Department of Zoology

School of Biological Sciences

Curriculum Framework

M.Sc. Zoology

Based on National Education Policy- 2020

Doctor Harisingh Gour Vishwavidyalaya
(A Central University)
Sagar-Madhya Pradesh-470003

M.Sc. Zoology

Name of Course	Paper Course Code	Paper Title	Credits
I Semester			
Discipline Specific Major-1	ZOO-DSM-121	Animal Diversity–Theory	04
	ZOO-DSM-122	Animal Diversity–Practical	02
Discipline Specific Major-2	ZOO-DSM-123	Animal Physiology–Theory	04
	ZOO-DSM-124	Animal Physiology –Practical	02
Multi-Disciplinary Major	ZOO-MDM-125	Cell: Structure and Function–Theory	04
	ZOO-MDM-126	Cell: Structure and Function – Practical	02
Skill Enhancement Course	ZOO-SEC-127	Applied Biology–Theory	03
	ZOO-SEC-128	Applied Biology–Practical	01
		Total Credits 22	
II Semester			
Name of Course	**Paper Course Code**	**Paper Title**	**Credits**
Discipline Specific Major-1	ZOO-DSM-221	Developmental Biology–Theory	04
	ZOO-DSM-222	Developmental Biology –Practical	02
Discipline Specific Major-2	ZOO-DSM-223	Fundamental Processes of Biology–Theory	04
	ZOO-DSM-224	Fundamental Processes of Biology –Practical	02
Multi-Disciplinary Major	ZOO-MDM-225	Evolution and Behavioral Science–Theory	04
	ZOO-MDM-226	Evolution and Behavioral Science –Practical	02
Skill Enhancement Course	ZOO-SEC-227	Inheritance Biology–Theory	03
	ZOO-SEC-228	Inheritance Biology –Practical	01
		Total Credits	**22**

III Semester			
Name of Course	**Paper Course Code**	**Paper Title**	**Credits**
Discipline Specific Major-1	**ZOO-DSM-321A**	**Cell Physiology–Theory**	**04**
	ZOO-DSM-321B	**Insect Morphology and Physiology - Theory**	**04**
	ZOO-DSM-321C	**Fish: Structure and Function–Theory**	**04**
	ZOO-DSM-321D	**General Parasitology–Theory**	**04**
	ZOO-DSM-322A	**Cell Physiology-Practical**	**02**
	ZOO-DSM-322B	**Insect Morphology and Physiology - Practical**	**02**
	ZOO-DSM-322C	**Fish: Structure and Function-Practical**	**02**
	ZOO-DSM-322D	**General Parasitology-Practical**	**02**
Discipline Specific Major-2	**ZOO-DSM-323A**	**Cell Transport and Signalling–Theory**	**04**
	ZOO-DSM-323B	**Insect Taxonomy, Ecology and Applied Entomology-Theory**	**04**
	ZOO-DSM-323C	**Applied Fish and Fisheries-Theory**	**04**
	ZOO-DSM-323D	**Medical Parasitology- Theory**	**04**
	ZOO-DSM-324A	**Cell Transport and Signalling - Practical**	**02**
	ZOO-DSM-324B	**Insect Taxonomy, Ecology and Applied Entomology -Practical**	**02**
	ZOO-DSM-324C	**Applied Fish and Fisheries-Practical**	**02**
	ZOO-DSM-324D	**Medical Parasitology-Practical**	**02**
Multi-Disciplinary Major	**ZOO-MDM-325**	**Ecological Principles-Theory**	**04**
	ZOO-MDM-326	**Ecological Principles –Practical**	**02**
Skill Enhancement Course	**ZOO-SEC-327**	**Tools, Technology and Scientific Writing -Theory**	**03**
	ZOO-SEC-328	**Tools, Technology and Scientific Writing –Practical**	**01**
		Total Credits 22	

IV Semester			
Discipline Specific Major	ZOO-DSM-421	Master's Thesis/Dissertation	16
			Total Credits 16
Grand Total Credits 82			

M.Sc. I Semester

Name of Course	Paper Course Code	Paper Title	Credits
Discipline Specific Major-1	ZOO-DSM-121	Animal Diversity–Theory	04
	ZOO-DSM-122	Animal Diversity–Practical	02
Discipline Specific Major-2	ZOO-DSM-123	Animal Physiology–Theory	04
	ZOO-DSM-124	Animal Physiology –Practical	02
Multi-Disciplinary Major	ZOO-MDM-125	Cell: Structure and Function–Theory	04
	ZOO-MDM-126	Cell: Structure and Function–Practical	02
Skill Enhancement Course	ZOO-SEC-127	Applied Biology–Theory	03
	ZOO-SEC-128	Applied Biology–Practical	01
		Total Credits	22

M.SC. COURSE
FIRST SEMESTER
DISCIPLINE SPECIFIC MAJOR-1
COURSE TITLE: ANIMAL DIVERSITY
COURSECODE: ZOO-DSM-121
THEORY

L	T	P	C
4	0	0	4

Objective: To acquire knowledge pertaining to systematics, as well as the structural and functional diversity observed in animals

Unit I: Principles & Methods of taxonomy

a. Broad classification of Animal Kingdom.
b. Concept of Species.
c. History of Nomenclature
d. Theories of Biological Classification.
e. Phylogenetic Systematics

Unit II: Protozoa and Mesozoa

a. Locomotion, Nutrition and Reproduction and in Protozoa
b. Porifera: Cell types and Canal System
c. Coelenterata: Polymorphism in Coelenterates
d. Ctenophora: Structural peculiarities and affinities
e. Nematodes: Pathogenic forms of nematodes.

Unit III: Bilateria and Minor Phyla

a. Platyhelminthes: Larval stages of Trematoda and Cestoda
b. Annelida: Coelom formation and Metamerism
c. Arthropoda: Larval forms of Crustaceans and Respiratory organs in Arthropods
d. Mollusca: Torsion in Gastropods
e. Echinoderms: Water Vascular Systems and larval forms
f. Structural peculiarities and affinities of Minor phyla: Rotifera, Phoronida, and Branchiopoda.

Unit IV: Protochordates and Lower Terrestrial Vertebrates

a. General characteristics and affinities of Hemichordata, Cephalochordates and Urochordates.
b. General characteristics and affinities of Cyclostomata
c. General characteristics of fishes (Ostracoderms, Dipnoi and Holocephali)
d. Amphibia: General organization, Origin of tetrapods, Neoteny.
e. Reptiles – Origin and adaptive radiation, Dinosaurus, Crodilia, Squamata and Rhynchocephalia.

Unit V: Birds and Mammals

a. Adaptations for flight in Birds.
b. Flightless birds and Migration in Birds.
c. Adaptive radiation in mammals and Dentition in Mammals.
d. Structural peculiarities and phylogenetic relations of Prototheria and Metatheria.
e. Aquatic Mammals.

Suggested Readings: (Latest Edition)

1. Carter, G. S. A. General Zoology of Invertebrates. Wick and Jackson Ltd., London.
2. Barnes, R. D. Invertebrates Zoology. Wiley Backwell.
3. Kotpal, R.L. Protozoa, Porifera, Coelenterata, Helminthes, Annelida, Arthropoda, Mollusca, Echinodermata and Minor Phyla. Rastogi Publications.
4. Hyman L.H. The Invertebrata, Vol. I to VI.
5. Waterman, A.J. Chordate Structure and Function. Macmillan Co. London.
6. Kapoor, V.C.Theory and Practice of Animal Taxonomy. Oxford and IBH Publishing Co., Pvt. Ltd. New Delhi.

Learning Outcomes:

After completing the course students will able to learn:

• understand the principles and practice of systematics.
• in-depth knowledge on the diversity and relationships in animal world.
• a holistic appreciation on the phylogeny and adaptations in animals.

M.SC. COURSE
FIRST SEMESTER
DISCIPLINE SPECIFIC MAJOR-1
COURSE TITLE: ANIMAL DIVERSITY
COURSE CODE: ZOO-DSM-122
PRACTICAL

L	T	P	C
0	0	2	2

1. Study of Representative Museum Specimens.

   Protozoa: *Amoeba, Paramecium, Trypanosoma* in blood; Porifera: *Euspongia* ; Coelentrata: *Physalia, Aurelia, Tubipora, Metridium, Pennatula, Madrepora, Alcyonium, Porpita, Gorgonia*; Platyhelminthes: *Taenia, Dugesia Fasciola*; Nematyhelminthes: *Ascaris* (Male and Female), *Ancylostoma*; Annelida: *Nereis, Heteronereis, Aphrodite, Hirudinaria Chaetopterus, Metaphire (Pheretima); Peripatus, Palaemon, Cancer, Limulus, Palamnaeus, Scolopendra, Julus, Periplaneta, Apis,Bombax mori,* Dragon fly, Musca, Mantis: *Arthropoda:* Mollusca: *Chiton, Pila, Unio, Loligo, Sepia, Octopus, Solen, Limax, Dantalium;* Echinodermata: Asterias, *Ophiothorix ,Holothuria*; Hemichordata: *Balanoglossus*; Urochordata: *Herdmania*; Cyclostomata *Petromyzon, Myxine;* Pisces; *Sphyrna, Pristis, Torpedo, Labeo, Exocoetus, Anguilla;* Amphibia. *Ureotyphlus, Salamandra, Bufo, Hyla;* Reptiles. *Chelone, Hemidactylus, Chamaeleon, Draco, Viper, Naja, Crocodylus, Gavialis;* Aves : Owl, Parrot and Mammals: *Platypus,* Bat, Lemur, Kangaroo.
2. Study of body sections of Acoelomate, Pseudocoelomate and coelomate to understand the evolution of different types of coeloms.
3. Study of prepared slides of mouth parts of Insects.
4. Study of *Balanoglossus, Amphioxus*, *Herdmania*, *Peteromyzon* and *Onychophora* to bring out their affinities.
5. Study of the following specimens with Reference to their adaptive features for their respective modes of life: a) *Echeneis*; b) *Ichthyophis*/*Uraeotyphus*; c) *Hyla*; d) *Draco*; e) Pigeon; f) Bat.
6. Study of skull types a) Fish; b) Frog; c) Snakes; d) Bird; e) Rat/Rabbit.
7. Study of different kinds of snakes in reference to their biting Mechanism.
8. Preparation of One Chart or Model showing Diversity in life forms.

M.SC. COURSE
FIRST SEMESTER
DISCIPLINE SPECIFIC MAJOR-2
COURSE TITLE: ANIMAL PHYSIOLOGY
COURSE CODE: ZOO-DSM-123
THEORY

L	T	P	C
4	0	0	4

Objective: To learn about the biology of the various systems in the body that are involved in the different metabolic processes.

Unit I: Circulatory System

Blood and circulation - Blood corpuscles, haemopoiesis, plasma function, blood volume, blood volume regulation, blood groups, haemoglobin, haemostasis.

Cardiovascular System: Pattern of circulation among different animal groups, Comparative Vertebrate Heart, Human Heart, Electrical activity of Heart, Cardiac cycle, Regulation of Heart Rate, Blood Vessels, Capillary Exchange and Electrocardiogram.

Unit II: Respiratory System and Thermal Regulation

Respiratory system - Comparison of respiration in in vertebrates, Human Respiratory System, Pulmonary Ventilation and Blood transport of respiratory gases, Respiratory pigments.

Thermoregulation– Heat gain and heat loss process, Effect of temperature on animals, Classification of animals on basis of heat regulation, Temperature regulation in in-vertebrates and Vertebrates, Temperature regulation in humans.

Unit III: Nervous System and Sense Organs

Nervous system–Invertebrate and Vertebrate nervous System, Structural and functional Organization of Nervous System, Ionic and Physical Basis of Membrane, Nerve Impulses generation and conduction, Synapses and Communication.

Sense organs–Organization of Sensory System,Mechanoreception and Touch, Vestibular Organ and Hearing, Chemoreception and Taste, Olfaction, Vision.

Unit IV: Digestive and Excretory System

Digestive System- Feeding habits in animals, Digestion in animals, Human Digestive System, Digestion and adsorption of proteins, carbohydrates and lipids and role of gastrointestinal hormones in digestion, Energy balance and BMR.

Excretory system - Comparative physiology of excretion, kidney, urine formation, urine concentration, waste elimination, micturition, regulation of water balance, electrolyte balance, acid-base balance.

Unit V: Reproduction and Endocrine glands

Reproductive process Comparative of Reproductive System in Animals, Male and Female Reproductive System, Hypothalamic-pituitary axis, Growth, development and function of ovarian follicle, Estrous Cycle.

Endocrine Glands Overview of endocrine glands (Pineal, Pituitary, Thyroid, Parathyroid, Thymus, Endocrine pancreas, Adrenal, Ovary and Testis), Mechanism of action of hormones basic mechanism of hormone action, Neuroendocrine feedback.

Suggested Readings: (Latest Edition)

1. Guyton, A.C. & Hall, J.E. Textbook of Medical Physiology. XI Edition. Hercourt Asia PTE Ltd. /W.B. Saunders Company.
2. Chatterjee, C. C.Human Physiology Volume 1 & 2. 11th edition. CBS Publishers.
3. Tortora, G.J. & Grabowski, S., Principles of Anatomy & Physiology. XI Edition John Wiley &Sons.
4. Christopher D. Moyes, Patricia M. Schulte, Principles of Animal Physiology. Pearson Education.
5. Verma,P.S. InvertebrateZoology, , S.Chand Publishing, New Delhi.
6. Kotpal, R.L.ModernTextBook of Zoology: Invertebrates. Rastogi Publicattion, Meerut UP.

Learning Outcomes:

The student at the completion of the course will be able to:

- understand various functional components of an organism body.
- infer the regulatory mechanisms for maintenance of function in the body

M.SC.COURSE
FIRST SEMESTER
DISCIPLINE SPECIFIC MAJOR-2
COURSE TITLE:ANIMAL PHYSIOLOGY
COURSE CODE: ZOO-DSM-124
PRACTICAL

L	T	P	C
0	0	2	2

1. Determination of Proteins.
2. Determination of Glucose.
3. Determination of Lipids.
4. Determination of Glycogen.
5. Estimation of Cholesterol.
6. Determination of Enzyme Activities.
7. Effect of Substrate Concentration and pH on Succinate Dehydrogenase Activity.
8. Estimation of Haemoglobin.
9. Estimation of Coagulation Time.
10. Histological study of pituitary, adrenal, testis, ovary, corpus luteum, pancreas and thyroid gland.

M.SC. COURSE
FIRST SEMESTER
MUTI-DISCIPLINARY MAJOR
COURSE TITLE; CELL: STRUCTURE AND FUNCTION
COURSE CODE: ZOO-MDM-125
THEORY

L	T	P	C
4	0	0	4

Objective: To learn about the different biological processes that happen in animals.

Unit I: General information of Cells

a. Universal features of cells
b. Chemical components of a cell: Macromolecules and energy sources.
c. Catalysis and use of energy by cells.
d. Structure and Function of Nucleic Acids.
e. Structural organization of eukaryotic chromatin chromosomes, Heterochromatin, Euchromatin, Transposons, Operon, unique and repetitive DNA, interrupted genes, gene families.

Unit II: Membrane-structure and Function

a. Plasma Membrane: Membrane transport mechanism; transport of macromolecules, Electrical properties of membranes.
b. Protein Sorting and Intracellular transport.
c. Electrical properties of Membrane.
d. Cellular energetics: Mitochondria and Chloroplast; Glucose and Fatty acid catabolism, peroxisomes, plastids and vacuoles.

Unit III: Structural organization of intracellular organelles

a. Nucleus: Nuclear envelop, Nuclear pore complex, Nuclear import and export signals/receptors, Nuclear lamina, Nuclei- structure and functions.
b. Cytoskeleton: Actin, Myosin, Microtubules and Microfilaments, role in motility.
c. Endoplasmic reticulum: Structure and functions; Protein modification, protein targeting and translocation, Protein transport to Golgi apparatus, ER signals.
d. Mitochondria: Structure and Mechanism of ATP formation
e. Golgi apparatus: Structure and functions, *cis*- and *trans* faces, matrix proteins, vasicular transport. Lysosomes: Structure and functions, lysosomal enzymes, Autophagy, lysosomal storage diseases.

Unit IV: Cell Communication, Growth and Development

a. Gene expression and its control at transcriptional and post transcriptional level.
b. Nerve Cells: Neurons and Glia, Voltage gated ion channels, Neurotransmission and its regulation, Communication at synapses, Sensational cells, Axon growth.
c. Cell Junctions: Types and functions; Cadherins mediated adhesion, Catenin, actin mediated contraction, role of Desmosomes for mechanical strength, tight junctions and transmembrane adhesion, scaffold proteins, Gap junctions: Metabolic and Electrical activity; Plasmodesmata; Calcium independent cell-cell adhesion.
d. Regulation of eukaryotic Cell Cycle: CDK regulation, MPF activity, Molecular mechanism of mitotic events, Cell cycle control in mammalian cells, check points in cell cycle regulation. Meiosis cell division, Gametogenesis and fertilization, Cell differentiation, Cell diversity and patterning in early vertebrate embryo.
e. Cancer: Oncogenes, Tumor Suppressor Genes, Cancer and cell cycle, virus induced cancer, metastasis, therapeutic intervention of uncontrolled cell growth.

Unit V: Cell signaling

a. Hormones and their receptors, Extracellular signal and cellular response.
b. Cell surface receptors, highly conserved components of intracellular signal transduction pathways.
c. G Protein coupled receptor systems: Regulation of ion channels; Activation or inhibition of adenylyl cyclase, activation of phospholipase C, Integration response of cells to environmental influences.
d. Cell signaling pathways that control gene activity: TGFβ receptors and Smad transcription factors; Cytokine receptors; Tyrosine kinase receptor; Activation of Ras and MAP kinase pathways; Activation of gene transcription; Signal induced protein cleavage.

Suggested Readings: (Latest Edition)

1. Nelson & Cox. Lehninger's Principles of Biochemistry, McMillan.
2. Cooper and Hausman. The Cell: A molecular Approach.ASM Press Washington.
3. Wilson and Walker.Practical Biochemistry – Principles and Techniques. Cambridge University Press
4. B. Alberts, D. Bray, J. Lewis, M. Raff, K. Roberts and J.D. Watson. Molecular Biology of the Cell Garland Publishing Ind., New York.

Learning Outcomes:

Students will gain insight into the most significant molecular and cell biology used today to expand understanding of biology.

M.SC. COURSE
FIRST SEMESTER
MUTI-DISCIPLINARY MAJOR
COURSE TITLE; CELL: STRUCTURE AND FUNCTION
COURSE CODE: ZOO-MDM-126
PRACTICAL

L	T	P	C
0	0	2	2

1. Visualization methods for cells and sub-cellular components: light microscopy, phase contrast microscopy, scanning and transmission microscopes.
2. Demonstration of cell sorting by flow cytometry.
3. Use of different types of centrifuges.
4. Staining of Golgi complex, mitochondria, peroxisomes etc.
5. Experiment on osmosis.
6. Study of hemolysis.
7. Data mining methods for sequence analysis to nucleic acid databases.
8. Data mining methods for sequence analysis to Protein databases.
9. Staining of neurons.
10. Preparation of Charts/models

M.SC. COURSE
FIRST SEMESTER
SKILL ENHANCEMENT COURSE
COURSE TITLE: APPLIED BIOLOGY
COURSECODE: ZOO-SEC-127
THEORY

L	T	P	C
3	0	0	3

Objective: To acquire knowledge on the various biological processes that can be employed for commercial purposes.

Unit I: Microbial Biology

a. Various methods of microbial control: physical, chemical and biological. Sterilization techniques- moist heat and dry heat sterilization, filter sterilization of thermolabile substances and air, chemical sterilization.
b. Culture media and preparation.
c. Microbial fermentation and production of small and macro molecules.
d. Molecular approaches to diagnosis and strain identification.

Unit II: Recent advances in biological sciences

a. Introduction to computational biology, Brief overview of sequence alignment (BLAST) and FASTA. Bioinformatics databases: NCBI, PDB, SWISS PROT etc.
b. Application of Bioinformatics - drug discovery, protein structure elucidation, molecular dynamic simulation, and genomic data analysis.
c. Overview of genomics, proteomics, metabolomics and metagenomics and its application to health and agriculture.
d. Transgenic animals.

Unit III: Applied Entomology

a. Sericulture: species of silkworm, life history of *Bombyx mori.*
b. Apiculture: species of honeybees, life history, products of bees, enemies of bee.
c. Lac culture: species of lac insect, life history of *Laccifer lacca,* enemies of lac industry.
d. Common pests of crops.

Unit IV: Cattle farming

a. Traits and economic importance of different species of livestock.
b. Breeding methods for improvement of dairy cattle and buffaloes.
c. Species hybridization, linebreeding, outbreeding, outcrossing, Conservation of germplasm.
d. An overview of breakdown of organic matter and biogas plant.

Unit V: Aquaculture

a. Overview of aquaculture practices.
b. Introduction to Polyculture of fish.
c. Freshwater fishes, cold water fishes and brackish water fishes.
d. Culture of shrimps, prawns, edible oysters and pearl oysters.
e. Fabrication and maintenance of the aquarium.

Suggested Readings: (Latest Edition)

1. Willey J, Sherwood Woolverton CJ. Prescott's. Microbiology. McGraw Hill Publishers.
2. Lesk, A. Introduction to bioinformatics. Oxford University Press.
3. Banerjee G. C.A Textbook of Animal Husbandry. Oxford University Press.
4. Indian Council of Agricultural Research, ICAR. Handbook of Fisheries and Aquaculture.
5. Ghosh, Z. and Mallick, B. Bioinformatics: Principles and Applications. Oxford University Press.

Learning Outcomes:

After successful completion of this course, the students will be able to:

- understand the basic and fundamental aspects of applied biology.
- develop an understanding about the basics and applied aspects of computation biology, sericulture, apiculture, lac culture, cattle farming and aquaculture.

M.SC. COURSE
FIRST SEMESTER
SKILL ENHANCEMENT COURSE
COURSE TITLE: APPLIED BIOLOGY
COURSE CODE: ZOO-SEC-128
PRACTICAL

L	T	P	C
0	0	1	1

1. Sterilization techniques, media preparation and agar plate preparation.
2. Visit to cell culture and microbial culture facility.
3. Familiarization with bioinformatics databases: NCBI, PDB, SWISS PROT.
4. Pairwise sequence alignment using BLAST.
5. Writing a sequence in FASTA format.
6. Sericulture: Life history of silkworm
7. Apiculture: Life history of honeybee
8. Lac culture: Life history of Lac insect.
9. Fish Culture: Layout of Pond.
10. Edible freshwater fishes.
11. Common pests of Crops.
10. Visit to animal breeding center/ biogas plant/Biofertilizer Unit and submission of visit report.

M.Sc. II Semester

Name of Course	Paper Course Code	Paper Title	Credits
Discipline Specific Major-1	ZOO-DSM-221	Developmental Biology–Theory	04
	ZOO-DSM-222	Developmental Biology –Practical	02
Discipline Specific Major-2	ZOO-DSM-223	Fundamental Processes of Biology–Theory	04
	ZOO-DSM-224	Fundamental Processes of Biology –Practical	02
Multi-Disciplinary Major	ZOO-MDM-225	Evolution and Behavioral Science–Theory	04
	ZOO-MDM-226	Evolution and Behavioral Science –Practical	02
Skill Enhancement Course	ZOO-SEC-227	Inheritance Biology–Theory	03
	ZOO-SEC-228	Inheritance Biology–Practical	01
		Total Credits	22

M.SC. COURSE
SECOND SEMESTER
DISCIPLINE SPECIFIC MAJOR-1
COURSE TITLE: DEVELOPMENTAL BIOLOGY
COURSE CODE: ZOO-DSM-221
THEORY

L	T	P	C
4	0	0	4

Objective: To learn various events involved in the developmental process of different animals.

Unit I: Principles of Development in Biology

a. Introduction to Developmental Biology: The Stages of Animal Development, Embryonic Homologies, Malformations and Teratology.
b. Developmental Patterns in Unicellular Protists and Metazoa.
c. The Developmental Mechanics of Cell Specification.
d. Pattern formation and Morphogenesis
e. Determining the Function of Genes during Development.

Unit II: Early Embryonic Development

a. Structure of Gametes, Recognition of Egg and Sperm, Acrosomal Reaction. Egg envelops and classification of eggs.
b. Mechanism of Fertilization in reference to Sea Urchin and Mammals.
c. Pattern of cleavage, Morulation, Blastulation.
d. Gastrulation: Germ layers, morphogenetic movements, Axis determination, Variation in gastrulation in Sea Urchin, frog, avian and mammalian embryo.
e. Morphogenesis, Neurulation, Organogenesis (Eye, Kidney, limb).

Unit III: Late Embryonic Development

a. Metamorphosis in Amphibians.
b. Metamorphosis in Insects.
c. Regeneration in *Hydra,* flatworms and Salamander.
d. Sex determination approaches in developmental biology.
e. The Development of Blood Cells: The Stem Cell concept, the pluripotential hematopoietic stem cells, Blood and lymphocyte lineages, hematopoiesis.

Unit IV: Ramifications of Developmental Biology

a. Environmental Regulation of Normal Development.
b. Environmental Disruption of Normal Development.
c. Hox Genes: Descent with Modification.
d. Homologous pathway of Development.
e. Epigenetic regulation of developmentally relevant genes.

Unit V: Genes and development: Techniques and ethical issues

a. The Embryological Origins of the Gene Theory.
b. Differential Gene Expression.
c. RNA Localization Techniques.
d. Determining the Function of Genes during Development.
e. Identifying the Genes for Human Developmental Anomalies.

Suggested Readings: (Latest Edition)

1. Gilbert, Scott F. Developmental Biology, Oxford University Press.
1. John E. Hall and Michael E. Hall. Medical Physiology, Elsevier Health Science Publisher.
2. Brian Dale, Fertilization: From Gamete to Early Embryo, Cambridge University Press.
3. Gautam N. Allahbadia and Caludio F. Chillik, Human Embryo Transfer,Springer Nature Publisher.

Learning Outcomes:

After completing the course, students will be able to learn:

- mechanism of developmental processes, which generate an organism's heterogeneous shapes, size, and structural features.

SECOND SEMESTER
DISCIPLINE SPECIFIC MAJOR-1
COURSE TITLE: DEVELOPMENTAL BIOLOGY
COURSE CODE: ZOO-DSM-222
PRACTICAL

L	T	P	C
0	0	2	2

1. Demonstration of different types of Ovarioles in insects.
2. Preparation of window on hen's egg to see the development of embryo.
3. Squash preparation of testes of male insects to demonstrate spermatogenesis.
4. Section of ovaries of mammals showing oogenesis, development of graafian follicles and cropus luteum.
5. Section of testes of a mammal (rat/rabbit) showing spermatogenesis.
6. Development of chick showing morphogenesis & organogenesis by using 2,4,6,8,10 days incubated hen's eggs.
7. Effect of xenobiotics on teratogenesis using snail egg masses as model material.
8. Project report on Embryology of Chick, Sea Urchin and *C.elegans*.
9. Preparation of Model/Charts.
10. Twins' formation.

M.SC. COURSE
SECOND SEMESTER
DISCIPLINE SPECIFIC MAJOR-2
COURSE TITLE: FUNDAMENTAL PROCESSES OF BIOLOGY
COURSE CODE: ZOO-DSM-223
THEORY

L	T	P	C
4	0	0	4

Objective: To acquire knowledge on the several fundamental processes involved in the metabolic activities of animals.

Unit I: DNA replication, repair and recombination

a. DNA structure & function; Different topological forms of DNA.
b. DNA denaturation and renaturation curves.
c. DNA replication in prokaryotes and eukaryotes: general rules, mechanisms of DNA polymerase.
d. DNA damage and repair mechanisms.
e. Homologous and site-specific recombination.

Unit II: RNA synthesis and processing

a. DNA-Dependent Synthesis of RNA.
b. Transcription factors and machinery, formation of initiation complex, transcription. activator and repressor.
c. RNA polymerases, capping, elongation, and termination.
d. RNA processing, RNA editing, splicing, and polyadenylation.
e. Structure and function of different types of RNA.

Unit III: Protein synthesis and processing

a. Ribosome, formation of initiation complex, initiation factors and their regulation. Elongation and elongation factors, termination, genetic code.
b. Aminoacyl tRNA synthetase, and translational proof-reading.
c. Translational inhibitors.
d. Post- translational modification of proteins.

Unit IV: Control of gene expression at transcription and translation level

a. Regulating the expression of phages, viruses, prokaryotic and eukaryotic genes.
b. Role of chromatin in gene expression.
c. Gene silencing.

d. Constitutive, Inducible and Repressible gene expression.

e. Lac, Tryptophan, arabinose operons; Concept of attenuation.

Unit V: Innate and adaptive immune system

a. Types of Immunity (Innate, Adaptive, humoral, cell-mediated).

b. Cells of Immune system (B & T lymphocytes, Phagocytes, Granulocytic cells, Mast cells, NK Cells, Dendritic cells) .

c. Organs of Immune system- (Primary and secondary lymphoid organs-Thymus, marrow, Bone lymph nodes, spleen, MAST).

d. Immunoglobulins (structure, Types/Classes & functions)

e. Antibody and Antigen diversity and interactions

Suggested Readings: (Latest Edition)

1. Alberts Bruce, Johnson A, Lewis J , Raff M , Roberts K, Walter P. Molecular Biology of the Cell. Taylor and Francis. New York, USA.
2. Krebs J.E., Kilpatrick S.T. and Goldstein E.S. Lewin' GENES XI, Jones & Bartlett Learning. Burlington, MA.
3. Judy Owen, Jenni Punt, Sharon Stanford and Patricia Jones. Kuby Immunology, International Edition.
4. William E. Paul. Fundamentals of Immunology, Wiley.
5. Delves Peter J., Martin Seamus J., Burton Dennis R., Roitt Ivan M. Roitt's Essential Immunology, Wiley Blackwell.

Learning Outcomes:

The student at the completion of the course will be able to understand:

- Molecular biology involved in fundamental processes.
- In depth understanding about Immune System.

M.SC. COURSE
SECOND SEMESTER
DISCIPLINE SPECIFIC MAJOR-2
COURSE TITLE: FUNDAMENTAL PROCESSES OF BIOLOGY
COURSE CODE: ZOO-DSM-224
PRACTICAL

L	T	P	C
0	0	2	2

1. Preparation of solutions for molecular biology experiments.
2. Isolation of total histones and electrophoretic analysis.
3. Isolation of non-histone chromosomal proteins (high mobility group proteins) and electrophoretic analysis.
4. Isolation of plasmid DNA from bacteria.
5. Isolation and characterization of DNA using agarose gel electrophoresis.
6. Quantification of DNA using Diphenyl amine method.
7. RNA isolation and analysis on formaldehyde gel.
8. Quantification and purity determination of DNA /RNA using UV-Visible spectroscopy.
9. Digestion of DNA using restriction endonucleases.
10. Resolution and molecular weight estimation of fragmented DNA using Agarose gel electrophoresis.
11. Blood film preparation and identification of cells.
12. Isolation of mouse spleenocytes by density gradient centrifugation
13. ELISA
14. Radial immune diffusion.
15. Immunological diagnosis (Blood group).

M.SC. COURSE
SECOND SEMESTER
MULTI-DISCIPLINARY MAJOR
COURSE TITLE: EVOLUTION AND BEHAVIORAL SCIENCE
COURSE CODE: ZOO-DSM-225
THEORY

L	T	P	C
4	0	0	4

Objective: To learn historical evolutionary biology and animal behavior in different environment.

Unit I: Evolutionary Thoughts and Molecular Evolution

a. Biological Evolution, Lamarckism; Darwinism; the Modern Synthesis.
b. Evidence for Evolution: On small and large scale.
c. Origin of life and Cellular evolution: Major events in the history of life.
d. Evolution of Horse and Human.
e. Phylogeny: Phylogenetic tree, Homology and homoplasy, Principle of Parsimony and Maximum likelihood.

Unit II: Mechanism of Evolution

a. Hardy-Weinberg Equilibrium.
b. Genetic drift.
c. Adaptive radiation: Convergent and Divergent
d. Co-evolution
e. Sexual Selection

Unit III: Assessment of Animal behavior

a. Historical background, Stimulus-Response, Causal factors, Quantitative aspects – Duration, interval frequency.
b. Types of Memory, decoding brain regions, Neural method of learning.
c. Neural basis of sleep and arousal.
d. Biological clock, Hormones and Behavior.
e. Ethical guidelines to study animal behavior.

Unit IV: Innate, Learned and Communication Behavior

a. Innate behavior: characteristics, types, conditions favor innate behavior.
b. Learning: characteristics and types.
c. Popular experiments related to innate and learning behavior.
d. Social Communication
e. Territorial behavior

Unit V: Social, Foraging and Migratory behavior

a. Sociobiology: Group selection, Kin selection, Altruism.
b. Factors affecting foraging; Solitary and Group foraging.
c. Migration: cause, types and orientations, homing and long-distance migration.
d. Migration in Birds and fishes.
e. Reproductive strategies, Mating systems, Courtship, Sexual selection- patterns, parental care and investment. Dance language of honeybees, Pheromonal communication (Ants and mammals).

Suggested Readings: (Latest Edition)

1. S.C.Stearns and R.F.Hoekstra. Evolution: An Introduction by Oxford University Press, New York
2. N. H. Barton, D.E.G. Briggs, J.A. Eisen, D. B. Goldstein and N.H. Patel. Evolution. Cold Spring Harbor Laboratory Press, New York.
3. Dugatkin, L. A. Principles of animal behavior: Third international student edition. WW Norton & Company.
4. Breed, M. D., & Moore, J. Animal behavior. Academic Press.
5. Bolhuis, J. J., Giraldeau, L. A. E. The behavior of animals: Mechanisms, function, and evolution. Blackwell Publishing.

Learning Outcomes:

After successful completion of this course students should be capable of:

- Designing and implementing experiments to test quantitative concept of evolution.
- Understand and identify the behavior in a variety of taxa and get a deep interest in evolutionary processes.

M.SC. COURSE
SECOND SEMESTER
MULTI-DISCIPLINARY MAJOR
COURSE TITLE: EVOLUTION AND BEHAVIORAL SCIENCE
COURSE CODE: ZOO-DSM-226
PRACTICAL

L	T	P	C
0	0	2	2

1. Study the Convergent and Divergent Evolution using Museum Specimens.
2. Study of Darwin finches.
3. Study the Practical Applications of Hardy-Weinberg Law.
4. Study Parental Care/ nest building/ sexual dimorphism.
5. Study of Learning Behavior.
6. Study of Learning Behavior in Mice by Using a Zigzag or T-Shaped Maze.
7. Study of Wall-seeking Behavior in Mice.
8. Preparation of Chart/Models.
9. A Field Study of Foraging or Trail Making Behavior in a Seed Harvester or Predatory Ant Species.

M.SC. COURSE
SECOND SEMESTER
SKILL ENHANCEMENT COURSE
COURSE TITLE: INHERITANCE BIOLOGY
COURSE CODE: ZOO-DSM-227
THEORY

L	T	P	C
3	0	0	3

Objective: To become familiar with the biology of inheritance and its common application.

Unit I: Mendelian genetics and its extension and methods of gene mapping

a. Dominance, segregation, independent assortment.
b. Concept of gene: allele, multiple alleles, pseudoalleles, complementation tests.
c. Extension of Mendelian principles: codominance, incomplete dominance, gene. interactions, pleiotropy, genomic imprinting, penetrance and expressivity, sex linked inheritance, extra chromosomal inheritance, dosage compensation.

Unit II: Methods of gene mapping, microbial, human and quantitative genetics

a. Recombination, linkage and crossing over, Linkage maps, tetrad analysis, mapping with molecular markers, somatic cell genetics.
b. Exchange of genetic material in bacteria: transformation, conjugation, transduction and sex-duction, mapping genes by interrupted mating.
c. Pedigree analysis: symbols used, construction and analysis of pedigrees, lod score for linkage testing.
d. Polygenic inheritance, heritability and its measurements, QTL mapping.

Unit III: Gene mutation and DNA repair

a. Types and causes of gene mutations, mutant types – lethal, conditional, biochemical, loss of function, gain of function, germinal versus somatic metants, insertional mutagenesis.
b. Structural and numerical alterations of chromosomes: deletion, duplication, inversion, translocation, aneuploidy and polyploidy.
c. Methods for detection of induced mutation.
d. DNA damage and repair mechanisms.

Unit IV: Eukaryotic chromatin structure and chromosome organization

a. Nature of genetic material, evidence of DNA as the genetic material
b. Chromosomal proteins: histones and their modifications, non-histone proteins,
c. Scaffold/matrix proteins.
d. Chromatin condensation, Heterochromatin and euchromatin, centromere, kinetochore and telomere.
e. Chromosome and chromatid type aberrations.

Unit V: Human genetic disorders

a. Overview of Mendelian inheritance and diseases.
b. Sickle cell, hemochromatosis, cystic fibrosis, Duchenne muscular dystrophy,
c. Huntington's disease, achondroplasia, phenylketonuria.
d. Turner syndrome, Down Syndrome, Patau syndrome, Klinefelter syndrome.
e. Metaphase chromosome banding, karyotypes.

Suggested Readings: (Latest Edition)

1. Snustad & Simmons. Principles of Genetics. John Wiley.
2. Griffith et al. Modern Genetic Analysis. Freeman.
3. Alberts et al. Molecular Biology of the Cell.Garland.
4. Hartl & Jones. Essential Genetics: A Genomic perspective, Jones & Bartlet.
5. Krebs et al., 2011.Lewin's Genes X.Jones & Barlett.

Learning Outcomes:

After successful completion of this course, the students will be able to:

- describe fundamental molecular principles of genetics.
- develop an understanding about the modern genetic analysis by explaining the mechanisms leading to genetic recombination and gene mapping.

M.SC. COURSE
SECOND SEMESTER
SKILL ENHANCEMENT COURSE
COURSE TITLE: INHERITANCE BIOLOGY
COURSE CODE: ZOO-DSM-228
PRACTICAL

L	T	P	C
0	0	1	1

1. Culture and handling of *Drosophila* and study of its life cycle, stages of growth and identification of anatomical structures.
2. Basics of setting up genetic crosses and observation of phenotypes from monohybrid and dihybrid crosses and verification of the results using chi square test.
3. Dissections of salivary glands from third instar larvae of *Drosophila* and temporary squash preparation of polytene chromosomes.
4. Study of meiosis in grasshopper testes by squashing method.
5. Study of sex chromatin in human female from buccal epithelial and hair bud cells.
6. Study of human karyotypes.
7. Study of permanent slides/photomicrograph of the following: (a) Dicentric bridge in the anaphase 1 chromosomes of grasshopper, (2) inversions in polytene chromosomes of *Drosophila,* (3)Lampbrush chromosomes, (4) G-banded and C-banded metaphase chromosomes, (5) chromatid exchanges and chromosomal anomalies, (6) sister chromatid exchanges.
8. Numerical Problems related to Genetics.

M.Sc. III Semester

Name of Course	Paper Course Code	Paper Title	Credits
Discipline Specific Major-1	ZOO-DSM-321A	Cell Physiology–Theory	04
	ZOO-DSM-321B	Insect Morphology and Physiology - Theory	04
	ZOO-DSM-321C	Fish: Structure and Function–Theory	04
	ZOO-DSM-321D	General Parasitology–Theory	04
	ZOO-DSM-322A	Cell Physiology-Practical	02
	ZOO-DSM-322B	Insect Morphology and Physiology - Practical	02
	ZOO-DSM-322C	Fish: Structure and Function-Practical	02
	ZOO-DSM-322D	General Parasitology-Practical	02
Discipline Specific Major-2	ZOO-DSM-323A	Molecular Biology of Cell – Theory	04
	ZOO-DSM-323B	Insect Taxonomy, Ecology and Applied Entomology-Theory	04
	ZOO-DSM-323C	Applied Fish and Fisheries-Theory	04
	ZOO-DSM-323D	Medical Parasitology- Theory	04
	ZOO-DSM-324A	Molecular Biology of Cell - Practical	02
	ZOO-DSM-324B	Insect Taxonomy, Ecology and Applied Entomology -Practical	02
	ZOO-DSM-324C	Applied Fish and Fisheries-Practical	02
	ZOO-DSM-324D	Medical Parasitology-Practical	02
Multi-Disciplinary Major	ZOO-MDM-325	Ecological Principles-Theory	04
	ZOO-MDM-326	Ecological Principles –Practical	02
Skill Enhancement Course	ZOO-SEC-327	Tools, Technology and Scientific Writing -Theory	03
	ZOO-SEC-328	Tools, Technology and Scientific Writing –Practical	01
		Total Credits 22	

M.Sc. COURSE
THIRD SEMESTER
DISCIPLNE SPECIFIC MAJOR-1
COURSE TITLE: CELL PHYSIOLOGY
COURSE CODE: ZOO-DSM-321A
THEORY

L	T	P	C
4	0	0	4

Objective: To make aware the students about various aspects of cell functioning.

Unit I: Introduction to the Cell

a. Universal features of Cell
b. Genetic Information in Eukaryotes
c. Chemical Components of a Cell
d. Cell Mechanism to obtain energy from food
e. Protein components and their functions

Unit II: Internal Organization of Cell

a. Membrane structure : Lipid Bilayer, Membrane Proteins
b. Principles of Membrane transport
c. Carrier proteins and Active Membrane transport
d. Ion Channels and the Electric properties of Membranes
e. Cell junctions

Unit III: Intracellular Compartments and Protein sorting

a. Compartmentalization of Cells
b. Transport of molecules between the nucleus and the cytosol
c. Peroxisomes and Endoplasmic reticulum
d. Transport into the cell from the plasma membrane: Endocytosis
e. Transport from the Tans Golgi Network to the cell exterior: Exocytosis

Unit IV: Cell cycle and Cell Division

a. An overview of Cell cycle
b. Components of the Cell-cycle Control System
c. Programmed Cell death
d. Extracellular Control of cell division and cell growth
e. Mechanics of Cell division (MPhase, Mitosis, Cytokinesis)

Unit V: Cell Communication and Cytoskeleton

a. Signaling through G-Proteins -Linked Cell Surface Receptors
b. Signaling through Enzyme -Linked Cell Surface Receptors
c. Signaling pathways
d. Structure of Cytoskeleton filaments
e. Cytoskeleton and Cell behavior

Suggested Readings: (Latest Edition)

1. B. Alberts, D. Bray, J. Lewis, M. Raff, K. Roberts and J.D. Watson. Molecular biology of the Cell. Garland Publishing Inc., New York
2. J.Darnell, H. Lodish and D. Batlimore, Molecular cell biology. Scientific American Book, Inc., USA

Learning outcome: Students will be able to understand structure and functioning of cells.

M.SC. COURSE
THIRD SEMESTER
DISCIPLINE SPECIFIC MAJOR-1
COURSE TITLE: INSECT MORPHOLOGY AND PHYSIOLOGY
COURSE CODE: ZOO-DSM-321B
THEORY

L	T	P	C
4	0	0	4

Objective: To acquaint students with the morphology and physiological systems of insects.

Unit I: General organization of the insect body

a. Head: Segmentation, structure, endoskeleton, antenna.
b. Mouth: Structure and mechanism of feeding, types of mouth parts.
c. Thorax: Structure, endoskeleton, structure and modification of legs.
d. Wings: Origin, structure, modification and function of wings.
e. Abdomen: Structure, pregenital appendages, cerci and external genitilia.

Unit II: Integument and Digestive System

a. Integument: Structure and functions, moulting.
b. Components of sclerotized cuticle (structural proteins, chitin, catechols, enzymes)
c. Digestive system: Structure of the alimentary canal and physiology of digestion.
d. Digestion of special food stuffs (wool, collagen, keratin, pollen, silk, wax.
e. Intermediary metabolism of carbohydrates, fats and protein, fat body.

Unit III: Respiratory, Circulatory and Excretory System

a. Respiratory system: Structure and physiology of respiration in terrestrial and aquatic insects, Respiratory adaptations in endoparasitic insects.
b. Circulatory system: Circulatory organs and physiology of circulation, types and functions of hemocytes.
c. Excretory system: Structure of excretory organs and physiology of excretion, Control of diuresis, Water regulation, Detoxification.

Unit IV: Neuro-endocrine System and Sense Organs

a. Endocrine glands and concept of neurosecretion, Biosynthesis and degradation of hormones, Function of JH and ecdysteroids, Eicosanoids and their functions.
b. Nervous system: Structure of brain and physiology of nervous system Neurotransmitters and neuromodulator system.
c. Neuron endocrine system: Structure of neuroendocrine glands, endocrine control of metamorphosis and reproduction.
d. Sense organs: photoreception, mechanoreceptor and chemoreception, sound production in insects.

Unit V: Reproductive System

a. Reproductive System: Structure of male and female reproductive system, spermatogenesis and oogenesis, Mating, insemination, oviposition.
b. Embryology: Pre and post embryonic development.
c. Bioluminescence: Light producing organs, mechanism and significance of light production.

Suggested Readings: (Latest Edition)

1. Chapman, R. The Insects: Structure and Function (S. Simpson & A. Douglas, Eds.). Cambridge: Cambridge University Press.
2. Gullan, P. J., & Cranston, P. S. The insects: an outline of entomology. John Wiley & Sons.
3. Marshall, S. A. Insects: their natural history and diversity: with a photographic guide to insects of eastern North America. Richmond Hill, Ont.: Firefly Books.
4. Imms. A General Text Book of Entomology (2 vols.), Asia Publishing House.
5. Wigglesworth. Principles of Insect Physiology, ELBS.

Learning Outcomes:

The course provides the basic concepts of Insect biology which will enable the students:

- An understanding of the various physiological systems of insects.
- An understanding of structural differences in the physiological systems of insects from varied habitats.

M.SC. COURSE
THIRD SEMESTER
DISCIPLINE SPECIFIC MAJOR-1
COURSE TITLE: FISH: STRUCTURE AND FUNCTION
COURSE CODE: ZOO-DSM-321C
THEORY

L	T	P	C
4	0	0	4

Objective: To learn structure and function of different systems of fishes to live in diverse water bodies.

Unit I: Integumentary and Skeletal System

a. Skin: structure, composition and function; Barbels in fishes.
b. Scales: Types, structure and composition.
c. Tail: structural modifications.
d. Axial and Appendicular Skeleton Cranium bones, Vertebrae and skeletal elements of fins.
e. Weberian Apparatus: Structure, homology and function.

Unit II: Lateral Line System and Specialized organs in fishes

a. Lateral line canal structure and function, Relationship of lateral line system with internal ear and Neuromast organs.
b. Electric organs: Structure and mechanism of function.
c. Sound producing organs: Sonic mechanism in various fishes and significance of sound production in fishes.
d. Poison glands: Difference between poisonous and venomous fishes, chemical nature of Fish toxins.
e. Light Producing Organ: Structure and mechanism of light emission.

Unit III: Respiratory and Blood vascular System

a. Structure and types of gills.
b. Blood supply and mechanism of respiration.
c. Accessory Respiratory Organs.
d. Structure of heart, Blood Vessels; Arterial and Venous System.
e. Mechanism of circulation of blood in fishes.

Unit IV: Digestive System and Excretory System

a. Digestive System in fishes
b. Digestive glands and their role in physiology of digestion
c. Adaptive modifications in digestive tract of fishes.
d. Structure of kidney and physiology of excretion.
e. Osmoregulation and Ionic Balance in marine and freshwater teleost.

Unit V: Nervous and Reproductive System

a. Structure and function of Central and peripheral nervous system.
b. Cranial nerves, Photoreception, chemoreception, mechanoreception, electroreception.
c. Gonads: male and female; Reproductive cycle and maturation.
d. Spawning and Development in fishes.
e. Parental care.

Suggested Readings: (Latest Edition)

1. Norman J. and Greenwood P.H. A History of Fishes, Halsted Press.
2. Lagler K.F., Bardach, J.E., Miller, R.R., Passino, D.R.M. Freshwater Fishery Biology by Ichthyology.John Wiley & Sons, New York.
3. Moyle P.B. Fishes: An introduction to Ichthyology. Printice-Hall, Englewood Cliffs.
4. Jayaram K.C. Fundamentals of Fish Taxonomy. Todays and Tomarrow Publication,New Delhi.
5. Gopal Ji Srivastava. Fishes of U.P. and Bihar. Rastogi Publication,Meerut.
6. Hoar W.S., Randall D.J. and Donaldson E.M. Fish Physiology. Academic Press, New York.
7. Pandey K. and Shukla, J.P. Fish and Fisheries. Rastogi publication, Meerut UP, India.
8. Khanna, S.S. and Singh, H.R., 2016. A textbook of Fish Biology and Fisheries, Narendra Publishing House, Delhi, India.

Learning Outcomes:

- After successfully completing this course, the students will be able to understand morphological and anatomical variations in different groups of fishes.

M.SC. COURSE
THIRD SEMESTER
DISCIPLINE SPECIFIC MAJOR-1
COURSE TITLE: GENERAL PARASITOLOGY
COURSE CODE: ZOO-DSM-321D
THEORY

L	T	P	C
4	0	0	4

Objective: To introduce students to recognize parasites which are important for human health and caused disease.

Unit I: General Parasitology

a) Scope and historical landmarks in Parasitology
b) Parasite fauna of hosts belonging to different groups
c) Properties of parasites, Kinds of parasites, Host specificity
d) Host-parasite relationship, Hyper-parasitism, Parasitoids
e) Relation of parasite fauna with food, age and migration of the host and season of the year.

Unit II: Parasitic Protozoa

a) Parasitic Protozoa: Form, Function and Classification
b) Amoebae : *Entamoeba histolytica*, *Naegleria fowleri*, *Acanthamoeba*.
c) Flagellates: *Giardia lamblia, Trichomonas vaginalis*, *Trypanosoma*, *Leishmania.*
d) Sporozoans: *Plasmodium*, *Toxoplasma gondii*, *Cryptosporidium parvum*, *Cyclospora cayetanensis*.
e) Veterinary importance protozoans: *Trypanosoma evansi*, *Eimeria*, *Isospora*, and *Babesia bigemina*.

Unit III: Helminthes parasites

a) Trematoda: Form, Function, and Classifications of Digeneans
b) Life cycle Strigeiformes, Echinosteomatiformes, Plagiorchiformes and Opisthoformes
c) Cestoidea: Form, Function, and Classifications of Tapeworms
d) General organization, life cycle, pathology, laboratory diagnosis, control and prevention of diseases caused by Clonorchis sinensis, *Paragonimus westermani*.
e) Characteristics of *Gastrothylax species*, Strigeidae, *Diplostomatidae* and Prohemistomidae.

Unit IV: Nematode parasites

a) Nematoda : Form, Function, and Classifications

b) General organization, life cycle: Trichinellida, Dioctophymatida, Enolplean, Tylenchina, Strongyloidea, Rhabditians, Oxyuridomorpha, Gnathostomatomorpha, Spiuromorpha, Filaroidea (Filarial worms), Dracunculoidea (Guinea worms), Nematomorpha (Hair worms), Acanthocephala (Thorny-Headed Worms)

c) Veterinary: *Trichostrongylus orientalis*, *Haemonchus contortus*, *Thelazia callipaeda*.

d) Plant: Stem nematodes (*Anguina tritici*). Root-gall nematodes (*Meloidogyne incognita*). Cyst-nematodes (Heterodera and Globodera). Predatory (Mononchus). Migratory (Xiphinema) and Free-living soil nematodes: *Tylenchus*, *Rhabditis* and *Dorylaimus*.

Unit V: Arthropod parasites

a) Arthropod Parasite: Form, Function and Classification

b) Parasitic Crustaceans

c) Parasitic Insects: Phthiraptera, Chewing and Sucking Lice, Hemiptera, Bugs, Diptera, Flies Strepsiptera, Hymenoptera.

d) Parasitic Arachnids: Subclass Acari, Ticks and Mites

Suggested Readings: (Latest Edition)

1. Gerald D. Schmidt & Roberts S. Larry. Foundations of Parasitology. McGraw-Hill Publisher, New York.
2. Belding D. L. Mereditch. Textbook of Parasitology. New York. Cameron T.W.M. and Black A.C. Internal Parasites of Domestic Animals London. Cameron T.W.M. Parasites and Parasitism (ELBS) John Wiley, New York.
3. Thorne G. Principles of Nematology. McGraw-Hill Book Company, New York.
4. Wee D.L. The Physiology of Nematodes. Oliver and Boyd Ltd, London

Learning Outcomes:

- After successfully completing this course, the students will be able to recognize specific and nonspecific parasites to human and comprehend the characteristics of parasites.

M.SC. COURSE
THIRD SEMESTER
DISCIPLINE SPECIFIC MAJOR-1
COURSE TITLE: CELL PHYSIOLOGY
COURSE CODE: ZOO-DSM-322A
PRACTICAL

L	T	P	C
0	0	2	2

1. Microscopic examination of blood cells
2. Microscopic examination of slides of cell division
3. Types of Centrifuges for cell organelles separation.
4. Localization of protein in Cells.
5. Localization of Lipids in Cells.
6. Demonstration of simple diffusion.
7. Demonstration of osmosis.
8. Preparation of chart/model showing uniport, symport and antiport.
9. Preparation of chart/model showing Glycolysis, Citric acid cycle, Oxidative Phosphorylation.
10. Preparation of chart/model showing various stages of Cell organelle.
11. Students will visit various recognized scientific institutions of India to understand the relevant equipment and their functions.

M.SC. COURSE
THIRD SEMESTER
DISCIPLINE SPECIFIC MAJOR-1
COURSE TITLE: INSECT MORPHOLOGY AND PHYSIOLOGY
COURSE CODE: ZOO-DSM-322B
PRACTICAL

L	T	P	C
0	0	2	2

1. Types of antenna and mouth parts.
2. Different types of wings, tegmina, hemielytra, different types of wings venation.
3. Male genitalia: Grasshopper and coleoptera and Female genitalia: Grasshopper, Gryllus, Coleoptera
4. Preparation of pericardial cells, oenocytes and nophrocytes.
5. Different types of spiracles, opening and closing mechanism respiratory organs in aquatic insects.
6. Preparation of stained histological slides of alimentary canal of cockroach (fore gut, mid gut and hind gut), salivary apparatus of cockroach/*Dysdercus* and malpighian tubules of cockroach.
7. Dissection of CNS of cockroach/*Dysdercus* and whole mount-stained preparation of Brain, Corpora cardiac, Corpora allata and Prothoracic gland.
8. Preparation of a permanent slide of sting apparatus of honeybee.
9. Dissection of salivary glands of *Drosophila* larvae and Chironomus larvae and demonstration of polytene chromosome.
10. Physiology experiments to show the functions of malpighian tubules.
11. Identification of different types of haemocytes from a given insect.
12. Demonstration of presence of chitin in the cuticle of cockroach.

M.SC. COURSE
THIRD SEMESTER
DISCIPLINE SPECIFIC MAJOR-1
COURSE TITLE: FISH: STRUCTURE AND FUNCTION
COURSE CODE: ZOO-DSM-322C
PRACTICAL

L	T	P	C
0	0	2	2

1. Major dissection
    a. Cranial nerves of teleost fishes.
    b. Blood vascular system of any teleost fish.
2. Minor dissection
    a. Weberian ossicles of *Clarias.*
    b. Dissection of Internal ear.
    c. Accessory respiratory organ, pituitary gland.
3. Permanent mounting of ctenoid and cycloid scales.
4. Study of museum specimen, slides and bones.
5. Display of visceral organs; preparation of fish skeleton.
6. RBC count of any fish.
7. Haemoglobin percentage of fish blood.
8. Comparative study of digestive enzymes of herbivore, carnivore and omnivore fishes.
9. Histology of fish: Submission of 50 slides.
10. Preparation of Skeleton, Models and Charts.

M.SC. COURSE
THIRD SEMESTER
DISCIPLINE SPECIFIC MAJOR-1
COURSE TITLE: GENERAL PARASITOLOGY
COURSE CODE: ZOO-DSM-322C
PRACTICAL

L	T	P	C
0	0	2	2

1. Permanent slides preparation and identification of various protozoan parasites and arthropod vectors.
2. Laboratory methods of examination (macroscopic and microscopic examination, saline wet mount, iodine wet mount, concentration techniques – floatation and sedimentation, Stoll's methods for counting eggs).
3. General methods of microscopic preparations (killing, fixing, washing, dehydration, staining, destaining, mounting).
4. Preparation of blood film.

M.SC. COURSE
THIRD SEMESTER
DISCIPLNE SPECIFIC MAJOR-2
COURSE TITLE: CELL TRANSPORT AND SIGNALLING
COURSE CODE: ZOO-DSM-323A
THEORY

L	T	P	C
4	0	0	4

Objective: To make aware the students about various aspects of cell functioning.

Unit I: Protein Transport across ER, Golgi and Lysosomes

a. Protein glycosylation, Protein folding and modification in ER, Degradation of misfolded protein in cytosol
b. Synthesis of membrane lipid
c. Transport of protein across ER membrane, Insertion of protein into ER membrane
d. Protein transport from ER to Golgi, Protein transport through cisternae

Unit II: Protein transport across Mitochondria and Chloroplast

a. Targeting of mitochondrial proteins, uptake targeting sequences of protein, targeting to inner membrane
b. Membrane receptors and translocons
c. Chimeric proteins and mitochondrial import
d. Energetics of protein transport
e. Signaling pathways for protein transport

Unit III: Protein transport across Nucleus, Lysosomes and Peroxisomes

a. Transport through Nuclear Pore Complex
b. Nuclear localization signals, nuclear export signals
c. Export of mRNA
d. Protein transport from TGN to Lysosomes
e. Sorting of peroxisomal proteins

Unit IV: Cell Signaling – I

a. Signal molecules, Cell surface receptors, intracellular receptors
b. GPCR and G-proteins, regulation of ion channels, activation or inhibition of adenylyl cyclase

c. cAMP and kinase A, protein kinases and phosphatases
d. Activation of phospholipase C
e. Cell response to environmental influences

Unit V: Cell Signaling – II

a. Receptor tyrosine kinases: Enzyme linked receptors, Ras-MAP kinase pathway, IP_3- DAG pathway, PI_3 kinase pathway,
b. Insulin signaling pathway, mTOR pathway
c. Tyrosine kinases associated receptors: JAK-STAT pathway
d. Serine/threonine kinase receptors
e. Chemotaxis in bacteria, Quorum sensing; Scatchard plot

Suggested Readings:

1. Molecular cell biology. J.Darnell, H. Lodish and D. Batlimore, Scientific American Book, Inc., USA
2. Molecular biology of the Cell. B. Alberts, D. Bray, J. Lewis, M. Raff, K. Roberts and J.D. Watson. Garland Publishing Inc., New York
3. Lehninger, Principles of Biochemistry, 5th Edition
4. Life Sciences, Fundamentals and Practice, Pranav Kumar, Usha Mina. Pathfinder Publication, New Delhi.

Learning outcomes: After completion of the course the students will be able to understand:

- Biochemicals transport in and out of the cell.
- Signaling for various transport and metabolic pathways.

M.SC. COURSE
THIRD SEMESTER
DISCIPLINE SPECIFIC MAJOR-2
COURSE TITLE: TAXONOMY, ECOLOGY AND APPLIED ENTOMOLOGY
COURSE CODE: ZOO-DSM-323B
THEORY

L	T	P	C
4	0	0	4

Objective:

To acquaint students with taxonomical and biological diversity of insects as well as their role in the ecosystems.

Unit I: Insect taxonomy

a. Overview of insect classification up to families following Imm's revised by Richards and Davis.
b. Identification of Apterygota: Thysanura, Diplura, Protura, Collembola.
c. Identification of Pterygota: Odonata, Orthoptera, Dictyoptera.
d. Identification of Hemipteroid: Hemiptera (Homoptera&Heteroptera).
e. Identification of Neuroptera: Coleoptera.
f. Identification of Panorgod insects: Diptera, Lepidoptera, Hymenoptera.

Unit II: Insect Plant Interaction

a. Major pests, nature of damage and pest management of the following:
b. Stored grain pests: Wheat, Gram and Rice.
c. Vegetable: Cabbage, Okra, Brinjal, Tomato and Potato.
d. Fruits: Mango, Citrus and Papaya.
e. Cereals: Yellow split Pigeon peas (Arhar), Yellow lentils (Moong) and Red lentils (Masoor).
f. Cash crops: Sugar cane, Cotton and Mustard.

Unit III: Insect Pest Management

a. Natural and Cultural Methods.
b. Chemical control: Classification of Insecticides and mode of action.
c. Biological control: Principle, Mechanism of action, Merits and demerits.
d. Role of Hormones, Pheromones, Antifeedants, Attractants and Repellents.
e. Concept and Procedure of Integrated Pest Management

Unit IV: Insect Ecology

a. Principles of Insect ecology.
b. Aquatic insect ecology.
c. Effect of temperature and light on biology of insects.
d. Social life and behaviour of Insects with special reference to Termite and Bees.
e. Environmental impact of Insecticides. Mechanism of developing resistance in Insects against insecticides.
f. Industrially important insects (Apiculture, Sericulture and Lac Culture).

Unit V: Urban entomology

a. Common Insects of Medical and Veterinary Sciences and their Life cycle.
b. Common vector insects their mode of Transmission, Life cycle, Diseases and Control.
c. Common Insects of Forensic and Forest Sciencesand their Life cycle.

Suggested Readings: (Latest edition)

1. Imms, A. D., Richards, O. W., & Davies, R. G. Imms' General Textbook of Entomology: Volume 2: Classification and Biology. Springer Science & Business Media
2. Gullan & Cranston. The Insects: An Outline of Entomology. Wiley Blackwell.
3. Schowalter, T.D. Insect Ecology: An Ecosystem Approach. Academic Press.
4. Snodgrass, R.E. Principles of Insect Morphology.Cornell University Press.
5. Mullen and Durden. Medical and Veterinary Entomology, Academic Press.
6. Atwal and Dhaliwal.Agricultural pests of India and South-East Asia, Kalyani Publishers,New Delhi.
7. Omkar. Ecofriendly Pest Management for Food Securit,Academic Press.
8. Byrd and Castner. Forensic Entomology, CRC Press.

Learning Outcomes:

At the end of the course the students will be able to:

- identify insect and important pests of crops.
- understand pest management measures.
- understanding of how insects interact with each other and their natural environment.

M.SC. COURSE
THIRD SEMESTER
DISCIPLINE SPECIFIC MAJOR-2
COURSE TITLE: APPLIED FISH AND FISHERIES
COURSE CODE: ZOO-DSM-323C
THEORY

L	T	P	C
4	0	0	4

Objective: To learn about different available fish resources and their application for the commercial use.

Unit I: Fish Systematics

a. Salient features of fishes
b. Berg's Classification of fishes
c. Salient features and Classification of Elasmobranchs
d. Salient features and Affinities of Holocephali
e. Salient features and Affinities of Dipnoi

Unit II: Fish Taxonomy and Ecology

a. Taxonomy of Bony fishes
   Clupeiformes, Cypriniformes, Cyprinidontiformes, Beloniformes, Mugiliformes, Mastacembaliforme.Pphiocephaliformes, Symbranchifrmes, Tetradontiformes
b. Induced breeding
c. Aquatic weeds and their control
d. Common Fresh water and Marine food fishes of India

Unit III: Capture Fisheries

a. Riverine Fisheries
b. Estuarine Fisheries
c. Lakestrine Fisheries
d. Costal Fisheries
e. Cold water fisheries and Hill stream adaptation

Unit IV: Fishpond Management and other Culture Practices

a. Construction and lay-out of different types of ponds (nursery, rearing, and stocking)
b. Types of cultivable fishes
c. Composite fish culture
d. Sewage fed fisheries
e. Larvicidal fishes in India

Unit V: Fish Preservation and Processing

a. Fish spoilage, rigor mortis, rancidity, enzymatic spoilage, microbial spoilage.
b. Principles of fish preservations and Methods of preservation.
c. Fish by-products.
d. Fish pathology: prevention, prophylaxis and treatment of Fungal, Bacterial, Viral and Protozoan Diseases.
e. Fish in relation to Man and Human Welfare.

Suggested Readings: (Latest edition)

1. Jhingran V.G. Fish and Fisheries of India, Hindustan Publishing Corporation,New Delhi.
2. Reid G.R. Ecology and Inland waters and Estuaries. Rein Hold Corp., New York.
3. Potts G.W. and Wootten R.J. Fish Reproduction: Strategies and Tactics, Academic Press.
4. Pandey K. and Shukla J.P.Fish and Fisheries, Rstogi Publication, Merrut UP.
5. 6.Khanna S.S. and Singh H.R. Fish Biology and Fisheries. Narendra Publishing House,Delhi.

Learning Outcomes:

The course will prepare the students for:

- self-employment, and
- the jobs related to the fish and fisheries.

M.SC. COURSE
THIRD SEMESTER
DISCIPLNE SPECIFIC MAJOR-2
COURSE TITLE: MEDICAL PARASITOLOGY
COURSE CODE: ZOO-DSM-323D
THEORY

L	T	P	C
4	0	0	4

Course Objectives: To understand life cycle of parasites, the diseases they produce and the epidemiology, transmission routs, pathogenesis, signs and symptoms and, diagnosis of such diseases, and the prevention and other control measures.

Unit I: Viruses and Bacteria

a) Virus introduction, Mode of transmission, Molecular characteristics
b) Clinical presentation and control measures of human viral diseases (Hepatitis A, B & C, Dengue, Mumps, Influenza and HIV)
c) General introduction to bird flu (avian influenza)
d) Control measures of human bacterial diseases (Meningitis, Tuberculosis, Typhoid and Leprosy Brucellosis, Plague)

Unit II: Immunization

a) Immunization: Immune response to bacterial, viral, protozoans and helminthic infections
b) Immunizing agents. Type of vaccine. The cold chain
c) Community based control by vaccination. Current vaccine practice
d) Factors influencing the success of vaccination. Hazards of immunization

Unit III: Epidemiology

a) Definition, aims and uses of Epidemiology. Basic measurements in Epidemiology
b) Measurement of mortality, morbidity; incidence and prevalence of diseases
c) Modes of transmission of communicable diseases.
d) Parasitic opportunistic infections in AIDS cases and Nosocomial parasitic infections.
e) Health advice to travelers. Sterilization and disinfection.

Unit IV: Pharmacology

a) Pharmacology: Routes of drug administration (local and systemic).
b) Pharmacokinetics: absorption of the drug, drug distribution, metabolism of drug, storage and excretion.
c) Pharmacodynamics: drug target, site of drug action, principles of drug action, factors affecting drug action, mechanism of drug action.
d) Antimicrobial agents: Definition, classification. Antibiotics- its rule while using, mechanism of action of antibiotics, problems while using antimicrobial agents. Anthelmintics and antiprotozoan medicines

Unit V Environmental Parasitology :

a) Water-related diseases.
b) Bio-medical waste management.
c) Milk Hygiene and milk-born diseases.
d) Disasters and communicable diseases.
e) Influence of human activity on the parasitic fauna of animals and man.

Suggested Readings: (Latest edition)

1. Bogitsh, Burton J. Human Parasitology. Academic Press, Amsterdam, Boston. Garcia, Lynn Shore, 2007. Diagnostic Medical Parasitology. ASM Press; Washington,
2. DC. Garcia, Lynne Shore. Practical Guide to Diagnostic Parasitology. ASM Press; Washington, DC.
3. Gillaspy, SH and PM. Hawkey . 1995. Medical Parasitology: A Practical Approach. IRL Press at Oxford University Press; Oxford; New York.
4. Loker, Eric S. and Hofkin, Bruce V. Parasitology: A Conceptual Approach. Garland Science, Taylor and Francis Group; New York and London.

Learning Outcome:

The course will prepare the students for:

- diagnosing the agent of parasitic-infectious diseases, control strategies, research, and education.
- participating in control and preventive program of parasitic disease

M.SC. COURSE, SESSION
THIRD SEMESTER
DISCIPLINE SPECIFIC MAJOR-2
COURSE TITLE: CELL TRANSPORT AND SIGNALLING
COURSE CODE: ZOO-DSM-324A
PRACTICAL

L	T	P	C
0	0	2	2

1. Study of cell organelles by EM photographs.
2. Study of membrane proteins and lipids.
3. Study of about targeting of proteins to ER, Golgi, Lysosomes and Peroxisome.
4. Study of model and chart showing cell surface receptors.
5. Study of model and chart showing mitochondrial import.
6. Study of model and chart showing transport through Nuclear Pore Complex.
7. Study of model and chart showing export of mRNA from nucleus.
8. Study of model and chart showing Insulin signaling pathway, mTOR pathway.
9. Study of model and chart showing Chemotaxis in bacteria.
10. Students will visit various recognized scientific institution of India to understand the relevant equipment and their functions.

M.SC. COURSE
THIRD SEMESTER
DISCIPLINE SPECIFIC MAJOR-2
COURSE TITLE: TAXONOMY, ECOLOGY AND APPLIED ENTOMOLOGY
COURSE CODE: ZOO-DSM-324B
PRACTICAL

L	T	P	C
0	0	0	2

1. Collection and preservation of different orders of Insects using:
    - Dry preservation methods (Direct pinning)
    - Liquid Preservation and processed Mounting Methods.
2. Study of key features of orders Orthoptera, Hemiptera, Diptera, Lepidoptera, Hymenoptera.
3. Study of Insect pests of stored grains.
4. Study of life cycle and habitat of mosquito House flies, Honey bee, Lac Insects and Silk Worm.
5. Preparation of a permanent slide of different body parts of Insects i.e. Antenna, Legs and Wings.
6. Study of a permanent slide (W. M.) of Insects and their Body parts.
7. Field study of Aquatic insects.

M.SC. COURSE
THIRD SEMESTER
DISCIPLINE SPECIFIC MAJOR-2
COURSE TITLE: APPLIED FISH AND FISHERIES
COURSE CODE: ZOO-DSM-324C
PRACTICAL

L	T	P	C
0	0	2	2

1. Fish Collection and Preservation and Identification.

2. Study of Morphometric and Meristic characteristics.

3. Taxonomic of bony fishes:
   - *Hilsa ilisha*
   - *Notopterus chitala*
   - *Catla catla*
   - *Cirrhinus mrigala*
   - *Labeo rohita*
   - *Mystus seenghala*
   - *Clarias batrachus*
   - *Heteropeneusts fossilis*
   - *Ompak bimaculatus*
   - *Xenentodon cancila*
   - *Hemirahamphus sp.*
   - *Mastacembalus*
   - *Anabas testudineus*
   - *Wallago attu*
   - *Channa punctatus*
   - *Tetradon culcutia*

4. Determination of Dissolved oxygen of Fishpond.

5. Determination of Alkalinity of Fishpond.

6. Determination of Chloride of Fishpond.

7. Determination of Hardness of Fishpond.

9. Aquatic weeds of Fishpond.

10.Planktons of Fishpond.

11.Project Report of Field visit of any fisheries Station.

M.SC. COURSE
THIRD SEMESTER
DISCIPLINE SPECIFIC MAJOR-2
COURSE TITLE: MEDICAL PARASITOLOGY
COURSE CODE: ZOO-DSM-324D
PRACTICAL

L	T	P	C
0	0	2	2

1. Preparation of media for bacteria, protozoa and helminthes culture.
2. Culture of bacteria, protozoa and helminthes.
3. Study of different stages of protozoan and helminthes (comparative study of trophozoite, cyst, and eggs).
4. Study on different zoonotic disease.
5. Examination of living animal hosts (definitive and intermediate: earthworm, cockroach, bony fish, toad, wall lizard, garden lizard, pigeon, fowl, rat etc.) for collection, preservation, and identification of different helminth parasites.
6. Identification of helminth parasites of man.
7. Identification of soil nematodes.

M.SC. COURSE
THIRD SEMESTER
MULTI-DISCIPLINARY MAJOR
COURSE TITLE: ECOLOGICAL PRINCIPLES
COURSE CODE: ZOO-MDM-325
THEORY

L	T	P	C
4	0	0	4

Objective:

To introduce students the fundamental concepts and principles of Ecology and make them aware of the importance of biodiversity and its conservation.

Unit I: the Environment and Ecological Niche

a. Physical Environment and Biotic Environment
b. Biotic and Abiotic Interactions
c. Concept of Ecological Niche
d. Niche Width and Niche Overlap
e. Niche Differentiation and Resource Partitioning

Unit II: Ecosystem, Community and Population Ecology

a. Ecosystem Structure and Function and Ecological pyramids
b. Energy Flow and Mineral Cycles
c. Community Structure and Species Richness patterns and Ecotone
d. Characteristics of Population, Population Growth curves
e. Concept of Metapopulation, Human Population Growth

Unit III: Species Interaction and Biogeography

a. Competition and Symbiosis
b. Herbivory and Carnivory
c. Terrestrial Biomes
d. Theory of Island Biogeography
e. Biogeographical Zones in India

Unit IV: Conservation Ecology

a. Major Approaches of Conservation Management
b. International Environmental Agreement
c. Wildlife conservation projects: Crocodile Conservation, Tiger project
d. Important rules related to Ecology
e. Important Indian Acts related to Ecology

Unit V: Applied Ecology

a. Environmental Pollution
b. Biodiversity Status, Monitoring and Documentation
c. Major Drivers of Biodiversity
d. Convention on Biological Diversity
e. National Biodiversity Authority, WCMC, CITES.

Suggested Readings: (Latest edition)

1. Smith T.M. and Smith R.L. Elements of Ecology, Pearson Education, India.
2. Odum E. P. Fundamentals of Ecology, Oxford and IBH Publishing Co. Pvt. Ltd.
3. Singh J.S., S.P & Gupta, S.R. Ecology, Environment and Resource conservation. Anamaya Publ., New Delhi.
4. Chapman J.L. & Reiss. M.J. Ecology: Principles and Applications. Cambridge Univ. Press.
5. Peter Stiling. Ecology: Global Insights & Investigations 2nd Edition. McGraw-Hill.
6. Krishnamurthy K.V.An Advanced Textbook on Biodiversity – Principles and Practice, Oxford and IBH Publishing, New Delhi.
7. Anne E. Magurranand Brian J. McGill. Biological Diversity: Frontiers in Measurement and Assessment. Oxford University Press.

Learning Outcomes:

The present course will enable the students to-

- understand the concepts and principles of Ecology.
- understand the structural and functional aspects of biodiversity and the need for its conservation be able to take up interdisciplinary research in Ecology.

M.SC. COURSE
THIRD SEMESTER
MULTI-DISCIPLINARY MAJOR
COURSE TITLE: ECOLOGICAL PRINCIPLES
COURSE CODE: ZOO-MDM-326
PRACTICAL

L	T	P	C
0	0	2	2

1. Study of communities by quadrat method and to determine % Frequency, Density and Abundance.
2. Study frequency of herbaceous species in grassland and to compare the frequency distribution with Raunkiaer's standard frequency diagram.
3. Study species diversity (richness and evenness), Index of dominance, Similarity index, Dissimilarity index and Species diversity index in grazed and protected grassland.
4. Study the characteristics of different types of soils.
5. Study the biotic components of a pond.
6. Measurement of temperature and pH of different water bodies.
7. Determine the total dissolved solids (TDS) in water.
8. Count phytoplankton by haemocytometer method.
9. Determine plankton biomass of a pond.
10. Determine the water holding capacity of Soil.

M.SC. COURSE
THIRD SEMESTER
SKILL ENHANCEMENT COURSE
COURSE TITLE: TOOLS, TECHNOLOGY AND SCIENTIFIC WRITTING
COURSE CODE: ZOO-SEC-327
THEORY

L	T	P	C
2	1	0	3

Objectives:

To introduce students about the use of modern biological tools and techniques and acquaint them with various aspects of scientific writing

Unit I: Biological data and Quantification

a. Types of Biological Data on ratio, interval, ordinal and nominal scale
b. Measures of central tendency
c. Measures of dispersion and Correlation and regression
d. Tests of statistical significance and their application, Chi-square test.
e. Analysis of variance; One-way and two One-way and two-way ANOVA

Unit II: Bio-instruments

a. Basic principles of microscopy.
b. Phase contrast microscope; Electron microscope; Fluroscence microscope, Confocal microscope
c. Colorimetry and spectrophotometry: Beer-lambert law
d. Thermocycler and Gel Documentation System
e. Flow cytometer and DNA sequencer

Unit III: Techniques

a. Biological Assays: cell viability and cell proliferation assays
b. Microbiological assays: microbial growth culture, antibiotics sensitivity test
c. Isolation and Purification of DNA & RNA isolation.
d. Principle and applications of PCR and Real-Time PCR
e. Surgical Techniques

Unit IV: Scientific Writing

a. Learn the structure and function of different types of scientific papers.
b. Data search and retrieval: bibliography, biological databases.
c. Overview of reference management tools: EndNote, Zotero, RefWorks, Mendeley Publication and Citation Metrics.
d. Ethics in publication
e. Computer awareness: drafting, editing, graphical, statistical presentations.

Unit V: Communication

a. Effective Communication
b. Audience and Purpose
c. Oral Presentation Structure
d. Email, Memos, Formal, Resume.
e. Thank you, letter.

Suggested Readings:

1. Jerrold H. Zarr, 2010. Biostatistical Analysis, Pearson Education Inc., Delhi.
2. John R.W., 2010. Masters Animal Cell Culture-A Practical approach, IRL Press.
3. Robert Braun, 2000. Introduction to Instrumental analysis, McGraw Hill International Edition.
4. Wilson K. and Goulding K. H., 2012. A Biologist Gide to Principles and Techniques of Practical Biochemistry, ELBS.
5. Westhead *et al.*,2003 Bioinformatics: Instant Notes, Viva Books, New Delhi.
6. https://www.nature.com/scitable/ebooks/english-communication-for-scientists-14053993/118520572.

Learning Outcomes:

The course will enable the students to:

- solve the biological problems during data analysis using various statistical methods.
- learn the working of various equipment which will be useful in the final semester for their experimental work.
- understand basic principles of scientific writing.
- effectively present their scientific ideas and findings.

M.SC. COURSE
THIRD SEMESTER
SKILL ENHANCEMENT COURSE
COURSE CODE: TOOLS, TECHNOLOGY AND SCIENTIFIC WRITTING
COURSE CODE: ZOO-SEC-328
PRACTICAL

L	T	P	C
0	0	1	1

1. Numerical problems on coefficient of variance.
2. Computation of Standard error.
3. Chi-square test.
4. Probability distribution curve.
5. Correlation.
6. Spectrophotometric measurement.
7. Quantification of DNA/RNA
8. Graphical presentation of Data
9. Presentation
10. Panel discussion

M.Sc. IV Semester

Name of Course	Paper Course Code	Paper Title	Credits
Discipline Specific Major	ZOO-DSM-421	Master Thesis/Dissertation	16
		Total Credits	16

M.SC. COURSE
FOURTH SEMESTER
DISCIPLINE SPECIFIC MAJOR
COURSE CODE: MASTER THESIS/DISSERTATION
COURSE CODE: ZOO-DSM-421
PRACTICAL

L	T	P	C
0	2	14	16

Objectives:

To provide students to conceptualize, design, plan and performed a short-term research project.

1. The candidate will select the research problem based on their research interest, in consultation with their assigned mentor, and thereafter obtain approval for the research strategy.
2. The experiment may be conducted either within the University or in an external setting beyond the University.

Evaluation:

a) First periodic assessment of the progress after 08 weeks: 20 marks

b) Second periodic assessment of the progress after 12 weeks: 20 marks

c) End semester examination will consist of:

i). Evaluation of project report/presentation: 50 marks

ii). Viva-Voce of the project: 10 marks

Mode of End semester examination: External examiner (Regular mode of End Semester practical examination).

Learning Outcomes:

Students will be able to do:

- explore in depth a topic that is of interest to them in lab/field.
- literature search to research of specific scientific topic.
- interpretation and analysis of scientific literature.
- scientific writing to enable production of a comprehensive literature review.
- allow students to explore in depth a topic that is of interest to them.