release and inactivation mechanisms and functions of the neurotransmitters. Viz. Acetylcholine & Catecholamines (Norepinephrine, Eponephrine, Dopamine and Serotonin).

Amino acid Neurotransmitters- Excitatory amino acids (Glutamate and Aspartate); Inhibitory Amino acids (GABA and Glycine).

Peptide Neurotransmitters: Oxytocin, Vasopression, Substance-P and Cholecystokinin.

UNIT-4.

Major drug classes-brief history-absorption-binding-tolerance-excretion physiological and Behavioral Effects of the following drugs; Opium; Stimulants (Amphetamine, Cocaine, Nicitine and Caffeine) Hypnotic and Anxyolytic drugs. (Barbiturates & Benzodiazepines); Mind altering drugs (Marijuana, LSD)

Drug abuse and treatment programs

Etiology, Pathology, Symptoms, Diagnosis and treatment strategies for the Neurological Disorders Viz.Schizophernia, Depression; Epilepsy, Alzheimer's and Parkinson 's disease.

Neurobiology :

Course Outcomes :

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

SUGGESTED READING MATERIAL:

1. Basic Neurochemistry-G.J. Siegal, RW. Albers, B.W. Agranoff, R Katzman (1981) Little, Brown and company. Boston.
2. Introduction to Nervous system- T.H. Bullock, R Cork, A. Granner (1977); W.H Free-man&Co.
3. Mechanism of Drug Action on the Nervous SystemM.A.B. Brazil, RW. Ryall. (1979), Cambridge University Press. Cambridge, London and New York.
4. Neuro anatomical Techniques, N.J. Stransfed and T.A. Miller Springer Verlag, New
5. Neurobiology. Shepherd, G.M. Oxford University press, London.
6. Principles of Neural Science -E.R Kandel and J.H. Schwertz. (1981); Elsevierl North Holland. NY. Oxford.
7. Principles of Neuro Phychopharmacology- Robert S. Feldman, Jerrold S. Meyer and Lind F. Quenzer. Sinauer Associates, Inc. Publishers. Sunderland. Massachusetts.
8. The Bio Chemical basis ofNeuropharmacology-J.R Cooper, F.E. Bloom, &RH. Roth. (1982); Oxford University Press, NY and London. York Heidelberg, Berlin, 1980.

CO-PO mapping

Cour	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	-	1	2	-	-	-	-	-	2
CO2	3	1	1	-	-	2	1	3	2	2	1	1
CO3	3	2	-	2	2	2	-	-	1	-	2	2
CO4	3	1	2	2	1	2	-	1	-	2	1	2
CO5	3	1	2	-	-	1	-	1	-	2	2	2

ZOO-402: TOXICOLOGY

Course objectives:

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

1. Provides broad theoretical knowledge within toxicology and development of a general working knowledge of the principles and practice of clinical toxicology.
2. Basic toxicology concepts including: mechanisms of toxicology, absorption, distribution and excretion of toxicants, xenobiotic metabolism, toxicokinetics, chemical carcinogenesis, hepatotoxicology. 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.
3. 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.
4. 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).
5. 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.
6. To apprise the students about the toxicants along with their application and their effects on biosphere as well as human health.

Unit- 1:

Introduction and scope of toxicology and classification of xenobiotics.

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.

Mechanism of toxic action of pesticides (Receptor concept, nature of receptors, Theory of toxicants- receptors interactions and mechanism of action of some pesticides)

Toxicokinetics-

Classic toxicokinetics

ii) Physiologic toxicokinetics

Unit- 2:

Translocation of toxicants; Absorption of Toxicants, Distribution of Toxicants, Excretion of Toxicants

Biotransformation of Xenobiotics; Biotransformation sites, Biotransformation enzymes, Biotransformation reaction and bioactivation

Bioaccumulation of Xenobiotics; Bioconcentration, Bioaccumulation and Biomagnification; Biomagnification of lipophilic and recalcitrant substances

Toxic effect of metals - Mercury, Lead, Cadmium and Arsenic

Unit- 3:

Toxic Response of Blood: Toxicology of erythron, leukon, platelets and homeostasis

Toxic Response of Liver; Mechanism and types of toxin – induced liver injury; critical factors in toxicant induced liver injury; detoxification mechanisms by liver.

Toxic Response of Kidney; Susceptibility of the kidney to toxic injury; Biochemical mechanisms / mediators of renal cell injury.

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:

Xenobiotic effect on basic metabolism (Carbohydrates, Proteins, Lipids)

Teratogens and Teratology (Relationships between maternal and developmental toxicity)

Antidotal therapy; Types of antidotes and antidotal procedures.

Risk assessment – Hazard identification; Risk characterization and Safety evaluation of Chemicals.

Course outcomes:

1. 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.
2. It is a discipline overlapping with biology, chemistry, medicine that involves the study of toxicants, their mechanism of action.
3. It involves the study of the adverse effects of chemical substances on living organisms.
4. Skill development in environmental and occupational Toxicology.

5. It provides opportunities for students research projects, internships in assessing the effects of toxic pollutants on the environment and in the food chain.
6. Identification of different routes of exposure of environmental toxins.
7. Understanding of the physiological and genotoxic effects of drugs and environmental toxins.
8. Knowledge of various techniques for Toxicity evaluation.
9. 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.
10. The students will learn handling of the pesticides in crop protection and understand the therapy and antidotes at the time of poisoning.
11. 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.
12. 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

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

CO-PO mapping

Cour	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	-	1	2	-	-	-	-	-	2
CO2	3	1	1	-	-	2	1	3	2	2	1	1
CO3	3	2	-	2	2	2	-	-	1	-	2	2
CO4	3	1	2	2	1	2	-	1	-	2	1	2
CO5	3	1	2	-	-	1	-	1	-	2	2	2

ZOO 403 P: Neurobiology and Toxicology

ZOO 404 P : Any Two Generic electives

Generic Electives: ZOO-405 A : ANIMAL BIOTECHNOLOGY AND MICROBIOLOGY

Course objectives:

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

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

Course Objectives:

This course enables the students to:

1. Establish an understanding of the basic techniques (concept of aseptic work, cultivation and identification) in microbiology
2. Describe different aspects of microbial nutrition and growth
3. Describe microbial interactions and their significance in environment
4. Describe microbial interactions and their significance in agriculture, food and pharmaceuticals

5. 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

6. 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

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This course enables the students to:

1. Establish an understanding of the basic techniques (concept of aseptic work, cultivation and identification) in microbiology
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5. 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

6. 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.

1.1 General Introduction and Achievements of Biotechnology

1.2 Genetic Engineering and r-DNA technology (Restriction endonucleases, DNA ligases, Topoisomerases, Methylases, Nucleases, Polymerases, Reverse transciptase and their Properties and functions).

1.3 Cloning vectors (plasmids, Bacteriophages, Cosmids, Yeasts Shuttle vectors, Viruses, PBR-322 and its derivatives, S.V 40 and other vectors) used in Gene cloning.

1.4 Cloning Strategies and Screening Analysis of recombinants (Single colony hybridization Technique), immunologic test, Southern blotting.

UNIT-2

2.0 Application of Biotechnology in veterinary sciences

2.1 Transgenic (Technology) animals, super bugs

2.2 Multiple ovulation in farm animals Genetic recombination in Mammalian cells and embryos production of cattle embryos in vitro; Artificial insemination, in vitro fertilization, Embryo Transfer technology

2.3 Application of Biotechnology in Medicine, Production of monoclonal antibodies (Hybridoma Technology), Production of vaccines, Production of Growth Hormone.

2.4 Gene therapy (Adenosine diaminase deficiency disease (ADA); Duchenne Muscular disease (DMD); Haemophilia; Phenyl ketonuria, alkaptonuria, Thalassemia, etc.

UNIT-3.

History and Scope of Microbiology

Microbial nutrition, growth and their control

Normal microbial flora of Human Body- Skin, Nose, Oral cavity, Pharynx, Respiratory tract, Eye, Ear, Stomach, Intestine, Genitourinary tract.

Microbial diseases and their control

a) Bacterial diseases - Tuberculosis,
Plague, Anthrax.

b) Viral diseases - Influenza,
AIDS, Hepatitis.

UNIT-4.

Microbiology of fermented food: Diary Products, Meat and Fish, Microorganisms as Sources of feed
Industrial Microbiology: Types of fermentation process, Types of fermentors, Down stream processing, Alcoholic beverages
Manufacture of various chemicals: Lactic acid, and Citric acid.
Therapeutic compounds: Antibiotics (penicillin), Industrial enzymes (Amylase,).

Course Outcomes:

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

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

1. Identify microbiological techniques, the defining characteristics of the major groups of microorganisms and apply to study microbial phylogeny
2. Classify the nutritional types of microorganisms and measure microbial growth
3. Evaluate how microorganisms interact with the environment in beneficial or detrimental ways
4. Assess impact of plant- microbe interaction on agriculture in both beneficial and detrimental ways. Identify industrially important microbes
5. Determine ways in which microorganisms play an integral role in disease, and the microbial and immunological methodologies are used in disease treatment and prevention

6. 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:

1. A text book of Biotechnology-RC. Dubey.S.Chand & Company Ltd., New Delhi -1996.
2. A text book on Biotechnology-(n Ed.) H.D. Kumar. EWP - Private Ltd., New Delhi -1998.
3. Animal Biotechnology-M.M. Ranga, Agrobios (India), 2000.
4. Biotechnology-Fundamentals & Applications-S.S .Purohit & S.K. Mathur, Agro Botonics-1999.
5. Biotechnology-V. Kumaresan. Saras Publication-1994.
6. C.M. Presscots, J.P. Harley & D.AKlein Mc Graw Hill. WCB Publication 4th Edition.
7. Elements of Micro biology, by MJ. Pelzar, Jr & E.C.S Chan International students Edition, 1981, MCGRA WHill international Book Company, New Delhi. Microbiology
8. General Microbiology by C.B. Powar & H.F. Daginawala 1st Edition, Himalaya Publishing House, Bombay, 1982.
9. Text Book of Microbiology, by R Aananthnarayan &C.K. Jayaram Panikar, 4th Edition, Orient Longmen, Hyderabad, 1990.

CO-PO mapping

Cour	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	-	1	2	-	-	-	-	-	2
CO2	3	1	1	-	-	2	1	3	2	2	1	1
CO3	3	2	-	2	2	2	-	-	1	-	2	2
CO4	3	1	2	2	1	2	-	1	-	2	1	2
CO5	3	1	2	-	-	1	-	1	-	2	2	2

Generic Electives: ZOO – 405 B : ANIMAL BEHAVIOUR AND WILD LIFE BIOLOGY

Animal Behavior:

Course Objectives :

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

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

UNIT-1

Habitat selection-food selection; Optimal foraging theory, Antipredator defenses.
Parental care in Fishes, Amphibians, Reptiles, Birds and Mammals.
Homing and territoriality; bird migration; orientation and navigation.
Social organization; Insects and Primates

UNIT-2

Conditioning Learning: Classical conditioning: Laws of classical condition, Extinction, Discrimination; Operant conditioning: Skinners Experiment, Measures of Operant Strength, Partial Reinforcement, Reinforcement Schedules, Shaping behavior.

Cognitive Learning: Reasoning, Physiology of Reasoning, Insight learning, Sign learning, Latent Learning.

Neural basis of memory and theories and memory: Kinds of remembering redintegrative Memory, Recall, Recognition, Types of memory phenomenon, Organisation of semantic Memory, Two process Theory of memory: Long-term and Short-term memory.

The nature of forgetting and improving memory: Decay through discuse, Inference effect, Proactive Inhibition, motivated forgetting, chemical process of memory.

UNIT- 3:

Importance of wild life conservation – Values of biodiversity - Modes of conservation.

Threats of biodiversity changes in habitat- hunting- pollution etc

Types of Biodiversity: Genetic biodiversity- species biodiversity- Domesticated Biodiversity- In-situ and Ex-situ conservation.

Seshachalam Biosphere reserve – Sanctuaries and National parks in Andhra Pradesh-World heritage sites.

Study of signs and symptoms: Recording basic field observations, Foot prints, types of tracks, animal droppings etc.

UNIT- 4:

Remote sensing and GIS usage for conservation and case studies(Slender loris, Golden geckos) - Role of Government and non Government agencies in wild life management Environmental impact assessment and methods of EIA in conservation Human and animal conflicts and remedial measures

Environmental pollution- Global environmental change - Biodiversity management - Wild life policy and legislation

Animal Behavior:

Course Outcomes :

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

SUGGESTED READING MATERIAL:

1. Alcock, J. Animal behaviour: An evolutionary approach. Sinauer Assoc., Sunderland, Mass. USA.
2. 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.
3. Bradbury, lW. and S.L.Vehrencamp. Principles of animal communication. Sinauer Assoc. Sunderland, Mass. USA.
4. Clutton-Brock, T.H. the evolution of parental care. Princeton Univ. Press, Princeton,USA.
5. Hosetti, B.B.Venkateswarlu, M. Trends in Wild life Biodiversity Conservation and Management.
6. K.C. Agarwal, Biodiversity (1998).
7. Kumar & Asija., Biodiversity Principles & Conservation, Published by Upadesh Purohit by Agrobios (India), Jodhpur, 2002.
8. M.Shamin Jairajpuri, Biological Diversity and Environment-CBS Publishers and Distributors, New Delhi, 1996.
9. T.I. Khan, YS. Shishodia, Biodiversity Conservation and Sustainable Development.
10. Wild life in India-V.V.Saharia, 1982, Natraco Pub., Dehradun.

CO-PO mapping

Cour	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	-	1	2	-	-	-	-	-	2
CO2	3	1	1	-	-	2	1	3	2	2	1	1
CO3	3	2	-	2	2	2	-	-	1	-	2	2
CO4	3	1	2	2	1	2	-	1	-	2	1	2
CO5	3	1	2	-	-	1	-	1	-	2	2	2

Generic Electives: ZOO-405 C : ENDOCRINOLOGY

Course Objectives :

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

Unit 1:

Classification of hormones. Brief account of structural features of endocrine glands. Hormonal effects and regulation – basic concepts and methods

Biosynthesis and secretion of pituitary. Factors influencing secretion. Endocrine disorders - brief description

Biosynthesis and secretion of pancreas, adrenal, and thyroid hormones. Factors influencing secretion.

Biosynthesis and secretion of sex steroid hormones. Factors influencing secretion.

Unit 2:

Peptide hormones, Steroid hormones. Hormones as messengers. Cell surface receptors. Cascade of reaction linked to signal transduction.

Evolution of pituitary gland; Physiological actions of pituitary hormones. Urophysis and action of its hormone(s). Pancreatic hormones and glucose homeostasis.

Evolution of discrete adrenal gland; Synthesis of corticosteroid, structural diversity of glucocorticoids among vertebrates.

Sex steroids. Cytoplasmic and nuclear receptors. Mechanism of action of steroid hormones. Prostaglandins. Calcium-magnesium-protein Kinase. Hormones and eukaryotic metabolic regulation

Unit 3:

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

Unit 4:

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

Course Outcomes :

1. Understand the structure, function and regulation of endocrine & neuroendocrine glands,
2. Develop a deep knowledge of the role of endocrine secretion in regulation of reproductive Cycle
3. Understand the pathways associated with Biosynthesis and secretion of Endocrine hormones and their role in the control of metabolism
4. Acquring the knowledge of signal transduction mechanisms
5. Through understanding of several endocrines including Peptide hormones, Steroid hormones, Pituitary hormones, Sex hormones, Thyroid hormones etc in the control of metabolic pathways
6. 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.

CO-PO mapping

Cour	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	-	1	2	-	-	-	-	-	2
CO2	3	1	1	-	-	2	1	3	2	2	1	1

CO3	3	2	-	2	2	2	-	-	1	-	2	2
CO4	3	1	2	2	1	2	-	1	-	2	1	2

Open Elective: ZOO 406 A : GENETIC ENGINEERING

Course Objectives :

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

UNIT - 1:

Enzymes used for the synthesis of DNA: DNA Polymerase I, Klenow fragment, Sequenase, Taq Polymerase, Reverse transcriptase, Terminal Transferase

Enzymes used for the synthesis of RNA: T3 and T7 RNA polymerases, SP6 RNA polymerase 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.

Enzymes used for ligation and modification of DNA: DNA ligase, Methylases, Kinase, Phosphatase

UNIT - 2:

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
Expression vectors – structure - promoters used in expression vectors - **lac, tac, λpL, T7** promoters and their significance in constructing expression vectors.
Promoter-probe vectors – Structure promoter probe vector - Reporter genes (lacZ, gfp, gus, luciferase) and strategies used to assay promoter activity. Vectors used for cloning in to mammalian cells - SV40 Vectors

UNIT – 3:

Isolation of gene/DNA fragments. Mechanical shearing, restriction digestion, cDNA synthesis, PCR amplification and chemical synthesis of gene.

cDNA synthesis - Mechanism of cDNA synthesis, Strategies used to obtain full length cDNA. 5' and 3' RACE.

PCR - Concept and technology- Properties of primers - Inverse, multiplex PCR, RAPD and its significance. Real time PCR.

Chemical synthesis - Designing gene from amino acid sequence, solid phase synthesis of oligonulceotides - In vitro synthesis of gene.

UNIT - 4:

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. Introduction of cloned genes into host - Transformation, conjugation, transduction, electroporation, particle bombardment, microinjection, liposome mediated DNA delivery.
Identification and characterization of cloned genes - Screening of genomic/cDNA libraries - genetic, molecular hybridization - immunochemical techniques
Expression of cloned genes – detection of expressed proteins – biological and molecular methods

Course Outcomes :

1.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.

2. This course exposes students to the applications of genetic engineering in biological research.

3. Students will be able to perform basic genetic engineering experiments at the end of course.

4. Students will acquire knowledge of advances in biotechnology- healthcare, agriculture and environment cleanup via recombinant DNA technology.

SUGGESTED READING MATERIAL:

1. Biotech's Dictionary of Genetic Engineering by Dinesh Arora.
2. D. Green; Philip Hilter Richard M. Myers Sue. Klapholz; Harold Riethman Jane Roskams.
3. DNA cloning: Mammalian systems - A Practical Approach by D.M. Glover, B. D. Hames.

4. From Genes to clones Introduction to Gene technology by Ernst-L- Winnacker.
5. Genetic disorders of Man by M.R. Goodman.
6. Genetic Engineering and its Applications by P. Joshi
7. Genetics - Monrve W. Strickberger. 3rd Ed., May, 2000.
8. Genetics-K.B.Allluwallia-1985.
9. Genome Alalysis - A laboratory Manual Volume-2 Detecting Genes by Bruce. Birren; Eric D.
10. Genome analysis - A laboratory manual volume-3 cloning systems by Bruce. Birren; Eric D. Green; Sue. Klapholz; Richard M. Myers & Harold Riethman Jane Roskams.
11. Genome Analysis - A laoboratory manual Voulume-4 Mapping Genomes by Bruce. Birren; Eric.
12. Green; Sue. Klapholz; Richard M. Myers Jane Roskam.
13. 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.
14. Molecular cloning by Sambrook.

CO-PO mapping

Cour	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	-	1	2	-	-	-	-	-	2
CO2	3	1	1	-	-	2	1	3	2	2	1	1
CO3	3	2	-	2	2	2	-	-	1	-	2	2
CO4	3	1	2	2	1	2	-	1	-	2	1	2

Open elective ZOO 406 B : ENVIRONMENTAL IMPACT ASSESSMENT AND GREEN AUDITING

Course Objectives:

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

1. Introduce students to the concept of Environmental Management
2. Develop skills in identifying and solving environmental problems
3. 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:

1. Explain the concepts about Environmental Impact Assessment, develop skills in identifying and solving problems
2. Locate, analyse and evaluate informations from various environmental matrices Systematically
3. Be able to access and analyse different case studies/examples of EIA in practice for evaluation/assessment

4. Explain the importance of environmental audits and other management tools in business for social benefit by improving environmental performance
5. Calculate the carbon footprint of any organization and identify suitable mitigation strategies for carbon reduction solutions.

SUGGESTED READING MATERIAL:

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

CO-PO mapping

Cour	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	-	1	2	-	-	-	-	-	2
CO2	3	1	1	-	-	2	1	3	2	2	1	1
CO3	3	2	-	2	2	2	-	-	1	-	2	2
CO4	3	1	2	2	1	2	-	1	-	2	1	2

OPEN ELECTIVE: ZOO-406 C: MEDICAL BIOTECHNOLOGY, IPR, BIO-SAFETY METHODS

Course objectives:

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

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

UNIT-1.

Disease diagnosis-probe: PCR,LCR immunologicalassay. Detection of genetic, Neurogenetic disorders involving Metabolic and Movement disorders. Treatmentproducts 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 behavioral 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:

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

SUGGESTED READING MATERIAL:

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

CO-PO mapping

Cour	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	-	1	2	-	-	-	-	-	2
CO2	3	1	1	-	-	2	1	3	2	2	1	1
CO3	3	2	-	2	2	2	-	-	1	-	2	2
CO4	3	1	2	2	1	2	-	1	-	2	1	2

CO-PO mapping

Cour	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	-	1	2	-	-	-	-	-	2
CO2	3	1	1	-	-	2	1	3	2	2	1	1
CO3	3	2	-	2	2	2	-	-	1	-	2	2
CO4	3	1	2	2	1	2	-	1	-	2	1	2

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Model Question Paper:

M.Sc DEGREE EXAMINATION

Branch-ZOOLOGY

FIRST SEMESTER

ZOO-101: Title of Paper

Time : 3Hours **Max.Marks: 80**

SECTION- A

Answer any FOUR questions. Each question carry 5 marks (4 x 5=20).

Two questions must be given from each unit.

1.
2.
3.
4.
5.
6.
7.
8.

SECTION- B

Answer ALL questions. Each question carries 15marks (4 x 15=60).

Two questions must be given from each unit.

9. A)

(or)

9. (B)

10. A)

(or)

10. (B)

11. A)

(or)

11. (B)

12. A)

(or)

12. (B)