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**	**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**
Discipline Specific Major-2	**ZOO-DSM-323A**	**Cell Transport and Signaling – Theory**	**04**
	ZOO-DSM-323B	**Insect Taxonomy, Ecology and Applied Entomology-Theory**	**04**
	ZOO-DSM-323C	**Applied Fish and Fisheries-Theory**	**04**
	ZOO-DSM-324A	**Cell Transport and Signaling -Practical**	**02**
	ZOO-DSM-324B	**Insect Taxonomy, Ecology and Applied Entomology -Practical**	**02**
	ZOO-DSM-324C	**Applied Fish and Fisheries-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, SESSION – 2023-2025
FIRST SEMESTER
DISCIPLINE SPECIFIC MAJOR-1
COURSE TITLE: ANIMAL DIVERSITY
COURSE CODE: ZOO-DSM-121
THEORY

L	T	P	C
4	0	0	4

Objective: In order 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. Biological Nomenclature and theories of Biological Classification.
d. Classical Methods of Taxonomy.
e. Phylogenetic Systematics and Numerical taxonomy.

Unit II: Protozoa and Mesozoa

a. Locomotion, Nutrition and Reproduction and in Protozoa.
b. Porifera: Cell types and Skeleton.
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: Adaptive radiation and 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: Origin of Deuterostomia and larval forms.
f. Structural peculiarities and affinities of Minor phyla: Rotifera, Phoronida, Ectoprocta, Entoprocta, Ctenophora and Branchiopoda.

Unit IV: Protochordates and Lower Terrestrial Vertebrates

a. General characteristics and affinities of Hemichordata, Cephalochordates and Urochordates.
b. General characteristics of fishes (Ostracoderms, Dipnoi and Holocephali)

c. Amphibia: General organization, Origin of tetrapods, Neoteny.

d. 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 of 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:

1. Carter, G. S. A.,1946. General Zoology of Invertebrates. Wick and Jackson Ltd., London.
2. Barnes, R. D., 2009. Invertebrates Zoology. Wiley Backwell.Hunter,1979. Life of Invertebrates, Collier Macmillan.
3. Kotpal, R.L.,1982. Protozoa, Porifera, Coelenterata, Helminthes, Annelida, Arthropoda, Mollusca, Echinodermata and Minor Phyla. Rastogi Publications.
4. Hyman L.H.,1940 - 1959. The Invertebrata, Vol. I to VI.
5. Borradile, L.A., 1955. The Invertebrata. Cambridge University Press.
6. Moore, R. C. Lalicker, C. G. and Fisher, A. G., 1952. Invertebrate Fossils, Mc. Graw Hill Book Co., New York.
7. Gardinar, M. S.,1972. Biology of the invertebrates, Mc Graw Hill Book Co., New York.
8. Waterman, A.J., 1971. Chordate Structure and Function. Macmillan Co. London.
9. Jolie, M.,1968. Chordate Morphology. East West Press.
10. Young, J.Z.,1950. Life of Vertebrates. Clarendon Press Oxford.
11. Colbert, E.H.,1955. Evolution of the Vertebrates. John Wiley and Sons Inc. New York.
12. Hobart M. Smith.,2000. Evolution of Chordate structure, Holt, Rinehart and Winston. Inc. New York.
13. Halstead, L.B.,1969. The Pattern of Vertebrate Evolution. Freeman and Co. San Francisco. U.S.A.
14. Kapoor, V.C., 1991.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.
- An holistic appreciation on the phylogeny and adaptations in animals.

M.SC. COURSE, SESSION – 2023-2025
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.
2. Study of selected Protozoans and Helminthes of medical importance.
3. Study of sections of certain animals from Coelenterata, Aschelminthes and Annelida to understand the evolution of different types of coelom.
4. Study of prepared slides of mouth parts of Honey bee, Housefly, Thrips, Mosquito, Bed bug and Butterfly to relate structure and type.
5. Study of *Balanoglossus, Amphioxus*, *Herdmania*, *Peteromyzon* and *Onychophora* to bring out their affinities.
6. Study of Dipnoi to bring out their affinities.
7. 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.
8. Study of skull types a) Fish; b) Frog; c) Snakes; d) Bird;e) Rat/Rabbit.
9. Study of different kinds of snakes in reference to their biting Mechanism.
10. Mounting of Sting of Honey bee, Nephridia of earthworms, cycloid scales.

M.SC. COURSE, SESSION – 2023-2025
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:

1. Guyton, A.C. & Hall, J.E.,2006. Textbook of Medical Physiology. XI Edition. Hercourt Asia PTE Ltd. /W.B. Saunders Company.
2. Chatterjee C C (2016) Human Physiology Volume 1 & 2. 11th edition. CBS Publishers.
3. Tortora, G.J. & Grabowski, S.,2006. Principles of Anatomy & Physiology. XI Edition John Wiley & Sons.
4. Christopher D. Moyes, Patricia M. Schulte, 2016. Principles of Animal Physiology. Pearson Education.
5. Hill, Richard W., et al. 2004 Animal physiology. Vol. 2. Sunderland, MA: Sinauer Associates.
6. Verma, P.S., 2000. Invertebrate Zoology, Jordan EL, S. Chand Publishing, New Delhi.
7. Kotpal, R. L.,2012. Modern Text Book of Zoology: Invertebrates. Rastogi Publicattion, Meerut.

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, SESSION – 2023-2025
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, SESSION – 2023-2025
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:

1. Nelson & Cox,2000, Lehninger's Principles of Biochemistry, McMillan.
2. Cooper and Hausman, 2010. The Cell: A molecular Approach.ASM Press Washington.
3. Zubay *et al*,1995. Principles of Biochemistry, WCB
4. Wilson and Walker,2000. Practical Biochemistry – Principles and Techniques. Cambridge University Press
5. B. Alberts, D. Bray, J. Lewis, M. Raff, K. Roberts and J.D. Watson, 2000. 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, SESSION – 2023-2025
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 centrifuge.
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, SESSION – 2023–2025
FIRST SEMESTER
SKILL ENHANCEMENT COURSE
COURSE TITLE: APPLIED BIOLOGY
COURSE CODE: ZOO-SEC-127
THEORY

L	T	P	C
3	0	0	3

Objective: In order 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, Pfam, 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.
e. Biosensors and its applications.

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. Basis of Sire selection and evaluation.
c. Heterosis, causes, measurement and its application in animal breeding.
d. Breeding methods for improvement of dairy cattle and buffaloes. Species hybridization, linebreeding, outbreeding, outcrossing, top crossing and grading up. Conservation of germplasm.
e. 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:

1. Willey J, Sherwood L,Woolverton CJ. Prescott's,2010. Microbiology. McGraw Hill Publishers.
2. Lesk, A.,2000. Introduction to bioinformatics. Oxford University Press.
3. Srivastava,2000. A text book of applied entomology, Vol II. Kalyani Publishers.
4. Banerjee G. C.,2012. A Textbook of Animal Husbandry. Oxford University Press.
5. Indian Council of Agricultural Research, ICAR., 2015. Handbook of Fisheries and Aquaculture.
6. Ghosh, Z. and Mallick, B.,2017. Bioinformatics: Principles and Applications. Oxford University Press.
7. David and Ramamurthy: Elements of Economic Entomology, Namrutha.
8. Hafez, E. S. E.,2005. Reproduction in Farm Animals. Lea & Fabiger Publisher.

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, SESSION – 2023-2025
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, Pfam, etc.,
4. Pairwise sequence alignment using BLAST.
5. Writing a sequence in FASTA format.
6. Sericulture: Life history of silk worm
7. Apiculture: Life history of honey bee
8. Lac culture: Life history of Lac insect.
9. Fish Culture: Layout of Pond.
10. Edible fresh water 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, SESSION – 2023-2025
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:

1. Gilbert, Scott F., 2017, Developmental Biology, Oxford University Press.
1. John E. Hall and Michael E. Hall, 2020.Medical Physiology, Elsevier Health Science Publisher.
2. Brian Dale, 2013.Fertilization: From Gamete to Early Embryo,Cambridge University Press.
3. Gautam N. Allahbadia and Caludio F. Chillik, 2015, Human Embryo Transfer,Springer Nature Publisher.
4. David K. Gardner, Botros R. M. B. Rizk, and Tommaso Falcone, 2011. Human Assisted Reproductive Technologies, Cambridge University Press.

Learning Outcomes:

After completing the course, students will able to learn:

- Variety of interacting processes, which generate an organism's heterogeneous shapes, size, and structural features
- The scientific reasoning exhibited in experimental life science.

M.SC. COURSE, SESSION – 2023-2025
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, SESSION – 2023-2025
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: In order 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. Aminoacylation of tRNA, tRNA-identity.
c. Aminoacyl tRNA synthetase, and translational proof-reading.
d. Translational inhibitors.
e. 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:

1. Alberts Bruce, Johnson A , Lewis J , Raff M , Roberts K, Walter P., 2014. Molecular Biology of the Cell. Taylor and Francis. New York, USA.
2. Krebs J.E., Kilpatrick S.T. and Goldstein E.S.,2013. Lewin' GENES XI, Jones & Bartlett Learning. Burlington, MA.
3. Judy Owen, Jenni Punt, Sharon Stanford and Patricia Jones, 2018. Kuby Immunology, International Edition.
4. Allison A. Elizabeth, 2012. Fundamental Molecular Biology. J Willey and Sons, Hoboken, New Jersey.
5. William E. Paul,2012. Fundamentals of Immunology, Wiley.
6. Delves Peter J., Martin Seamus J., Burton Dennis R., Roitt Ivan M., 2017. Roitt's Essential Immunology, 13th Edition. Wiley Blackwell

Learning Outcomes:

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

- About genes at molecular level.
- Molecular biology involved in fundamental processes.
- In depth understanding about Immune System.

M.SC. COURSE, SESSION – 2023-2025
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, SESSION – 2023-2025
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. Evidences for Evolution: On small and large scale.
c. Origin of life and Cellular evolution: Major events in the history of life, Origin of life, Evolution of DNA molecules; Controversy about the origin of life, Molecular clock, Evolution of genome.
d. The history of earth, Geological time scale, Mass extinction.
e. Evolution of Horse and Human.
f. Phylogeny: Phylogenetic tree, Homology and homoplasy, Principle of Parsimony and Maximum likelihood.

Unit II: Mechanism of Evolution

a. Hardy-Weinberg Equilibrium.
b. Mutation on Allele frequency.
c. Genetic drift.
d. Adaptive radiation: Convergent and Divergent
e. Co-evolution
f. 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 favors 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 honey bees, Pheromonal communication (Ants and mammals).

Suggested Readings:

1. S.C.Stearns and R.F.Hoekstra, 2005. 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, 2005. Evolution. Cold Spring Harbor Laboratory Press, New York.
3. Ridley, M., 2004. Evolution III Edition Blackwell publishing Hall,UK.
4. Jones and Barlett Alcock, J. 2013. Animal Behavior: An Evolutionary Approach. Tenth Edition.
5. Sherman, P.W. and J. Alcock, 2013. Exploring Animal Behavior: Readings from American Scientist. Sixth Edition. ISBN-13: 978-1605351957.
6. Dugatkin, L. A., 2013. Principles of animal behavior: Third international student edition. WW Norton & Company.
7. Breed, M. D., & Moore, J., 2015. Animal behavior. Academic Press.
8. Mellgren, R. L.,2000. Animal cognition and behavior (Vol. 13). Elsevier.
9. Bolhuis, J. J., Giraldeau, L. A. E.,2005. 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, SESSION – 2023-2025
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. Demonstration of Reflexes in Man.
6. Study of Learning Behavior.
7. Study of Learning Behavior in Mice by Using a Zigzag or T-Shaped Maze.
8. Study of Wall-seeking Behavior in Mice.
9. Preparation of Chart/Models.
10. A Field Study of Foraging or Trail Making Behavior in a Seed Harvester or Predatory Ant Species.

M.SC. COURSE, SESSION – 2023-2025
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 use

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, evidences 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:

1. Snustad & Simmons,2012. Principles of Genetics. John Wiley.
2. Griffith et al., 2008. Modern Genetic Analysis. Freeman.
3. Russell, 2010. Genetics. Benjamin Cummings.
4. Alberts et al., 2008. Molecular Biology of the Cell.Garland.
5. Hartl & Jones,2009. Essential Genetics: A Genomic perspective,Jones & Bartlet.
6. Karp,2010. Cell and Molecular Biology,John Wiley & Sons.
7. 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, SESSION – 2023-2025
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-322A	Cell Physiology -Practical	02
	ZOO-DSM-322B	Insect Morphology and Physiology--Practical	02
	ZOO-DSM-322C	Fish: Structure and Function-Practical	02
Discipline Specific Major-2	ZOO-DSM-323A	Cell transport and Signaling – Theory	04
	ZOO-DSM-323B	Taxonomy, Ecology and Applied Entomology-Theory	04
	ZOO-DSM-323C	Applied Fish and Fisheries-Theory	04
	ZOO-DSM-324A	Cell transport and Signaling -Practical	02
	ZOO-DSM-324B	Taxonomy, Ecology and Applied Entomology-Practical	02
	ZOO-DSM-324C	Applied Fish and Fisheries-Practical	
Multi-Disciplinary Major-3	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, SESSION 2023-2025
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: Cell Components

a. Purification of cell organelles.
b. Isolation, culture and differentiation of metazoan cells.
c. Localization of protein in cell.
d. Lipid composition of biomembrane: Phospholipids, Sphingolipids and Cholesterol synthesis and their intracellular movements.
e. Protein components and their functions.

Unit II: Membrane Transport-I

a. Hydrophobic and hydrophilic molecules.
b. Diffusion, Facilitated diffusion, ionic transport through charged pores.
c. Uniport transport of glucose and water.
d. D-hexose permease of erythrocytes.
e. Endocytosis and Exocytosis.

Unit III: Membrane Transport- II

a. Active transport across membrane: Primary and Secondary active transport.
b. Thermodynamics of transport.
c. Non-gated ion channels and the resting membrane potential.
d. Co-transport by symporters and antiporters.
e. Trans epithelial transport.

Unit IV: Bioenergetics and Metabolism

a. Thermodynamic principles, Free energy, Free energy change, Phosphagens, Redox reaction.
b. Aerobic respiration: Glycolysis.

c. Citric acid cycle.
d. Oxidative phosphorylation, Inhibitors of electron transport.
e. Electrochemical proton gradient, ATP synthesis.

Unit V: Cellular Mechanism of Photosynthesis

a. Photosynthetc pigments, Pigment system.
b. Photosynthetic unit, Hill reaction.
c. Light reaction: Non-cyclic electron flow, ATP synthesis, Cyclic electron flow.
d. Fixation of CO_2 in chloroplast stroma, Synthesis of Sucrose.
e. Photorespiration: C4 cycle, CAM Pathway

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 outcome: Students will be able to understand:

- Functioning of cells
- How autotrophs synthesize food?
- Energetics of the body of all living organisms.

M.SC. COURSE, SESSION – 2023-2025
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:

1. Chapman, R., 2012. The Insects: Structure and Function (S. Simpson & A. Douglas, Eds.). Cambridge: Cambridge University Press.
2. Gullan, P. J., & Cranston, P. S., 2014. The insects: an outline of entomology. John Wiley & Sons.
3. Marshall, S. A., 2006. Insects: their natural history and diversity: with a photographic guide to insects of eastern North America. Richmond Hill, Ont.: Firefly Books.
4. Klowden, 2002. Physiological Systems in Insects, Academic Press.
5. Imms, 1997. A General Text Book of Entomology (2 vols.), Asia Publishing House.
6. Wigglesworth, 1972. Principles of Insect Physiology, ELBS.

Learning Outcomes:

The present 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, SESSION – 2023-2025
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:

1. Norman J. and Greenwood P.H., 1975. A History of Fishes, Halsted Press.
2. Lagler K.F., Bardach, J.E., Miller, R.R., Passino, D.R.M., 1977. Freshwater Fishery Biology by Ichthyology, 2nd Ed. John Wiley & Sons, New York.
3. Moyle P.B., 1982. Fishes: An introduction to Ichthyology. Printice-Hall, Englewood Cliffs.
4. Jayaram K.C., 2008. Fundamentals of Fish Taxonomy. Todays and Tomarrow Publication, New Delhi.
5. Gopal Ji Srivastava, 1995. Fishes of U.P. and Bihar. Rastogi Publication, Meerut.
6. Brown M.E., 1966. Physiology of fishes. Vol. I and II Academic Press. New York.
7. Hoar W.S., Randall D.J. and Donaldson E.M., 1983. Fish Physiology. Academic Press, New York.
8. Pandey K. and Shukla, J.P., 2018. Fish and Fisheries. Rastogi publication, Meerut UP, India.
9. Khanna, S.S. and Singh, H.R., 2016. A text Book of Fish Biology and Fisheries, Narendra Publishing House, Delhi, India.

Learning Outcomes:

After successfully completing this course, the students will be able to:

- Understand the external morphology and physiology of insects which help to distinguish one kind of insect from another.
- Develop an understanding of how an insect lives, functions, and reproduces.

M.SC. COURSE, SESSION – 2023-2025
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. Types of Centrifuge for cell organelles separation.
2. Purification of cell organelles.
3. Localization of protein in Cells.
4. Localization of Lipids in Cells.
5. Aerobic respiration.
6. Demonstration of simple diffusion.
7. Demonstration of osmosis.
8. Photosynthesis: hills reaction.
9. Preparation of chart/model showing uniport, symport and antiport.
10. Preparation of chart/model showing Glycolysis, Citric acid cycle, Oxidative Phosphorylation.
11. Preparation of chart/model showing various stages of photosynthesis.
12. Students will visit various recognized scientific institutions of India in order to understand the relevant equipment and their functions.

M.SC. COURSE, SESSION – 2023-2025
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 honey bee.
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, SESSION – 2023-2025
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. Webberian 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, SESSION 2023-2025
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, SESSION – 2023-2025
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 Sciences and their Life cycle.

Suggested Readings:

1. Imms, A. D., Richards, O. W., & Davies, R. G., (Eds.). 2012. Imms' General Textbook of Entomology: Volume 2: Classification and Biology. Springer Science & Business Media
2. Gullan & Cranston, 2014. The Insects: An Outline of Entomology (5th ed.) Wiley Blackwell.
3. Schowalter, T.D., 2016. Insect Ecology: An Ecosystem Approach. Academic Press.
4. Snodgrass, R.E. 1993 (originally 1935). Principles of Insect Morphology (with new forward by George Eickwort). Cornell University Press.
5. Mullen and Durden, 2002. Medical and Veterinary Entomology, Academic Press.
6. Atwal and Dhaliwal, 2012. Agricultural pests of India and South-East Asia, Kalyani Publishers,New Delhi.
7. Omkar, 2002. Ecofriendly Pest Management for Food Securit, Academic Press.
8. Byrd and Castner,2001 Forensic Entomology, CRC Press, 2001

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, SESSION – 2023-2025
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 Taxonomy and Systematics

a. Salient features of fishes.
b. Berg's Classification of fishes.
a. Salient features and Affinities of Placoderms.
b. Salient features and outline classification of Elasmobranchs.
c. Salient features and Affinities of Holocephali and Dipnoi.

Unit II: Induced Breeding and Ecology

a. Bundh breeding, Artificial Fertilization by Shipping.
b. Induced breeding by Hypophysation.
c. Breeding techniques and factors influence induced breeding.
d. International water code for responsible fisheries.
e. Aquatic weeds and their control.

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: Fish Pond Management and other Culture Practices

a. Construction and lay-out of different types of ponds (nursery, rearing, and stocking).
b. Maintenance of Fish Farm.
c. Types of cultivable fishes.
b. Composite fish culture.

c. Sewage fed fisheries.

d. 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:

1. Jhingran V.G., 1991. Fish and Fisheries of India, Hindustan Publishing Corporation,New Delhi.

2. Jhingran V.G. and R.S.V. Pullin A., 2000. Hatchery Manual for the Common, Chinese and Indian Major Asian Development Bank, ICLARM, Manila, Philippines.

3. Reid G.R., 1961. Ecology and Inland waters and Estuaries. Rein Hold Corp., New York.

4. Pilley T.V.R, and Dill, W.M.A., 1979. Advances in Aquaculture. Fishing News Books, Ltd. England.

5. Pillay T.V.R and Kutty M.N. 2005. Aquaculture- Principles and Practices. Blackwell.

6. Nikolsky G.V., 1963. Ecology of Fishes, Academic Press.

7. Norman J.R. and Greenwood P.H., 1975. A History of Fishes, Halsted Press. London.

8. Potts G.W. and Wootten R.J., 1984. Fish Reproduction: Strategies and Tactics, Academic Press.

9. De Silva S.S. & Anderson T.A., 1995. Fish Nutrition in Aquaculture. Chapman & Hall Aquaculture Series.

10. Ojha J.S., 2005. Aquaculture Nutrition and Biochemistry. Daya Publication, New Delhi.

Learning Outcomes:

The present course will prepare the students for:

- Self-employment, and
- The jobs related to the fish and fisheries.

M.SC. COURSE, SESSION – 2023-2025
THIRD SEMESTER
DISCIPLINE SPECIFIC MAJOR-2
COURSE TITLE: CELL TRANSPORT AND SIGNALING
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 in order to understand the relevant equipment and their functions.

M.SC. COURSE, SESSION – 2023-2025
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, SESSION – 2023-2025
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 Identification and phylogeny of following fishes:
    - *Catla catla*
    - *Cirrhinus mrigala*
    - *Labeo rohita*
    - *Mystus seenghala*
    - *Clarias batrachus*
    - *Heteropeneusts fossilis*
    - *Ompak bimaculatus*
    - *Labeo rohita*
    - *Wallago attu*
    - *Channa punctatus*
4. Age determination of fish by scale method.
5. Determination of Dissolved oxygen of Fish pond.
6. Determination of Alkalinity of Fish pond.
7. Determination of Chloride of Fish pond.
8. Determination of Hardness of Fish pond.
9. Phytoplankton of Fish pond.
10. Zooplankton of Fish pond.
11. Project Report of Field visit of any fisheries Station.
12. Study and report of fishing gears and nets.
13. Students will visit various recognized scientific institutions/Fisheries of India in order to understand the relevant equipment and their functions, and better practices of fish farming.

M.SC. COURSE, SESSION – 2023-2025
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. Wild life 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:

1. Smith T.M. and Smith R.L., 2015. Elements of Ecology, Pearson Education, India.
2. Cain M.L., Bowman, W.D. and Hacker S.D., 2011. Ecology, 2nd Edition, Sinauer Associates Inc.
3. Odum E. P., 2004. Fundamentals of Ecology, Oxford and IBH Publishing Co. Pvt. Ltd.
4. Singh J.S., S.P & Gupta, S.R., 2006. Ecology, Environment and Resource conservation. Anamaya Publ., New Delhi.
5. Miller G.T., 2004. Environmental Science. Thomson, California.
6. Chapman J.L. & Reiss. M.J. 1998. Ecology: Principles and Applications. Cambridge Univ. Press.
7. Peter Stiling, 2015. Ecology: Global Insights & Investigations 2nd Edition. McGraw-Hill.
8. Krishnamurthy K.V., 2003. An Advanced Textbook on Biodiversity – Principles and Practice, Oxford and IBH Publishing, New Delhi.
9. Singh J.S., Singh S.P. and Gupta S.R., 2014. Ecology, Environmental Science and Conservation. S. Chand & Company Pvt. Ltd.
10. Primack R. B., 2012. A Primer of Conservation Biology. Sinauer Associates is an imprint of Oxford University Press.
11. Anne E. Magurran and Brian J. McGill, 2011. 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, SESSION – 2023-2025
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, SESSION – 2023-2025
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 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. PCR machine, Gel Documentation System, Gel Apparatus
e. Flow cytometer, DNA sequencer, Microarray, Microplate reader

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 present 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, SESSION – 2023-2025
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, SESSION – 2023-2025
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.