COURSE STRUCTRURE FOR THE P.G. DEGREE PROGRAMME IN UNIVERSITY DEPARTMENT

(With effect from the academic year 2016-2017 onwards)

MANONMANIAM SUNDARANAR UNIVERSITY, TIRUNELVELI

M. SC. ZOOLOGY

Course Structure under Choice Based Credit System

Semester	Sub.No.	Subject Status	Subject Title	Contact Hrs./Week	Credit
I	LZOC11	Core-I	Animal Biodiversity	4	4
	LZOC12	Core-II	Functional morphology and Systematics of Invertebrates and Chordates	4	4
	LZOC13	Core-III	Biochemistry	4	4
	LZOC14	Core-IV	Cell and Molecular Biology	4	4
	LZOL11	Core Practical	Core Practical-I	2	2
	LZOEA LZOEB	Elective-I	**Optional Paper:** Aquaculture (**or**) Poultry Farming	3	3
			Sub Total	**21**	**21**
II	LZOC21	Core I	Evolution and Taxonomy	4	4
	LZOC22	Core II	Microbiology	4	4
	LZOC23	Core III	Animal Physiology	4	4
	LZOC24	Core IV	Bioinstrumentation	4	4
	LZOL21	Core Practical II	Practical II	2	2
	LZOEC LZOED	Elective-II	**Optional paper** : Animal Feed Technology (**or**) Animal Breeding	3	3
	LZOSA	Supportive Course	Sericulture	3	3
			Sub Total	**24**	**24**

III	LZOC31	Core I	Biostatistics and Computer Application	4	4
	LZOC32	Core II	Developmental Biology	4	4
	LZOC33	Core III	Immunology	4	4
	LZOC34	Core IV	Genetics	4	4
	LZOL31	Core Practical III	Core Practical III	2	2
	LZOEE LZOEF	Elective III	**Optional paper** : Population Ecology and Animal Behaviour (**or**) Environmental Health	3	3
	LZOSB	Supportive Course	Probiotics	3	3
			Sub Total	**24**	**24**
IV	LZOC41	Core-I	Environmental Biology	4	4
	LZOC42	Core-II	Animal Biotechnology	4	4
	LZOL41	Core Practical	Core Practical-IV	2	2
	LZOEG LZOEH	Elective-IV	**Optional paper :** Fishery Biology (**or**) Economic Zoology	3	3
	25		Project	10	10
			Sub Total	**23**	**23**
			Total	**92**	**92**

Credits Project:10

Total Number of Credits: 92

Total Number of Core Courses: 14

Total Number of Elective Courses: 4 out of 8

Total Hours: 92

Introduction

More than 99 percent of all species, amounting to over five billion species, that ever lived on Earth are estimated to be extinct. Estimates on the number of Earth's current species range from 10 million to 14 million of which about 1.2 million have been documented and over 86 percent have not yet been described. According to recent report (2016), scientists reported that 1 trillion species are estimated to be on Earth currently with only one-thousandth of one percent described. In this report the animals occupied in this plant is as 63% . It is now evident that animals are abundantly distributed in diversified environments. On diversity aspect also animals are numerous, and so many aspects of animal life have been uncovered; also zoology has diversified into a countless of allied sciences. Zoology is the branch of biology that includes the study of animals and animal life, including, but not limited to, the study of the structure, physiology and classification of animals. Zoological Knowledge and theories applicable to maintain health and diversity of animal and also to control the epidemic diseases. Various types of living organisms are closely associated in a particular environment and interaction of prey-predator relationship, food chain in the biodiversity. Various products of animals such as coral, pearl, honey, wax, silk, lac, shell of turtle, bones, feather, tusk, leather and fur are of high demand. These products can be increased from our knowledge. The improvement of farm/domestic animals is one of the major tasks of zoologists. Application of zoological science in fisheries, cattle, poultry farming and pests management in agriculture and stored food grains are well known. It is the study of economic zoology for the higher production of food crops and fisheries to meet the challenge of protein rich food materials at the reasonable cost

Future Scope for Zoologist

The Service of the trained zoologist is the need of the hour because of the development of advanced technologies in uncounteless areas. Due to global warming and

climate change and also due to pollution, environment is getting deteriorate day by day. Both national and State pollution control board required the service of Zoologist for the proper assessment of environmental damage (EIA study) and also to propose strategies for environment management. For this EIA study the service of Zoologist is very much needed for proper diversity assessment and systematic documentation. Zoologists are also hired for zoos, wildlife services, botanical gardens, conservation organizations, national parks, nature reserves, universities, laboratories, aquariums, animal clinics, fisheries and aquaculture, museums, research, pharmaceutical Companies, veterinary hospitals and Food Corporation of India (FCI) etc. Not only this, few other people who are zoologists by nature; Animal Behaviourists, Animal breeders, Animal Trainers, Animal Caretakers, Animal and Wildlife Educators, Conservationists, Documentary Maker, Forensic Experts, Lab Technicians, Researcher, Wildlife Biologists, Veterinarian, Zoo keeper, Zoo Curator, and many more. Over and above the students of Zoology can learn about animals and Zoological principles which may help them for proper maintenance of life. Zoologist acquires the power to evaluate the nature, which is not possible by the other means. The scope of applied Zoology is innumerable. It provides the knowledge of medicine, dentistry, Veterinary Medicine, Medical Technology, Nursing, Museum Work, Zoological Teaching, Zoological Research, Environmental Science and Conservation. Genetics is the branch of Zoology. Further, channels like National Geographic, Animal Planet, Discovery Channel is in constant need of Zoologists for research and documentaries.

Eligibility for Admission:

Those who have passed and secured ≥ 50 percentage marks in the following courses *viz*., B.Sc. Zoology, B. Sc. Advanced Zoology, B.Sc. Applied Zoology, B.Sc. Animal Science and Biotechnology, B.Sc. Advanced Zoology and Biotechnology, B.Sc. Life Science, B.Sc. Biology (Hon.), B.Sc. Biotechnology and B.Sc. Biochemistry from recognized university are eligible to apply.

Course structure and Syllabus:

The two years MSc Zoology programme is divided into four semesters. In the first three semester four core papers, two core practical and one elective papers are offering. This is the case for second and third semester. In fourth semester two core papers, one core practical and one optional paper are given. Additionally two other departmental papers are also accommodated as Extra departmental course (EDC) respectively on second and third semesters. Overall the syllabus of M.Sc. Zoology programme is prepared by giving due consideration to incorporate UGC-NET syllabus in the respective subject papers. Also eight optional papers are added so as to impart skill based education towards Animal husbandry techniques and also aquaculture techniques.

Duration of the course:

Two years (Four semesters)

Date of Effect:

For the students admitted during the academic year **2016-17** batch and onwards.

Examinations

Practical Examination:

M.Sc. Zoology Core Practical Examination having the following marks:

Internal - 25

Major Practical	=	15 marks
Minor Practical	=	5 marks
Spotters (ABC&D) 2x2 1/2	=	5 marks

Total	**=**	**25 marks**

External – 75

Major Practical	=	20 marks
Minor Practical	=	15 marks
Minor Practical	=	15 marks
Spotters (ABC&D) 4x5	=	20 marks
Record	=	5 marks

Total	**=**	**75 marks**

Theory Examination:

The M.Sc. Zoology core and Elective theory Examination having the following marks.

Internal Marks – 25

Test	=	15 marks
Assignment	=	5 marks
Seminar	=	5 marks

Total	**=**	**25 marks**

External Marks – 75

Section A: 10x 1 (Q.No. 1 to 10)	=	10 marks
Section B: 5 x 5 (Q.No. 11 to 15)	=	25 marks
Section C: 5 x 8 (Q.No. 16 to 20)	=	40 marks

Total	**=**	**75 marks**

LZOC11: ANIMAL BIODIVERSITY

L	P	T	C
4	0	0	4

Objective : To provide knowledge on animal diversity, its significance in natural environmental and conservation strategies.

Learning Outcome:

- Understand the ecosystem, diversity of organisms and their ecological relationship.
- Know the genetic relationship of an animals, animal distribution and biological hotspot areas.
- Realize the importance of animal classification and taxonomy; species concept and their evolutionary significance.
- Inculcate conservation strategies of ecosystem and various enactments relating to conservation policy at national and international status.
- Learn the measurement of biodiversity richness, species evenness and geometric analysis.

Unit I : **BIOLOGICAL DIVERSITY**: Species – Origin of new species, Community and ecosystem diversity, Genetic diversity, Systematics in Diversity – Environment and Genetic Variations – Biological Classification – Phylogenetic Relationship – Ecological Biodiversity –Species Concept – Biological and Phylogenic Concepts; Species Inventory – Biodiversity hot spots. -15 h

Unit II : **SPECIES DIVERSITY**: Global distribution of species – Tropical species diversity- Diversity in terrestrial, marine and fresh water – Species extinction and Endangered Species; Monitoring indicator species and habitats; Threats to biodiversity; Extinction – Past rate of extinction – Human caused extinctions – Endemic species –Man and animal conflicts. -15 h.

Unit III : **CONSERVATION OF BIODIVERSITY**: Biodiversity conservation methods; *In-situ* conservation: Sanctuaries, Biospheres reserves, National parks, nature reserves - Ex-*situ* conservation and In-*situ* Conservation of threatened species - Germplasm maintenance - Biodiversity Management: International/National policies and conservation strategies: Role of MAB, International Union for

Conservation of Nature (IUCN), Intellectual property rights – TRIPS, role of Indigenous Knowledge System (IKS). -18 h

Unit IV : **BIODIVERSITY REGULATING AGENCIES**: National Biodiversity authority, function and powers of the national biodiversity authority. State biodiversity authority – Duties of central and State Government biodiversity management committees-Hurdles in enforcement of existing laws. -12 h

Unit V : **BIODIVERSITY INDICES:** Basic Measurement methods, Computation of species richness, Biodiversity indices – Univariate method –Shannon Weiner Index, Simpson Index, Similarity and Dissimilarity index - Graphical/distributional techniques. Multivariate Method – Cluster analysis. - 12 h

REFERENCE BOOKS:

1. Barnes, R.D. 1982. Invertebrate Zoology (6th edn). Toppan International Co., New York.

2. Barrington, E. J. W. 1969. Invertebrate Structure and Functions. English Language Book Society.

3. Benton, M.J.2005. Vertebrate Paleontology (3rd edn). Blackwell Publishing Com. Oxford, UK.

4. Hickman Jr., Cleveland, Larry Roberts, Susan Keen, Allan Larson, and David Eisenhour. 2011. Animal Diversity. McGraw-Hill Companies, Inc. New York.

5. Niles, E. 2000. Life on earth: an Encyclopedia of Biodiversity, Ecology and Evolution (Vol.1&II). ABCCLIO, Inc.CA, USA

7. Kotwal, P.C. and S. Banerjee. 2002. Biodiversity Conservation – In Managed forest and Protected areas, Agrobios, India.

8. Chaudhuri, A.B. and D.D. Sarkar, 2003. Mega diversity Conservation, flora, Fauna and Medicinal Plants of India's hot spots, Daya Publishing House, Delhi.

9. Singh, M.P., B.S. Singh and Soma S. Dey, 2004. Conservation of Biodiversity and Natural Resources., Daya Publishing House, Delhi.

10. Dadhich, L.K. and A.P. Sharma, 2002.Biodiversity –Strategies for Conservation, APH Publishing Corporation, New Delhi.

11. David Eisenhour, Allan Larson, Susan Keen, Larry Robers and Cleveland Hickman Jr. 2009. Animal Diversity, McGraw Hill International, Boston.

LZOC12 : FUNCTIONAL MORPHOLOGY AND SYSTEMATICS OF INVERTEBRATES AND CHORDATES

L	P	T	C
4	0	0	4

Objective:

To impart knowledge on functional morphology of invertebrates and chordates.

Learning outcome:

- Understand the classification of animal kingdom.
- Learn the ecology, ethology and reproductive system of invertebrates and chordates.
- Know about the coral reefs and sponges and their biological significance.
- Understand the medical importance of various classes of invertebrates and chordates.
- Know the morphological features and reproductive biology of Pseudocoelomates, Eucoelomates and molluscs.
- Learn about the adaptive feature of invertebrates and chordates.
- Understand the origin and evolution of invertebrates and chordates
- Understand the structural peculiarities of Arachnida, Arthropoda and Archiannelida
- Appreciate the economic importance of each phylum of invertebrates and chordates.

Unit I : **BROAD CLASSIFICATION OF ANIMAL KINGDOM:** Principles involved. Protozoans and Parazoans . Nutrition, reproduction and respiration in protozoa. Origin and evolution of metazoa – Theories. Symmetry and its significance in animal organization. Porifera – Canal system – Symbionts. -16h

Unit II : **RADIATES AND ACOELOMATES**: **CNIDARIA** (Colenterates) – Different classes – Reproduction, digestion and nervous system. Corals and coral reefs- structure of polybs -types and formation. CTENOPHORA:Structural peculiarities and affinities. Platyhelminthes – Classes – Functional morphology and adaptive biology for parasitic mode of life**. -16h**

Unit III : **PSEUDOCOELOMATES AND EUCOELOMATES:** Aschelminthes – Reproductive biology. Annelida – Archiannelida, morphological features. Arthropoda –xiphosuran – Structure and affinities. **MOLLUSCA**: General Morphology and Adaptive radiation. Echinodermata -phylogeny and evolution – Coelom and coelomocytes, water vascular system. -12 h

Unit IV : **PISCES AND AMPHIBIA**: Classification of chordates – Origin and evolution of elasmobranchs – Adaptive radiation of elasmobranches and bony fishes – Migration in fishes- Dipnoi. Origin and evolution of Amphibia – Adaptive radiation in Amphibia – Terrestrialization. -12h

Unit V : **REPTILES, AVES AND MAMMALS**: REPTILES: Evolution of the reptiles. **AVES:**–origin and evolution of bird –Migration of birds- Connecting links between reptiles, birds and Mammals. MAMMALS: Structural peculiarities of prototheria, metatheria and eutheria. origin and evolution of paired fins and limbs. Comparative anatomy – integumentary system, Urinogenital system, heart and aortic arches and brain of vertebrates. -16h

TEXT BOOKS:

1. Barnes, R.D.1982. Invertebrate zoology, IV Ed., Holt Saunders International Edition.
2. Waterman, A.J. 1971. Chordate structure and function, the Macmillan company.

REFERENCE BOOKS:

1. Hyman, G.H.1997. The Invertebrates, Vol. I to VII, McGraw Hill Book Co. Inc., New York.
2. Vasant, K.A. and Kashyap, 1997. Life of invertebrates, Vikas Publishing House Pvt. Ltd., New Delhi.
3. Colbert, H and Edwin, 1989. Evaluation of vertebrates, Wiley Eastern Limited, New Delhi.
4. Harrey Pough, John. B Heisher and W.N.Mc Farland.1990. Vertebrate life, Macmillan publishing co., New York.
5. Jollie, M. 1962. Chordate morphology, Reinholt publishing corporation, New York.
6. Romer, A.S. 1979. Hyman's Comparative Vertebrate Anatomy, III Ed., The University of Chicago Press, London.
7. Young, J.Z. 1950. Life of Vertebrates, Clarendon Press, Oxford.
8. Barrington, E.J.W.1979.Invertebrate structure and functions, II Ed., ELBS and Nelson.
9. Moore, R.C., Lolicker and Fischer, A.G.1952. Invertebrate palaentology, McGraw Hill Book Co., Inc. New York.

LZOC13 : BIOCHEMISTRY

L	P	T	C
4	0	0	4

Objective : To impart knowledge on structure, synthesis, functions and metabolism of biomolecules, enzymes and hormones.

Learning outcomes:

- Know the structure of atoms, bonding nature of molecules, pH and their molecular interactions.
- Understand the energy production, metabolism and catabolism of biological molecules, ATP synthesis and energy utilization of organisms.
- Learn the biosynthesis pathway, structure and function of proteins.
- Know the metabolism and catabolism of protein.
- Realize the classification, structure and function of carbohydrate and lipids.
- Learn the Glyconeogenesis, Glycolysis and oxidation of lipids and bioenergetics.
- Imbibe the knowledge on enzymes classification, biocatalytes and kinetics of enzymes.
- Enable to know the structure, function and classification of hormones,
- Know the biological mechanism of hormones.

Unit I : **INTRODUCTION TO BIOCHEMISTRY**: Atoms, molecules, bonding – Chemistry of water- Biological importance, pH and Acid base balance. Henderson-Hasselbech equation. Biological importance of buffers – Acidosis, alkalosis – electrolytes - Bioenergetics and strategy of metabolism: strategy of energy production in cell. Oxidation and reduction reactions- coupled reactions and group transfer - ATP production, Theories of ATP synthesis – Transport of free energy.

Unit II : **AMINOACIDS AND PROTEINS**: Amino acids – Structure, Classification and function. Isoelectric point, Zwitter ion – Protein structure, Classification. Protein biosynthesis and catabolism of proteins - Biological functions of proteins.

Unit III : **CARBOHYDRATE AND LIPIDS** : Carbohydrates – structure, classification and biological functions – Metabolism – Glycogenesis, Glycogenolysis, Glyconeogenesis, Glycolysis, HMP shunt – Lipid structure,

classification and biological functions – Biosynthesis and oxidation of fatty acids – Bioenergetics.

Unit IV : **ENZYMES:** Enzymes as biocatalysts, Enzyme classification – Enzyme specificity, Active site, Co-enzymes – Activators and Inhibitors – Allosteric enzymes – Regulation of enzymatic activity - Enzyme Classification, Kinetics; Michaelis Menten equation – Factors affecting enzyme function.

Unit V : **HORMONES**: Classification and general functions of hormones – Steroid hormones, protein hormones, tissue hormones – Vasoactive peptide, Synthetic hormones – Mechanism of hormone action.

REFERENCE BOOKS:

1. Lehninger, 2006. Principles of Biochemistry, 4th edition, D.L. Nelson and M.M. Cox, Macmillan worth Publishers.
2. D.Voet and J.G. Voet, 2004. Biochemistry, John Wiley & Sons, USA
3. D. Friefelder, 1982. Physical Biochemistry, (2nd edition), W.H. Freeman & Company.
4. Jain, J. L. Jain, S. and Jain N. 2005. Fundamental of Biochemistry, S. Chandra Co. Ltd. New Delhi.
5. Ambika Shanmugam. 2005. Fundamentals of Biochemistry for Medical students (7th Ed.) Lippincott Williams and Williams.
6. S.C. Rastogi, Biochemistry, 2nd edition. 2003. Tata McGraw Hill Publishing Company Ltd., N. Delhi.
7. L. P. Adams, John T. Knowler and David P. Leader, 1992. The Biochemistry of Nucleic acid – Tenth Edition-Roger Chapman and Hall Publications.
8. R.K. Murray, D.K. Granner and V.M Rodwell., 2006. Biochemistry, Illustrated Harpers 28th edition, The McGraw-Hill companies, Inc.
9. Thomas M. Devlin. 2006. Textbook of Biochemistry with Clinical Correlations, 6th edition, John Wiley & Sons Inc., Publications.
10. Jeremy M. Berg, John L. Tymoczke and Lubert Stryer. 2007. Biochemistry, 5th edition, W.H. Freeman and Company, USA.

LZOC14: CELL AND MOLECULAR BIOLOGY

L	P	T	C
4	0	0	4

- PRAC

Unit I : **STRUCTURE AND FUNCTION OF CELL**: Structure of eukaryotic cell – Organelles –Ultrastructure and biological functions of plasma membrane – Endoplasmic Reticulum – Lysosomes – Golgi complex – Mitochondria - Ribosome. - 12 h

Unit II : **CHROMOSOMES AND CELL CYCLES**: Structure and function of chromatin – Euchromatic and heterochromatin – unusual chromosomes (Polytene and Lampbrush) – Cell cycle stages G0 – G1– Check points -Cell cycle and cancer. Spindle organization – Regulation and synchronization of cell division. - 14 h

Unit III : **NUCLEIC ACIDS AND THEIR FUNCTIONS**: Chemistry of DNA and RNA - Structure, Types and functions – Replication of DNA – DNA repair mechanism – Gene action and protein synthesis. – 15 h

Unit IV : **RECOMBINANT DNA TECHNOLOGY**: Reverse transcription and cDNA synthesis – steps involved in rDNA technology – Construction of Chimeric DNA and cDNA Libraries. - 15 h

Unit V : **REGULATION OF GENE EXPRESSION**: Regulatory mechanism in eukaryotes - Mechanism of positive and negative control of gene expression – Regulation at Transcriptional and Translational levels - Control of regulatory mechanism of gene expression – Gene rearrangement and Reversible Protein Phosphorylation. - 16 h

REFERENCE BOOKS:

1. Gupta, P.K. 2004. Cell and molecular Biology. Rastogi Publications, Meerut.
2. Watson, J.D., Basker, T. A.,Bell, S.P., Gann, A., Levine, M. and Losick, R. 2004. Molecular Biology of the Gene. Pearson Education (Singapore) Pvt., Ltd.
3. Wilson, G.B. and Morrison, J.H. 1967. Cytology, II edition, Reinhold Publishing Corporation, New York.
4. Giese, A.C. 1979. Cell Physiology, W.B. Saunders Company, Philadelphia.

5. Harvey Lodish, 2000. Molecular Cell Biology 4th Edition, W.H Freeman and Company, New York

TEXT BOOKS:

1. De Robertis, EDP and De Robertis EMF.1987. Cell and Molecular Biology. Lea and Febiger, VIII Edition, Philadelphia.
2. Powar, CB.1983. Cell Biology, Himalaya Publishing House, Bombay.
3. Weaver R.F.2008. Molecular biology, McGraw Hill higher education, USA.
4. Alberts B., A. Johnson, J. Lewis, M. Raff, K. Roberts, and P.Walter. 2007. Molecular biology of the cell, Garland publishing Inc, New York.
5. Hunter L. E. 2009. The Process of life - An Introduction to Molecular Biology, The MIT press, USA.

LZOL11-Core Practical I

L	P	T	C
0	2	0	2

Objectives:

- To understand the biodiversity of phytoplankton and zooplankton, primary Productivity and diversity indices.
- To know the identification of larval forms and medical importance of major phyla of invertebrates.
- To know the structure of digestive, nervous and reproductive systems of fish, insects and prawn.
- To identify the amino acid compounds.
- To know the principles of Microtomy and photography.
- To observe the polytene chromosome of chironomous larva.
- To observe the mitosis in Onion root tip

Learning Outcome:

- Analysis the biodiversity of phytoplankton and zooplankton.
- Learn the biodiversity indices
- Enable to understand the TLC, UV-Spectroscopy, Electrophoresis and Centrifuge.
- Learn the physiological process of digestive, nervous and reproductive systems of fish, insects and prawn.
- Learn the structure of polytene chromosome.
- Learn the mitosis process in onion.

Animal Biodiversity

1. Plankton diversity: Phytoplankton – Zooplankton – Primary productivity.

2. Fish community study: Species Identification – Diversity -Density – Abundance distribution.

4. Study of museum specimens / lab specimens – Invertebrates and vertebrates (List the studied items with brief description – Diagrams necessary)

Functional Morphology of Invertebrates and Chordates

Invertebrates

1. Identification and study of selected Protozoan and Helminthes of medical importance.

2. Identification and study of : Trochopore larva, Nauplius larva, Zoea larva and Bipinnaria larva.

3. Identification and study of larval forms from all major phyla of invertebrates.

4. Dissection of nervous system of Prawn, any insect (cockroach), Pila.

5. Dissection of reproductive system of any insect.

6. Mounting of :

a. Sting of Honey bee

b. Pedicellaria of Sea urchin

c. Aristotle lantern of Sea urchin

Chordates

1. Dissection of aortic arches in Teleost.

2. Study of the following skull types with reference to jaw suspensions

a. Fish

b. Frog

c. Snake

3. Study of the following specimens with reference to their adaptive features for their respective modes of life.

a. Echeneis

b. Pigeon

c. Bat.

d. Types of feathers

e. Types of fins in fish

f. Adaptive radiation in the beak and hind limbs of birds

Biochemistry

1. Preparation of buffers: Phosphate buffer and Citrate buffer.

2. Qualitative detection of proteins, carbohydrates and lipid in tissue samples.

3. Quantitative estimation of glucose, urea and creatinine in the serum of goat.

4. Determination of aminoacids in body fluids of Cockroach or Goat using paper chromatography.

5. Separation of compound by TLC.

6. Principles and application of spectrophotometry or calorimetry, electrophoresis and Centrifuge.

Cell and Molecular Biology

1. Principles of microscopy and optics.

2. Cell size determination.

3. Microtomy and photography.

4. Mounting of polytene chromosomes.

5. Preparation of mitosis in Onion root tip.

6. Electrophoretic separation of proteins.

7. Human Buccal smear.

LZOEA- AQUACULTURE

L	P	T	C
3	0	0	3

Objective: To provide knowledge on important, status and significance of aquaculture practice and its management.

Learning outcome:

- Learn the scope and importance of aquaculture at national and international level.
- Know the methods for construct the pond and different fish culture systems.
- Learn the Integrated farming and eco-friendly management of aquaculture.
- Acquired knowledge on the classification of cultivable fishes.
- Know the economic importance of fishes.
- Learn the artificial insemination process of fishes.
- Understand the hybridization technique and sex reversal process of fishes.
- Learn the method for the preparation of artificial fish feed and their storage technique.
- Know the preparation and maintenance of live feed culture.
- Understand the diseases diagnosis and management of fishes.
- Imbibe the post harvest process and marketing of fishes.

Unit I : **INTRODUCTION**: Importance and need for aquaculture – Indian and Global Scenario of aquaculture –Types of aquaculture-culture systems; Pond culture, Cage culture, raft Culture and Pen culture Eco-friendly aquaculture;Integrated farming. - 6 h

Unit II : **CULTIVABLE SPECIES AND CULTURE SYSTEM**: Taxonomy and Characteristics of cultivable fish species – Criteria for the selection of cultivable species – Nutritional requirement of cultivable fishes. Selection of suitable site for aquaculture – Design and construction of culture ponds – Preparation and management of culture ponds-Hatchery and Nursery ponds. - 8 h

Unit III : **BROOD STOCK AND INDUCED BREEDING**: Brooders-Brood stock management- Induced breeding in fin fish and shell fish-Selective Breeding-Hybridization (Androgenesis and Gynogenesis)-Sex reversal-Cryopreservation. - 7 h

Unit IV : **LIVE AND ARTIFICIAL FEED**: Live feed culture (Microalgal culture, culture of Artemia, Rotifer and copepods – significance of live feed culture– Bioencapsulation-Artificial feed-Types of Artificial feed, Medicated feed -

FCR–Feeding strategies and feed dispersion and Management.

- 8 h

Unit V : **FISH DISEASES** : Bacterial, viral, fungal and parasitic diseases in fin and shell fishes – Diagnostics –Prophylactic measures- molecular diagnosis- Treatment measures – Predators – Harvesting methods – Post harvest technologies. - 7 h

REFERENCE BOOKS:

1. Balugut, E.A. 1989. Aquaculture system and practices. A selected review publishing House, New Delhi.
2. Michael, B.N. and Singholka, B. 1985. Freshwater Prawn Farming. A manual of culture of *Macrobrachium rosenbergii*. Daya Publishing House, New Delhi.
3. Pillai, TVR. and M. N. Kutty., 2005. Aquaculture: Principles and Practices, Wiley-Blackwell.
4. Bose, A.N., Yang, C.T., and Misra, A. 1991. Coastal Aquaculture Engineering. Oxford and IBH Publishing Co., PVt. Ltd., New Delhi.
5. Sinha, V.R.P. 1993. A Compendium of Aquaculture Technologies for Developing Countries. Center for Science and Technology and Oxford and IBH Publishing Co., Pvt., Ltd., New Delhi.
6. Robert R. Stickney., 2009. Aquaculture: An Introductory Text, CAB International Publishers.

(or)

LZOEB-POULTRY FARMING

Objective: To provide knowledge on important, status and significance of poultry farming and management.

Learning Outcome:

- Learn the poultry farm management practices
- Know the disease diagnosis and prophylactic measures.
- Understand the poultry feed preparation and feed management.
- Enable to know the post harvest technology and value added poultry products.

Unit I :**INTRODUCTION**: Status of Indian Poultry farming – Classification of Poultry, Common breeds of Poultry – General Anatomy – Skin – Skeletal system – Digestive system – Reproductive system - Endocrine System – Habitat of Fowl – Food and Feeding of Fowls. - 6 h

Unit II **POULTRY HOUSING**: Types of Poultry houses - Brooder house – Broiler house – Californian cages - Environmentally controlled housing: advantages and disadvantages – Equipments – Feeders, waterers – Nests – Hatchery and Hatchery equipments. General management of Poultry – sexing of one day old chicks, lighting, debeaking, and breeding. - 8 h

Unit III : **POULTRY NUTRITION**: Classification, selection of common feed ingredients and their nutrient composition – Nutrient requirement for different age group – Feed formulation – Feed additives – Commercial mineral mixture - Non-nutritive feed additives including herbal, bio-enhancers, and anti-nutritional factors. Feed storage – Feed management.

- 7 h

Unit IV : **COMMON POULTRY DISEASES**: Bacterial, fungal, viral, parasitic diseases – Vaccination principles types, methods, pre and post vaccination – Vaccination schedule – Types of administration – general principles and precautions with emphasis on administering medication through water and feed - commonly used drugs in poultry diseases. Disinfectants types - mode of action - recommended procedure, precaution and handling. - 8 h

Unit V : **HARVESTING AND POST HARVESTING TECHNIQUES** – Role egg in human nutrition - Nutritional value of poultry meat – Value added products in poultry meat - Export/import of poultry and poultry products. - 7 h

REFERENCE BOOKS:

1. Gnaanamani, M.R. 2008. Modern Aspects of Commercial Poultry Keeping. Giri Publications, Madurai.
2. Prashad J. 2005. Poultry Production and Management. Kalyani Publishers, New Delhi.

3. G.S. Shukla and V.B. Upadhyay, 2000. Economic Zoology, Rastogi Publications, NewDelhi.
4. Scanes, C.G, Brant, G and Ensminger, M.E., 2004. Poultry Science, 4th Ed. Prentice Hall, USA.
5. Jull, M.A. 2003. Successful Poultry Management.
6. Leeson, S and Summers, J.D. 2005. Commercial Poultry Nutrition, International Pub. House.

Semester II

L	P	T	C
4	0	0	4

LZOC21: EVOLUTION AND TAXONOMY

Objective: To impart knowledge on evolution and taxonomy of animal with emphasize on theories and concepts of evolution, speciation and adaptation.

Learning outcome:

- Understand the evolutionary pattern of organisms and their historical significance.
- Know the modern methods of animal classification.
- Enable to prepare the check list for identification of organisms.
- Know the collection and preservation technique of specimens.
- Realize the pattern of isolation and formation of speciation.
- Understand the geological time scale for the origin of animals and their evolutionary significance.
- Acquire knowledge of the past, present and future evolution of humans.
- Know the adaptive radiation and geographic distribution of animals.

Unit I : **THEORIES AND CONCEPTS OF EVOLUTION**-Gene pool, Gene frequency- Hardy-Weinberg law of genetic equilibrium – Detailed account of destabilizing forces - Natural selection, Mutation, Genetic drift, migration and Meiotic drive - Evolution of gene families– Assessment of molecular variation -Modern trends in taxonomy – Chemotaxonomy, Cytotaxonomy, Molecular taxonomy. - 13 h

Unit II : **TAXONOMIC PROCEDURES**: Collection, preservation, curetting and process of identification – Taxonomic keys – different types of keys, their merits and demerits – Systematic publications – different kinds of publications – International code of Zoological Nomenclatures (ICZN) – its operative principles, interpretation and application of important rules – Zoological nomenclature, formation of scientific name of various taxa - Theories of biological classification - 16 h

Unit III : **GENETICS OF SPECIATION** – Isolation: Isolating mechanisms – prezygotic and post zygotic isolating mechanisms – Factors affecting isolation and mechanism and role in evolution – Phylogenetic and biological concepts of species – Models of speciation (Allopatric, sympatric,, parapatric, peripatric) –

Co-evolution and sexual selection, altruism, gradualism and punctuated equilibrium. - 16 h

Unit IV : **EVOLUTIONARY TRENDS** – Orthoselection, Patterns of evolution – Divergent evolution, Convergent evolution, Micro evolution, Macro evolution and Mega evolution. Geological Time scale, organic evolution at human level, culture and control of human evolution of man, future evolution.

- 15 h

Unit V : **ADAPTATION**: Adaptation and evolution – colouration of animals, non-adaptive characters -Animal distribution – evolutionary significance.

- 12 h

Reference Books

1. Barton, N.H., Briggs, D.E.G., Eisen, J.A., Goldstein, D.B and Patel, N.H, 2007. Evolution. CSHL Press.
2. Dobzhansky, T., Ayala, F.J., Stebbins, G.L and Valentine, J.W. 1977. Evolution. Surjeet Publications, New Delhi.
3. Stebbins, G.L., 1969. Process of Evolution. Tata McGraw-Hill.
4. Volpe, E.P. and Rossenbaum, P.A. 1999. Evolution. Mc-Graw Hill Science Engineering.
5. Hall, B.K. and Hallgrimson, B. 2008. Strickberger's Evolution. 4th edn. Jones and Bartlett.

Reference Books

1. Kapoor, V.C. 1991. Theory and Practice of Animal Taxonomy. Oxford and IBH Publishing Co., Pvt. Ltd. New Delhi.
2. Narendran, T.C. 2008. An introduction to Taxonomy. Zoological survey of India.
3. Niles, E. 2000. Life on earth: an Encyclopedia of Biodiversity, Ecology and Evolution (Vol.1&II). ABCCLIO, Inc. CA, USA.
4. Strickberger, M.W. 2005. Evolution. Jones and Bartett Publishers, London.
5. Hickman Jr., Cleveland, Larry Roberts, Susan Keen, Allan Larson, and David Eisenhour, 2011. Animal Diversity. McGraw-Hill Companies, Inc. NY.
6. Arthur, W. 2011. Evolution – A Developmental Approach, Wiley-Blackwell, Oxford,UK.
7. Brian K. Hall., 2010. Evolution: Principles and Processes, Jones & Bartlett Learning.

LZOC22 : MICROBIOLOGY

L	P	T	C
4	0	0	4

Objective: To provide knowledge on history and development of microbiology, distribution of microorganisms in environment and industrial application of microbes.

Learning Outcome:

- Identify standard protocol for the isolation, identification, culturing and characterization of microorganisms
- Enable to know the isolation, identification of microbes for commercial application.
- Carry out experiments to evaluate microbial quality of food products, water and soil.

Unit I :**HISTORY AND DEVELOPMENT OF MICROBIOLOGY:** Classification of bacteria, fungi, yeast and virus – Structure and function of bacteria and viruses. **- 12 h**

Unit I :**STERILIZATION**: Dry heat, moist heat, filtration, pasteurization, radiation – Media preparation – Methods of collection of sample – Methods of estimation of microorganisms in soil, water and air – Isolation and identification of bacteria – Biochemical tests – staining techniques and fermentation tests.

- 14 h

Unit III : **MICROBIAL PATHOGENESIS:** bacterial, viral, fungal and protozoan diseases – Mode of transmission – Control and preventive measures – Antimicrobial therapy – Source, Classification and mode of action. – 14 h

Unit IV :**MICROORGANISMS DISTRIBUTION:** Distribution of microorganisms-**s**oil, water and air – Factors influencing the distribution of microorganisms – Microbial interactions between plant and animals – Role of microorganisms in the productivity of ecosystem. - 16 h

Unit V :**INDUSTRIAL MICROBIOLOGY:** Industrially important microorganisms – Fermentation-Definition, types-upstream and downstream process. Bioconversion –Bioremediation–Production of industrial microbial products – Penicillin, ethanol, vinegar, vitamin B12 – Citric acid and glutamic acid production.

- 16 h

Text Book

1. Pelzar, M.J.J., Chan, ECS and Kerig, NR. 1993. Microbiology – Concepts and Applications.

2. Prescott, L.M., Harley, J.D and Klein, D.A. 1999. Microbiology, WEB Mc Graw – Hill.

3. Dubey, H.C., 2004. A text book of fungi, bacteria and viruses, Vikas Publishing House.

4. Atlas, R.M. 1995. Principles of Microbiology. Mosby - Year Book Inc.

5. Ananthanaryanan, T and Paniker, J.C.K. 2000. Text Book of Microbiology Oriental Longman Ltd., Madras

Reference Books

1. Rheinhemer, G. 1980. Aquatic Microbiology, John Wiley and Sons.

2. Davis, D., Dulbecco, R., Eisen, H.N and Ginsberg, H.S. 1980. Microbiology, Third Ed., Harper and Row Publishers, Hagertown.

3. George, W. Burns. 1980. The Science of Genetics: An introduction to Heredity, Fourth Edition, Mc Milan Publishing Co., Inc., New York.

4. Tewari, 2000. Advances in Microbial Technology, APH, New Delhi.

5. Rajni Gupta and Mukherji, 2001. Microbial Technology, APH, New Delhi.

LZOC23 : ANIMAL PHYSIOLOGY

L	P	T	C
4	0	0	4

Objective: To provide knowledge on vital physiological process, muscle and endocrine of animals.

Learning outcome:

- Understand the structure and function of muscles.
- Know the biological functions, structural arrangement of nervous system.
- Enable to know the structure and function of various systems of human body.
- Know the biological significance of hormones.
- Acquired knowledge on the respiration, circulatory process and BMR.
- Learn to maintain the cardiac rhythm and maintain, measure the blood pressure.
- Understand the excretory system and eliminate the metabolic byproducts.
- Enable to understand the biological clock mechanism of organisms.
- Know the mechanism of hormonal action.

Unit I : GENERAL STRUCTURE AND TYPES OF MUSCLES – Ultra structure of the skeletal muscle. Mechanism of muscle contraction. Actin-myosin interaction – Chemical changes during muscle contraction. Neurons: Nature of nerve impulse – resting potential and action potential – Neuroanatomy of brain, spinal cord – Central and peripheral nervous system. Structure of synapse, mechanism of synaptic transmission – electrical and chemical transmission. - 16 h

Unit II:NUTRITION IN ANIMALS: Different mechanism of food intake in different animals – Organization of alimentary canal – Role of salivary glands, liver, pancreas and intestinal glands in digestion. Digestion and absorption of proteins, carbohydrates and lipids. Role of gastrointestinal hormones in digestion. - 15 h

Unit III: RESPIRATION: Respiratory organs and their ventilation – Respiratory pigments and their functions – Exchange of gases – Transport of oxygen and carbon-di-oxide - Regulatory mechanisms -Basal metabolic rate and its measurement. Circulation: Types of hearts – control of heart beat – Pace maker and specialized conducting fibres - cardiac cycle – factors controlling circulation of blood – blood pressure.

- 17 h

Unit IV: EXCRETION: Excretion in different animal groups – vertebrate kidney – urine formation - Urine formation – Nitrogenous wastes – acid base regulatory mechanisms – Endocrine regulation of water and mineral balance. – 12 h

Unit V: ENDOCRINE GLANDS – Basic mechanism of hormone action; hormones and diseases – Reproductive process – neuroendocrine regulation. Animal behavior: Biological clock – Cardiac rhythm – Circannual and lunar periodicity. - 12 h

Reference Books:

1. Gordon, A., Wyse, Marget Anderson., 2008. Animal Physiology, 2nd edition, Richard W. Hill.

2. P.S.Verma, B.S. Tyagi and U.V.Agarwal, 2005. Animal Physiology. S.Chand and Company Ltd, New Delhi.

3. S. T. Rastogi, 1988. Essentials of Animal Physiology. Wiley, Eastern Limited, Madras.

4. Shier, D., Butler, J. and Lewis, R., Hole‟s, 2003. Human Anatomy and Physiology, (10th edition) WCB/McGraw Hill, Boston.

5. Wilson. A, 1979. Principles of Animal Physiology. Macmillan Publishing Co., Inc. New York

6. Neville G. Gregory., 2005. Physiology and Behavior of Animal Suffering (UFAW Animal Welfare), 1st edition, Wiley – Blackwell.

7. Hoar, W.S.1991. General and Comparative Physiology. Prentice Hall of India, New Delhi.

8. Herkat, P.C and Mathur, P.N.1976. Text Book of Animal Physiology, S. Chand Co. Pvt, Ltd., New Delhi.

LZOC24 : BIOINSTRUMENTATION

L	P	T	C
4	0	0	4

Objective: To provide knowledge on instruments used in Biological research and their significant applications.

Learning Outcome:

- Understand the working mechanism of major and advanced instruments and microscopes.
- Know the macro and micromoles separation techniques by using advanced instrumentations (TLC, HPLC, CCMS, LCMS and FPLC)
- Learn the electrophoresis technique, PCR amplification, SDS-PAGE, Blotting techniques.
- Know to isolate and analyze the DNA and RNA molecules.
- Understand the instrumentation and application of spectroscopy.
- Enable to know the radio isotope and their medical applications.

Unit I : **MICROSCOPIC TECHNIQUES**: Principles and application of light, phase contrast, fluorescence microscopy – Scanning and Transmission Electron Microscopy. Preparation of animal and microbial samples for microscopy – pH meter – Centrifuge – Types of centrifuge. - 12 h

Unit II :**CHROMATOGRAPHY:** Principles and applications of Chromatography- Thin layer (TLC) - Ion exchange and affinity chromatography –High performance liquid chromatography (HPLC), Gas chromatography (GC), Liquid chromatography – Mass spectrometry (LC-MS) and Fast protein liquid chromatography (FPLC). - 16 h

Unit III : **ELECTROPHORESIS** – General principles – Electrophoresis of proteins: SDS – PAGE, Native gels, Two dimensional gel Elecrophoresis – Isoelectro focusing – Detection and estimation of proteins – Western Blotting – Electrophoresis of nucleic acids: Agarose gel electrophoresis of DNA, DNA sequencing – PCR techniques. – 16 h

Unit IV : **PRINCIPLES AND APPLICATIONS OF SPECTROSCOPY** – UV and Visible spectroscopy – Raman spectroscopy – Flourescence spectroscopy,

Atomic absorption spectroscopy – Nuclear Magnetic Resonance Spectroscopy – Turbidometry – Nephlometry. - 12 h

Unit V : **RADIOISOTOPES** :Introduction– Radioactive decay – Types and measurement – Principles and applications of Geiger – Muller (GM) counter – Solid and Liquid Scintillation Counter – Autoradiography – Radioimmunoassay – Radiation Dosimetry. - 16 h

REFERENCE BOOKS

1. Kothari, C.R., Second Edition, 2004. Research methodology -methods and techniques. New Age International (P) Limited publishers, New Delhi.
2. Ernster, L. 1985. Bioenergetics. Elsevier, New York, USA.
3. Gupta, A. 2009. Instrumentation and Bio-Analytical Techniques. Pragati Prakashan, Meerut.
4. Alonso, A. and Arrondo, J.L.R., 2006. Advanced Techniques in Biophysics, Springer, UK
5. Varghese, T. and Balakrishna, K.M. 2012. Nanotechnology-An Introduction to Synthesis, Properties and Applications of Nanomaterials. Atlantic Publishers and Distributors. (P) Ltd. New Delhi.
6. Ghatak, K.L. 2011.Techniques and Methods in Biology. PHI Learning Pvt. Ltd. New Delhi.

Text Books

1. Ghatak, K.L. 2011.Techniques and Methods in Biology. PHI Learning Pvt. Ltd. New Delhi.
2. Keith Wilson and John M. Walker. 2010. Principles and Techniques of Biochemistry and Molecular Biology, Cambridge University Press.
3. David, T. Plummer, 2008. An introduction to practical biochemistry (2nd Ed.). New Delhi: Tata McGraw- Hill Publishers
4. Hawk and Oser Bernard, 1995. Hawk's Physiological Chemistry, Tata McGraw-Hill Publishing Company, Ltd. Bombay - New Delhi, 14th ed. 112-118.

LZOEC- ANIMAL FEED TECHNOLOGY

L	P	T	C
3	0	0	3

Objective: To impart knowledge on significance formulation, processing and evaluation of animal feed.

Learning outcome:

- Acquire knowledge on feed ingredient resources and nutritional status.
- Understand the techniques of processing of feed ingredients
- Imbibe the knowledge on digestibility of feed ingredients
- Learn the various types of feed additives.
- Understand the various methods of feed formulation and and feed process of feed manufacturing including basis of feed mill.
- Know the various types of artificial feed, feeding methods and strategies and feed storage
-

Unit I : **FEED INGREDIENTS**: Feed ingredients of plant and animal origin-Nutritional Values of feed ingredients-Protein, Carbohydrate, lipid, fatty acids, amino acids-Energy values-Feed ingredients resource. - 8 h

Unit II: **PROCESSING OF FEED INGREDIENTS**-Processing methods of feed ingredients- Digestibility of feed ingredients-factors affecting digestability of feed ingredients-conversion of feed ingredients (Bioconversion and chemical treatment). - 8 h

Unit III : **FEED ADDITIVES**: Feed Additives-Binders (Natural and artificial). Antioxidants- Immunostimulants-Preservatives- Antinutritional factors-Exoenzymes-Probiotics-Prebiotics and synbiotics. - 7 h

Unit IV: **FEED FORMULATION**: Need for feed formulation-Square method-Linear programming-feed manufacturing (Basis of feed mill).Feed stability -feed storage-feed spoilage (Bacterial and Fungal toxins)-factors affecting feed storage and nutrient loss. - 7 h

Unit V : **ARTIFICIAL FEED**: Types of artificial feed-Methods of feeding and feed dispersion-feeding strategies-feed efficiency(FCR and AFCR)-Factors influencing FCR- Feed economics. - 6 h

Reference Books:

1. Pillai, TVR. and M. N. Kutty., 2005. Aquaculture: Principles and Practices, Wiley-Blackwell.
2. Michael, B. New. 1985. Feed and feed technology.
3. CMFRI Bulletin-1: Feed Technology

LZOL21-CORE PRACTICAL – II

L	P	T	C
0	2	0	2

Objectives:

- To impart knowledge on the evolutionary significance of analogy and homology structure.
- To acquire knowledge on the isolation, identification and culturing of microbes.
- To estimate the RQ value and salt loss and salt gain of fish in different medium.
- To acquire knowledge the instrumentation of TLC, SDAS-PAGE, Electrophoresis, Spectrophotometer and Elisa.

Learning Outcome:

- Understand the structural peculiarities and adaptive characteristic of organisms.
- Acquire Knowledge on the identification and taxonomy of microbes.
- Learn the antibiotic and enzymatic assay of microbes.
- Understand the physiological functions of animals (Osmoregulation, excretion and respiration etc.)

EVOLUTION AND TAXONOMY

1. Observation of forelimbs and hindlimbs of vertebrates (Frog, bird and mammals).

2. Observation of fossils to study paleontological evidences of evolution.

3. Observation of leaf insects and stick insects in the museum to study adaptation by cryptic colouration and natural selection.

MICROBIOLOGY

1. Preparation of Non-Selective and Selective culture media.

2. Enumeration of microorganisms through spread plate and pour plate method.

3. Staining methods: Preparation of smears for staining – Simple staining, Negative staining, Gram staining.

4. Identification of bacteria – Staining method – Gram positive and Gram negative bacteria.

5. Measurement of bacteria through microscopy.

6. Bacterial growth curve – Counting.

7. Antibiotic susceptibility test.

ANIMAL PHYSIOLOGY

1. Estimation of RQ in fish with reference to temperature.

2. Rate of salt loss and salt gain in fish using different experimental media.

3. Qualitative study of digestive enzymes in cockroach.

4. Principles and application - Sphygmomanometer, Kymograph and Haemoglobino meter.

BIOINSTRUMENTATION

1. Spectrophotometer – Estimation of biomolecules.

2. Centrifugation – Demonstration and working.

3. Separation techniques – Paper and Thin layer chromatography.

4. SDS-PAGE electrophoresis – Demonstration and usage.

5. Theories and principles of Atomic absorption spectrophotometer, HPLC and ELISA reader.

EDOC - SUPPORTIVE COURSE

LZOSA-SERICULTURE

L	P	T	C
3	0	0	3

Objective: To provide knowledge on scope, importance of rearing and management practice of silkworm.

Learning Outcome:

- Enable to construct small and large scale silkworm industry.
- Enhance the self employability and generate income for uplifting the poor family.
- Acquire knowledge on the mass rearing of silkworm and cultivation practices of mulberry.
- Know the research activities and opportunities in sericulture industry in private as well as government sectors.
- Evolve the pests and diseases management practices of silkworm and mulberry plantation.
- Understand the silk reeling process and marketing of raw silk.

UNIT 1 : INTRODUCTION : Scope and Importance of sericulture-sericulture in India-Role of central Silk Board-Life Cycle of *Bombyx mori*- Classification based in number of larval moults and voltinism and cocoon colour shape-Morphology of *Bombyx mori* (egg-larval-pupa-adult)-Silk gland –Non mulberry Silkworm. - 10 h

UNIT II: MORICULTURE : Morphology of mulberry plant-High yielding varieties-optimum conditions for mulberry growth-planting –irrigation- manuring –pruning –harvesting and storing of mulberry leaves-Common diseases of mulberry (causative agent, symptoms and treatment). – 12 h

UNIT III: GRAINAGE TECHNOLOGY: Egg breeding stations-procedure in Grainage-silkworm rearing –rearing house- rearing appliances-rearing operations. - 8 h

UNIT IV: DISEASES OF SILKWORM: Causative organism, symptoms and treatment for Bacterial diseases (Flacherie, Septicemia, Sotto)-fungal diseases (muscardine)Viral diseases (infectious flacherie, Gattine, Grasserie) and protozoan disease (Pebrine)-Genetic reistance of the silk worm, Bombyx mori to bacterial and viral diseases-silkworm transgenesis and application. - 12 h

UNIT V: SILK REELING : Cocoon marketing-characteristics of cocoon-cocoon stifling-Types and storage of stifled cocoons-reeling operations-reeling appliances (country charka, cottage basin)-raw silk testing. - 10 h

REFERENCES:

1. Ganga,G and Sulochan Chetty, 1991.An Introduction to Sericulture. Oxford IBH Publ. PVT. LTD., New Delhi.
2. Hisao Aruga. 1996. Principles of Sericulture. Oxford IBH Publ. PVT. LTD., New Delhi.
3. G. Rangasamy, 1972. Mulberry cultivation-Central Sericulture Research and Training Institute, Mysore.
4. Ullal, S. and Narasimhana, M.N. 2003. Hand Book of Practical Sericulture-CSB, Bombay.

Semester III

LZOC31- Biostatistics and Computer Application

L	P	T	C
4	0	0	4

Objective:

To learn the application of statistical tool in research and other surveillance programme.

Learning outcome:

- Learn the sampling pattern, collection, maintenance and analysis of data.
- Enable to construct the experimental design before starting the experiments.
- Know the needs and handling of statistical package with the aid of computer.
- Acquire the knowledge on computer operations and database management by using statistical software packages.

UNIT I : Definition – Development of Biostatistics, Data in Biostatistics – Samples and population, variables, accuracy and precision, derived variables, frequency distribution, handling of data. Graphical representation of data using simple statistics, univariate and multivariate analysis, spatial data representation.-12 h

UNIT II : Statistical Methods - Measures of central tendency and dispersal - Probability distributions {Binomial, Poisson and normal} - Sampling distribution - Difference between parametric and non-parametric statistics - Confidence Interval – Errors - Levels of significance. – 16 h

UNIT III : Test of significance - Regression and Correlation - Analysis of frequencies t-test - Analysis of variance – Chi square test - Statistics analysis of variance (One-ANOVA) - Two way analysis of variance (two-ANOVA).

- 20 h

UNIT IV : History of computers - Classification of computers - Hardware components - Input devices – Output devices - Memory devices – Auxillary storage devices - Microprocessors; Software - Computer languages - Industrial application, Library Information System, Digital information processing.

- 12 h

UNIT V : Operating system – Windows - Computer applications - Office automation (MS Word, MS Excel, MS Power point), Database management - Internet and its applications. Software packages-SPSS, MSTAT, ORIGIN PRO

- 12 h

References

1. Sokal, R. and F. James. 1973. Introduction to Biostatistics, W.H. Freeman and Company Ltd., Tokyo, Japan.
2. Zar, J.H. 1984. Biostatistical analysis. (2nd Edn.), Prentice Hall International Inc.
3. Stansfield, W.O. 1984. Theory and Problems of genetics (including 600 problem) Schaum's outline series. Mc Graw - Hill Book, Co., New York.
4. Daniel, W.W. 1987. Biostatistics: A foundation for analysis in the health science. John Wiley and Sons, New Delhi.
5. Hunt, R. and J. Shelley.1988. Computers and common sense. Prentice-hall of India Pvt. Ltd. New Delhi.
6. Bailey, N.T.J. 1997. Statistical Methods in Biology, III Ed., Cambridge University Press, New York.
7. Milton, J.S. 1992. Statistical methods in Biological and Health Sciences. Mc Graw Hill Inc., New York.
8. Rajathi. A. and P.Chandran.2010. SPSS for you. MJP Publishers, Chennai 600005.

LZOC31- Developmental Biology

L	P	T	C
4	0	0	4

Objective:

To study metamorphosis , development and growth of organisms.

Learning Outcome:

- Learn the history in the field of embryology.
- Understand the reproductive system and fertilization process of living organisms.
- Enable to know the organogenesis pattern of organisms.
- Learn the role of hormone on metamorphological changes of organisms.

UNIT I : History and basic concepts: The origin of developmental biology- cell theory, mosaic and regulative development, discovery of induction, genetics and development; basic concepts of developmental biology- cell division, cell differentiation, signaling, patterning. Model systems: Fish, Frog, Chick, Mouse and Drosophila. - 13 h

UNIT II : Introduction to Gametogenesis – Spermatogenesis - Regulation of sperm motility (tail fiber complex and role of dyenin ATPase), role of pH and divalent cation - Oogenesis: synthesis and storage of maternal transcripts, proteins and cell organelles, transcription lampbrush chromosomes, vitellogenesis. - 13 h

UNIT III : Fertilization: Species specific sperm attraction, recognition of egg and sperm, acrosome reaction, signal transduction, molecular strategy to ensure monospermy and species specificity in fertilization. Types of eggs and cleavage patterns**:** Concepts in Pattern formation, animal vegetal axis, gradients, origin, and specification of germ layers – Blastulation - Gastrulation – Morphogenetic movements – Fate maps – Principles, patterns and physiology of gastrulation (Amphibians, Chick and Mammals).

- 15 h

UNIT IV : Organizer: Role of Spemann's primary organizers in frog and Hensen's node in bird – analysis of nature and mechanism of induction. Organogenesis - Formation of organ rudiments, differentiation and development of heart and kidney in different mammals. Mesoderm induction in *Xenopus:* Role of signals in dorsal, intermediate and ventral mesoderm induction. Pattern formation in *Drosophila*.: Bicoid, Nanos and Torso Morphogen gradients and

regulation of Hunchback. Neural competence and molecular signaling during neural induction. - 15 h

UNIT V : Organogenesis in vertebrates – Derivatives of ectoderm, mesoderm and endoderm – Development of Brain, Eye, Heart, Reproductive system, Alimentary canal – Regeneration ability in animals – Types – Autotomy, reparative and physiological regeneration – Mechanism of Salamander limb, factors affecting regeneration – Metamorphosis in amphibians, Insects, Hormonal regulation of metamorphosis - Growth and post embryonic development events: Metamorphosis in Amphibians – Morphogenetic and biochemical mechanisms – Hormonal control – Regeneration in vertebrates: tail, limb, lens and retina. Apoptosis - Mechanism and Significance – Ageing and Senescence Hayflicks experiment. Cryopreservation of Gametes and Embryos. - 16 h

References

1. Rover, C.P. 1968. An Outline of Developmental Physiology, Pergamon Press.
2. Saunders, J.W. 1982. Developmental Biology-Patterns, Principles and Problems. Macmillan Publishing Co., New York.
3. Kalthoff, K. 1996. Analysis of Biological Development, McGraw-Hill Publishers, New York.
4. Wolpert L. and C. Tickle. 2011. Principles of Development. (4th Edn). Oxford University Press, Oxford, UK.
5. Gilbert, S.F. 2011. Developmental Biology, Sinauer Associates, Inc. Publishers, Sunderland, Massachusetts.
6. Balinsky, B.I. 2012. Introduction to Embryology, Holt Saunders International, (5th Edn), Philadelphia.
7. Todd Streelman, J. 2013. Advances in Evolutionary Developmental Biology. Wiley-Blackwell Publishers.

LZOC33: Immunology

L	P	T	C
4	0	0	4

Objective:

- **To study the immune system of organism and their function.**

Learning outcome:

- Understand the function of immune system.
- Enable to know the Antigen –Antibody interaction.
- Learn the synthesis, transport and mode of action of Immunoglobulins.
- Know the Hybridomo technology and their use in cancer treatment.
- Realize the principle for vaccine production and vaccination for various kinds of diseases.
- Imbibe the knowledge on disease diagnosis and treatment.

UNIT I : Historical perspectives and early theories of Immunity - Components of the immune system, cells, tissues and organs involved in immune system – Principles of innate and acquired immunity, the recognition and effector mechanisms of the adaptive immunity- antigen and immunogenicity, clonal selection theory. - 12 h

UNIT II : Antigen – Classification - Antigen recognition by immune cells: Adaptive immunity- antibody structure, antigen recognition by B lymphocytes, TCR, antigen recognition by T- cells, co- receptors – Antibodies: Immunoglobulins – Domain structure – classes – IgG, IgA, IgM, IgD, IgE Characteristics- Isotypes– Allotypes – Idiotypes – Humoral mediated immunity. Antigen–Antibody interactions: Cross-reaction, Agglutination, Precipitation - Kinetics of antibody response - Hybridoma Technology – Monoclonal Antibodies – Applications. – 15 h

UNIT III : Complement system – Classical pathway, alternate and lectin pathways - Biological consequences of complement activation; Major Histocompatibility Complex (MHC) - Types, Antigen processing and presentation; B lymphocyte development and survival, humoral immune response - T lymphocyte development and survival, production of effector T- cells, cytotoxic T- cell effector mechanisms; NK and NKT - Mucosal immunity - Immunological memory - Regulation of immune response: cytokines and chemokines, leukocyte activation and migration, APC regulation of the immune response. - 16 h

UNIT IV : Immunity in health and disease: Introduction to infectious disease, innate immunity to infection, adaptive immunity to infection, evasion of the immune response by pathogens. Immunodeficiency diseases- inherited immunodeficiency diseases, acquired immune deficiency syndrome; Allergy and hypersensitivity reactions – types – diseases; Autoimmunity- responses to self antigens; Transplantation Immunology- Tissue typing and organ transplantation; Tumor Immunology.

- 16 h

UNIT V : Immunization – active and passive – Vaccines: Types of vaccines – Principles and methods of vaccine preparation – Immunological techniques: Detection of molecules using ELISA, ELISPOT, RIA, Western blot, Immunoprecipitation, flowcytometry, immunoflourescence and RIA. - 13 h

References

1. Springer T.A. 1985. Hybridoma technology in Biosciences and Medicine, Plenum Press, New York.
2. Paul, W.E.M. 1989. Fundamentals of Immunobiology. Current Biology Ltd., London.
3. Janeway, C., Travers, P., Walport, M., Shlomchik, M. and M.J. Shlomchik. 2004. Immunobiology: The Immune System in Health and Disease. Garland Publication.
4. Kuby, J. 2006. Immunology (4th Edn.), Goldsby, R.A., Kindt, T.J., Osborne, B.A., W.H. Freeman and Company.
5. Roitt, I.M, 2006. Essential of Immunology (12th Edn.), ELBS, Blackwell Scientific Publication
6. Abbas, A. K., Lichtman, A. H. and S. Pillai. 2006. Cellular and molecular Immunology (6th Edn). W.B.Saunders Company.
7. Chakraborthy, A.L. 2006. Immunology and Immunotechnology. Oxford University Press, New Delhi.

LZOC34- Genetics

L	P	T	C
4	0	0	4

Objective:

To study the hereditary process, concept of gene and genic interactions.

Learning Outcome:

- Understand the transmission of hereditary characters in populations.
- Know the phenotypic and genotypic expression of gene.
- Learn the structure and function of genome of organisms.
- Enable to know the mutagenic substance and their biological impacts.
- Realize the structural and numerical aberrations of chromosomes.
- Understand the concept sex determination pattern of organisms.
- Know the gene expression for protein synthesis and post transcriptional modifications of protein products.

UNIT I : Definition and scope of Genetics - Mendel's laws and their chromosomal basis; extension of Mendel's principles: allelic variation and gene function- incomplete dominance and co-dominance, allelic series, testing gene mutations for allelism; Gene action- from genotype to phenotype– penetrance and expressivity, gene interaction, epistasis, pleiotropy; Methods of gene mapping: 3- point test cross in *Drosophila*, gene mapping in humans by linkage analysis in pedigrees – Tetrad analysis in *Neurospora*. - 13 h

UNIT II : Gene mutation and DNA repair: Types of gene mutations - Methods for detection of induced mutations - P- element insertional mutagenesis in *Drosophila* - DNA damage and repair; Regulation of gene activity in *lac* and *trp* operons of *E. coli*; General introduction to gene regulation in eukaryotes at transcriptional and Post-transcriptional levels, organization of a typical eukaryotic gene, transcription factors, enhancers and silencers, non coding genes. - 15 h

UNIT III : Sex determination and dosage compensation: Sex determination- in humans, *Drosophila* and other animals; Dosage compensation of X-linked genes – hyperactivation of X-linked gene in male *Drosophila*, inactivation of X-linked genes in female mammals; Human genetics- karyotype and nomenclature of metaphase chromosome bands; chromosome anomalies and diseases- chromosomal anomalies in malignancy (chronic myeloid leukemia, Burkitt's lymphoma, retinoblastoma and Wilms' tumor); Genetic analysis of complex traits - complex pattern of inheritance, quantitative traits, threshold traits.**18 h**

UNIT IV : Chromosomal aberrations – Numerical – Euploidy (Monoploidy, Haploidy and Polyploidy) - Polyploidy – Autopolyploidy and allopolyploidy. Aneuploidy – Monosomes, Nullisomes and Trisomes. Structural aberrations: Deletions, Duplications, Translocations and Inversions. Evolutionary significance of chromosomal aberrations – 12 h

UNIT V : Concept of gene – Gene expression and control in eukaryotes; Genetic regulation of development and differentiation – Sequential expression of genes with model organisms: Drosophila and Zebra fish - Genetics and cancer: Oncogenes- tumor inducing retroviruses and viral oncogenes; chromosome rearrangement and cancer; tumor suppressor genes- cellular roles of tumor suppressor genes, pRB, p53, pAPC, genetic pathways to cancer.

- 14 h

References

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Optional paper

LZOEE- Population ecology and animal behaviour

L	P	T	C
3	0	0	3

Objective:

To study the ecology, population growth and behaviour of organisms.

Learning outcome:

- Understand the population dynamics and demography of organisms.
- Know the behavior ecology of organisms.
-

UNIT I : Ecology of Population and communities- Population dynamics - Model presentation and assumptions, predictions and variations – Metapopulation structure - Theories on metapopulation - Metapopulation and extinction Characteristics of a population - population growth curves- population regulation-life history strategies (r and K selection). Demography : Life tables, generation time, reproductive value. - 6 h

UNIT II : Biodiversity Conservation -Biodiversity laws- significance and management approaches - Case studies in population dynamics with two examples from areas such as fisheries and wildlife. Adaptation - Levels of adaptation, mechanisms and significance of body size. Biogeography - Major terrestrial biomes - biogeographical zones of India.

- 7 h

UNIT III : Types of behavior - Innate and learned behaviour - Role of behavioural study in animal conservation. Analysis of behaviour (ethgoram) - Biological rhythms- Foraging behavior-Avoiding predation-Reproductive behavior-Mating types- Sex ratio - Causes of tilt in operational sex ratio- Sexual selection - Male rivalry - female choice - Epigamic qualities-Hypotheses explaining sexual selection. - 7 h

UNIT IV : Neural and hormonal control of behaviour - Genetic and environmental components in the development of behavior- Bioluminescence - Electric organs and behaviour - Biological rhythms- Circadian and circannual rhythms - Orientation and navigation - Migration of fishes, turtles and birds - Learning and memory-Conditioning, habituation, insight learning, association learning, reasoning - Fisher's hypothesis and Handicap hypothesis. - 8 h

UNIT V : Social behavior- aggregations, schooling in fishes, flocking in birds, herding in mammals - Group selection- kin selection – Altruism, reciprocal altruism, inclusive fitness - Social organization in insects -Social Organization in primates - Homing, behaviour, dispersal, host-parasite relations - Language of communication in invertebrates and vertebrates. Role of visual and auditory systems, hormones and pheromones. - 8 h

References

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LZOEF- Environmental Health

L	P	T	C
3	0	0	3

Objective:

To study the environmental impact assessment, activities of planning board and aware on the zoonotic diseases.

Learning outcome:

- Learn the Environmental impact assessment (EIA)
- Enable to understand the waste handling process.
- Know the Environmental laws in India

UNIT I **:**Analysis and prediction of Environmental issues: Environmental Planning- Establishment of Health and Environmental standards, measuring Sustainable Development- - Concept of clean environment- Basis and necessity for standards- Non-point pollution sources; Environmental impact assessment (EIA): - 6 h

UNIT II : Housing standards and effect on health Problems and methods of excreta disposal - Arthropods of medical importance. Vector-borne diseases: transmission and control - Impact of fleas, ticks and mites on health. Zoonotic diseases and their prevention and control - Hospital environment in the context of health and disease - 7 h

UNIT III : Waste Minimization & Cleaner Production: Introduction, waste minimization in industries –Distilleries, textile industry, leather industry – cleaner production related to the above industries. Health problems in different types of industries – Occupational Health and Safety considerations in Wastewater Treatment Plants - Measures for Workers - Health Education Medical First - Aid and Management of Medical Emergencies.

- 7 h

UNIT IV : Solid waste management – Methods of disposal of solid waste - Diseases related to soil pollution. classification, origin, methods of solid waste treatment and disposal compositing, sanitary land filling, thermal process (incineration, Pyrolysis) Recycling and reuse. - Methods of disposal of solid

waste - Diseases related to soil pollution. Hazardous waste – sources, identification and management of hazardous waste – treatment and Disposal - waste minimization approaches, cleaner production - Biotreatment technology. - 8 h

UNIT V : Environmental laws in India: Environmental Policy and laws- Constitutional and Statutory laws in India: Doctrine Principles of State Policy, Fundamental Duties and Fundamental Rights and Panchayat Raj System- Environmental education system in India and other countries Role of NGO"s and Government organizations in wildlife conservation - Wildlife celebration days in India.- 8 h

References

1. Hommadi, A. H. 1989. Environmental and Industrial Safety, I.B.B Publication, New Delhi.
2. Goel, P.K. and K.P. Sharma. 1996. Environmental Guidelines and Standards in India, Techno science Publications, Jaipur, India.
3. Chandra, P. 1999. Environment Pollution and Development, Mittal Publications, New Delhi, India.
4. Peter, C. 1998. Hand Book of Environmental Risk Assessment and Management, Blackwell-Synergy, London.
5. Sally, L. B. and A. B. David. 2001. A Practical Guide to Understanding Management and Reviewing Environmental Risk Assessment Reports, Lewis Publishers, Washington D.C.

EDOC –Supportive Course

LZOSB- PROBIOTICS

L	P	T	C
3	0	0	3

Objective:

To study the role of beneficial microbes on disease diagnosis and their industrial applications.

Learning Outcome:

- Gain knowledge on history, characteristics and use of probiotics
- Understand the technology know how to isolation, screening and production of probiotics.
- Realize the importance of probiotics in bioconversion and exo-enzyme production.

Unit I : Introduction to probiotics : Definition, History of Probiotics, Characteristics of probiotics, Uses of Probiotics, Probiotics in human and animal health, sources of Probiotics, Mode of action of probiotics.

- 10 h

Unit II : Isolation and screening of probiotics microbes : Isolation of probiotics microbes, screening of probiotic microbes (Enzyme production, antagonistic activity, *in vitro* and *in vivo* screening towards pathogenicity) – Production of probiotics. - 11 h

Unit III : Probiotics in Human and Animal Health : Probiotics in Human Health. Probiotics in Animal Health : Probiotics as feed additives, Growth promoters and Immune modulators. Probiotics in Bioconversion. Probiotic Exoenzymes : Enzymes as feed additives. - 12 h

Unit IV : Probiotic and Environment Health : Denitrifying, Ammonia oxidizing, Phosphate Solubilizing bacteria, Poly and hydrocarbon degrading bacteria, water probiotics. - 10 h

Unit V : Prebiotics : Definition – Characteristics of probiotics – Synbiotics – Prebiotics in animal health (Growth Promoting Immune Modulation). Prebiotics in Human Health. - 11

Reference

1. Pillai, TVR. and M. N. Kutty., 2005. Aquaculture: Principles and Practices, Wiley-Blackwell.
2. Dr. S. A. Ali. 2010. Feed and Feed Technology Eds. (CIBA Publication).
3. Michael J. Pelczar, E. C. S. Chan and Noel R. Krieg, Microbiology –5th Edn., Mc Graw – Hill Publishing Company Ltd., New Delhi.

Semester IV

LZOC41- Environmental Biology

L	P	T	C
4	0	0	4

Objective: To acquire knowledge on the ecosystem, energy flow, food trophics, population ecology and renewable, non-renewable energy resources.

Learning outcome:

- Understand the structure and functional properties of natural and manmade ecosystems.
- Realize the unique features of marine natural resources
- Acquire knowledge on habitat ecology, population ecology and growth.
- Know the importance of conservation tools.
- Inculcate the significance and importance of non-renewable and renewable resources.
- Distinguish types of pollution and understand the role of biological indicators in environmental monitoring.
- Learn laws related to environmental pollution.
- Enable to understand the impact of climate change and global warming on living organisms and emergence of vector borne diseases.

UNIT I : Natural and manmade ecosystem – Energy flow – Trophic level and structure in Ecosystem –Food chain and Food web, Ecological Pyramids. Definition, nature and flux of energy through communities. Influence of competition, predation and disturbances - Unique features of Coral Reefs, Seaweeds, Seagrasses and Mangroves. Natural resources and their conservation.-14h.

UNIT II : Structure and distribution - Growth curves – Groups, Natality, Mortality – Density indices. Factors affecting population growth – Carrying capacity. Population regulation and human population control. Biogeochemical cycles – carbon, nitrogen and phosphorus - Hydrological cycle and global water balance. **Habitat Ecology: (**Freshwater habitat – Marine habitat –Estuarine habitat – Terrestrial habitat. **Population ecology and growth**; population patterns, habits, habitats, habitat selection; prey predator relationship. **Tools in Conservation**: Interpretation of various data on wildlife - GIS - remote sensing). -17 h

UNIT III : Concept – classification – Non-renewable and Renewable resources. Non Renewable resources: Fossil fuel (Coal, Petrol & Natural Gas), Nuclear Fuels. Renewable resources – Biomass, Biogas, Solar energy, Wind

Energy, Tidal Energy, Geothermal Energy – Conservation and Management. 12 h

UNIT IV : Pollution: Classification of pollution and their biological effects – Air, Water, Soil, Marine, Heavy metal and Radiation pollution. Biological indicators and their role in environmental monitoring – Environmental laws. -12 h

UNIT V : Effect of climate change, global warming and its effect on living organisms – Tsunami, Cyclone Earth Quake - Flood: Causes, consequences, control and management - Remediation and reclamation of the Environment – Role of microbes in bioremediation. Basics of Green house gases –- Climatic change and its Significance and Causes - Impact of global warming on eco- system - Fossil fuel in Global warming- present and future trends. Climate change Human Health. Climate change and Vector prevalence – Vector Borne diseases - Carbon sequestration. -17 h

References

1. Odum, E. P. 1972. Fundamentals of Ecology by Eugene. W.B. Saunders Company, London.
2. Smith, R.L .1986. Elements of Ecology. Harpet and Row Publishers, New York.
3. Trivedi, P.R. and K. Gurdeepraj. 1992. Environmental Biology, Akashdeep Publishing House, New Delhi.
4. Dash, M.C. 1993. Fundamentals of Ecology. Tata McGraw Hill Publishing Company Ltd. New Delhi.
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LZOC42-Animal Biotechnology

L	P	T	C
4	0	0	4

Objective: To study the biotechnological for constructing rDNA, gene transfer method, gene cloning and cell toxicity**.**

Objetives:

- Understand the animal cell structure and concept of genetic engineering
- Know to construct the plasmid and gene transfer method and application enzymes for rDNA technology.
- Enable to construct the cDNA and genomic library.
- Learn different culture media for cell culture and cell line maintenance.
- Imbibe the knowledge about the IVF , artificial insemination and production of transgenic animals.
- Learn the knowledge on cloning procedure.

UNIT I : Definition – Animal cell structure – macromolecules in cell, concepts of genetic engineering, scope of biotechnology, principles of recombinant DNA technology – Genet transfer methods: Physical and chemical methods: Viral mediated gene transfer. 10 h

UNIT II : Classification of plasmids, isolation and purification of DNA, RNA and plasmids – Basics of cloning – Concept of restriction and modification: Restriction endonucleases, DNA modifying enzymes, Ligases – Gene cloning vectors - Plasmid vectors, Vectors based on the lambda Bacteriophage, Cosmids, Phagemids, M13 Vectors, shuttle vectors Expression vectors, Vectors for cloning and expression in Eukaryotic cells: YAC and BACs – Selectable markers. - 15 h

UNIT III : Definition – Construction of genomic and cDNA library – screening of DNA library and cDNA libraries, Gene tagging, Expression of cloned genes – PCR - principles - molecular markers – applications. Screening of recombinant clones – nucleic acid hybridization, DNA sequencing, DNA finger printing and paternity decisions. -14 h

UNIT IV : History – Definition – animal cell culture environment – Cell culture media - Equipments required for animal cell culture. Advantages and disadvantages of serum in culture. Synthetic media - Primary culture and subculture – Development and maintenance of cell lines – Organ culture, whole embryo culture, tissue engineering – Up scaling of cell lines - Monolayer and suspension culture – Characteristics of cells in culture – Types of culture methods –Measurement of cell viability and cytotoxicity – Stem cells: sources – embryonic and adult stem cells and their applications. Cell culture products: Insulin, tissue plasminogen activator (tPA), blood factor. -19 h

UNIT V : *In vitro* fertilization, Embryo transfer, Artificial insemination in cattle, super ovulation, mating, splitting, cryopreservation, stem cell method, targeted gene transfer – knock in and knock out technology, transgenic mice, goat cattle – gene pharming and other applications – Cloning of Animals - Application of Genetic Engineering - Mosquitoes as potential vectors of human diseases – control measures. -14 h

References

1. Alberts, B., Bray, D., Lewis, J., Raff, M., Roberts, K and J.D. Watson. 1994. Molecular Biology of the Cell. (3rd Edn.), Garland Publishing Inc., New York.
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Optional Paper

L	P	T	C
3	0	0	3

LZOEG- Fishery Biology

Objective: To study the fish ecology and fishery management practices**.**

Learning outcome:

- Understand the life history of fishes, classification, morphometry and taxonomy of fishes.
- Know the growth performance of fishes and the spawning season of fishes.
- Learn the inland estuarine management strategies.
- Enable to address the problems in fish grafting technology
- Understand the post harvest process of fish.

UNIT I : Classification and biology of fishes: Outline classification of fishes- Major group of fishes and their characteristics - Morphometric and meristic characters of elasmobranches and teleost fishes. Basic economics of fish - digestive, circulatory, respiratory, nervous and reproductive systems - Food, feeding habits and digestion - Alimentary canals and their modifications.

-8 h

UNIT II : Growth, reproduction, maturation and spawning: Length and weight relationship - Age determination - Factors influencing growth -Reproductive organs (male and female), maturation and spawning - Seasonal changes in gonodosomatic Index (GSI) - Migration for spawning.

-8 h

UNIT III : Inland estuarine and marine fisheries: Inland fisheries - Riverine fisheries, reservoir fisheries-Cold water fishery of lakes and riverines -Estuarine and marine fisheries. -5h

UNIT IV : Fishing grafts and gear: Fishing grafts-Fishing gears, spear and haspoon, fish traps, nets, types of nets-preservation of nets-Fishing by electric current-Modernization of fishing methods. -5 h

UNIT V : Adaptation in hill stream and deep sea fishes: Condition in hill streams-origin of hill stream fishes, modifications in the hill stream fish fauna-mechanism of adhesion. Conditions in the deep sea- adaptations in mesopelagic,

bathypelagic and benthic fishes- Food and feeding habits, eyes and other sense organs-Bioluminescence- Methods for maintaining buoyancy-Adaptations for reproduction and spawning.

-10 h

References

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5. Khanna, S.S. and Sing, H.R. 2003.Fish Biology and fisheries, Narenrdra Publishing House, New Delhi, India.

Or

LZOEH-Economic Zoology

L	P	T	C
3	0	0	3

Objective: To study the scope and economic aspects of fishery, Diary, Sericulture, Apiculture and vermiculture.

Learning Outcome:

- Enable to generate self employability and reduce jobless problem.
- Learn to know the packages of farm management practices (fishery, Diary, apiculture ,sericulture and vermiculture).

UNIT I : Fishery: Economic value of fishes - Fish as food, fish as food for live stock, fish oil, fish manure, fish silage, fish glue and isiglass, fish sausage and soap, fish flour and biscuits, fish leather - Artificial pearl - Insulin-Fish as biocontrol agent -Fish for decoration - Harmful fishes.

-8h

UNIT II : Diary: Diary farming-scope of dairy farming - diary animals, breeds, housing and raising -Diary management - artificial insemination - IVF for stock improvement - Milk composition - Diary products and economics.

-6 h

UNIT III : Apiculture: Importance of bee keeping –products of bee keeping-Honey composition, quality and economic value. -4 h

UNIT IV : Sericulture: Importance of sericulture - sericulture industry - distribution and prospects -Silkworm moth species-life cycle of silk worm - Silk composition, kinds and uses - Mulberry cultivation- Rearing of silkworm, silk reeling, disposal of cocoons, twisting and weaving.

- 14 h

UNIT V : Vermiculture: Earthworm species-condition for efficient vermiculture – vermicompost -economic value of vermicompost. -4 h

References

1. Srivastava, P.A. 1977. Economic Zoology. Commercial Publication Bureau, Kanpur, India.
2. Jhingran , V.C. 1991. Fish and Fisheries in India. Hindustan Publishing Company, New Delhi, India.
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4. Mishra, R.C. 1995. Applied and Industrial Zoology. Associated Publishing Company, New Delhi, India.
5. Bhat Nagar, R.K. and R.K. Palta. 2003. Earthworm: Vermiculture and vermicompositing. Kalyani Publisher, India.
6. Khorana, S.S. and H.R. Singh. 2003. Fish Biology and fisheries. Narendra Publishing House, New Delhi, India.
7. Carters, G.A. 2004.Bee Keeping. Biotech Books, New Delhi, India.

LZOL31- CORE PRACTICAL III (IX – XII)

L	P	T	C
0	2	0	2

Developmental Biology

1. Structure of spermatozoa and egg
2. Study on types of cleavage
3. Vital staining and mounting of chick blastoderm
4. Regeneration in Amphibians
5. Study of insect metamorphosis

Immunology

1. Identification of blood groups A, B, ABO and Rh.
2. Preparation of blood antigen - Demonstration
3. Preparation of blood antiserum - Demonstration
4. Differential blood counts
5. Oucterlony double diffusion test
6. C – reactive protein test
7. Pregnancy test (or) HCG test
8. Slide showing T.S. of spleen, thymus and lymphnodes

Genetics

1. Experiments on Mendelian inheritance.
2. Preparation of Buccal smear to show squamous epithelial cells.
3. Mounting of salivary glands of Drosophila larvae or Chironomous larvae.
4. Human pedigree construction for a family data.
5. Study of hereditary disorders with the aid of chromosome karyotyping (Klienfelter's syndrome, Turner's syndrome, Down's syndrome)

LZ0L41-CORE PRACTICAL IV (XIII – XIV)

L	P	T	C
0	2	0	2

Environmental Biology

1. Measurement of Primary productivity in an ecosystem.
2. Estimation of Dissolved oxygen, Salinity, Nitrate, Phosphate and Alkalinity in water samples.
3. Collection, isolation and identification of planktons.
4. Estimation of dissolved solids in water.
5. Field visit
   a. Visit to drinking water treatment plant
   b. Visit to sewage treatment plant

Animal Biotechnology

1. Isolation of Plasmid DNA
2. Isolation of Chromosomal DNA from Animal Tissue
3. Restriction and ligation digestion of plasmid DNA
4. Agarose Gel electrophoresis
5. Preparation of competent cells & Transformation
6. Sterilization of glass and plastic wares of cell culture.
2. Preparation of culture media and sterilization
3. Primary culture technique for chicken embryo fibroblast (Demonstration)
4. Trypsinizing and subculturing cells from a monolayer (Demonstration)
5. Cultivation of continuous cell lines (Demonstration)
6. Cell viability by trypan blue exclusion.
7. Assay of cell viability by dye uptake.

Project work*