

SCHEME OF TEACHING, EXAMINATION AND SYLLABUS AS PER

NEP 2020 for M. Sc. ZOOLOGY

Choice Based Credit System (Semester Pattern) Effective from 2023-2024

Program Outcomes (POs)

- PO 1- M.Sc. program produces post-graduates who have great readiness in playing active role either in government or non-government organization by designing processes/strategies that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
- PO 2-Students developed analytical and creative thinking from the conducive research environments and interacting with scholars/ faculties that will help in identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational, and personal) from different perspectives.
- PO 3- To use research-based knowledge and research methods including review research literature, accession of primary literature, identify relevant works for a particular topic, design of experiments, analysis, evaluation and interpretation of scientific data, and synthesis of the information to provide valid conclusions in real situations.
- PO 4- To empower students to create, select, and apply appropriate techniques, resources, and ICT tools for understanding of the science.

- PO 5- Apply ethical principles and commit to professional ethics and responsibilities and norms of the work/research practice. Also, to promote learning and research aptitude and attitude to serve the society.
- PO 6- Students are encouraged to develop an analytical mind as they ask questions, take part in topic-based quiz and debates, and are made aware of recent study and research on relevant topics.
- PO 7- To enhance the ability of writing research project activities, problem-solving, to design and carry research project.
- PO 8- M.Sc. program produces post-graduates who have great confidence which allows them to have a positive and realistic perception of themselves and their abilities in the scientific and social environment.
- PO 9- Students acquiring skill-based education will make them self-employable and can generate employment.
- PO 10- Students are encouraged to develop analytical and critical thinking minds which will help to develop scientific temperament in the community.

Program Specific Outcomes (PSOS)

- PSO 1-Students will acquire techniques and skills to implement the knowledge in the design and execution of research in different branches of Zoology. This will help in careers related to teaching, research in Zoology; as well as in having innovative ideas and necessary training to initiate unique start-ups and entrepreneurship in the realm of life sciences.

- PSO 2- To learn and apply the ethics in animal handling, during laboratory practices and experimentation.
- PSO 3. In addition to the curriculum, the students will also gain skill-based learning, practical knowledge to facilitate experiments in the subject Zoology.
- PSO 4- Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings. Demonstrate knowledge and understanding of Zoology and management principles and apply these to one's own work, as a member and leader in a team.
- PSO 5- To acquired knowledge across a broad range of Zoology including recent trends which will help to solve the scientific problem logically in the context of biological process. Thus, leading to self-directed learning and evaluation.
- PSO 6- Perform laboratory procedures as per standard protocols in various areas of Zoology including Animal Diversity, Cell Biology, Genetics, Molecular Biology, Physiology, Developmental Biology, Comparative Endocrinology, Immunology, Mammalian Reproductive Physiology, Fish and Fisheries and Entomology.
- PSO 7- Understand the applications of zoological science in Apiculture, Sericulture, Lac culture, Fish and Fisheries, Mammalian Reproductive Physiology and Animal Physiology.
- PSO 8- Develop knowledge and understanding of living organisms at several levels of Zoological and Biological organization from molecular level, through cells and ultimately the whole organisms and its impact on ecosystems.

- PSO 9- To develop interest and elective modules by selecting specialization in various aspects and understanding the methods of zoological research.
- PSO 10- The M. Sc. Program will lead the students to impart a scientific temperament which will help them to add new scientific knowledge/information in the field of Zoology research.

M.Sc. Zoology Semester-I

MZO1T01 Paper- Biology of Non- Chordata

Course Outcomes (COS)

- Students will be able to identify, classify, describe, discuss and explain invertebrate specimen in the field as well as maintain and organize museum specimen. Develop a skill to demonstrate and explain different anatomical systems, physiological body processes and diversity of invertebrates, animal architecture and functions.
- Create the awareness of the economic importance, significance and explain structural and functional relationship between invertebrate phyla. Assess and evaluate a taxonomic status of primitive members of arthropods and molluscs.
- Describe and analyze the sea star's body plan, elucidate the origins and evolutionary significance of echinoderm larval forms, comprehend the mechanism of movements based on fluid filled cavities in invertebrates and identify and classify minor invertebrate specimen.
- Perform the whole mount preparations of given invertebrate material.

MZO1T02- Cell Biology and Genetics

Course Outcomes (COs)

- Students will be able to describe and explain the structure and function of plasma membrane through fluid mosaic model, types of membrane proteins, transport and organization of cytoskeleton, cell organelles and endomembrane system.
- Differentiate and illustrate the mechanism of Cell division, cell cycle regulation, types of cell signalling, signal transduction pathways and various receptors involved in cell signalling.
- Describe and differentiate the types and functions of cellular communication, cell adherence molecule and extracellular matrix interaction.
- Differentiate Mendelian, non-Mendelian inheritance and solve the problems of inheritance based on probability. Explain, differentiate and compare codominance, incomplete dominance, gene interactions, linkage, crossing over, sex limited and sex influenced characters.
- Illustrate and differentiate the mode of inheritance of polygenic and monogenic traits, role of genetic and environmental factors of inheritance, inbreeding and its consequences and deduce coefficient of inbreeding and consanguinity.
- Explain, distinguish and describe the mutation and its types, structural and numerical alterations of chromosomes as well as the extra chromosomal inheritance, maternal inheritance, microbial genetics, genetic mapping and human genetics by Janam

MZO1T03-Electives

1. Mammalian Reproductive Physiology - Male

Course Outcomes (COS)

- Students will be able to describe and demonstrate the development processes and functions of different units of testis. Deduce the structure, functions, regulation, anomalies and disease of male reproductive and accessory reproductive organs and understand the mechanism of sperm capacitation.
- Explain and discuss the role of hormones in the regulation of reproductive behavior and types of breeding systems. Recognize and identify structural and functional aspect of different types of pheromones. Illustrate and counsel about the factors responsible for infertility.
- Assess and describe reproductive health dysfunction affected by aging in males.
- They could able to demonstrate fructose, acid and alkaline phosphatase, sialic acid and sperm count analysis.

2. Blood and Cardiac Physiology

Course Outcomes (COS)

- The students will be able to illustrate the structure, properties and function of cardiac muscle along with the anatomy, histology, nerve innervation and valves of the heart.
- They will further be able to classify and compare the pacemakers and conducting fibers present in the heart, and illustrate various types, causes, symptoms, diagnosis, and factors affecting blood pressure and treatment.

- Illustrate and compare the mechanism of the cardiac cycle, heart sound, working principle of ECG, cardiac output, haemodynamic, haemorrhage, cardiac murmur, circulatory shock and cardiac failure.
- Describe, explain and compare the cellular composition and functions of blood, blood groups, blood transfusion, bone marrow aspiration and pathological conditions of blood glucose and lipids along with blood coagulation.
- Compare and illustrate the transport of gases by blood, diagnosis, symptoms and treatment of bleeding disorders and blood cancer.
- Illustrate the mechanism of formation, composition, transport and functions of lymph.
- Differentiate, describe and explain anaemia and polycythemia, platelets and Blood substitute.
- Students will be able to demonstrate the components of the blood such as RBCs, WBCs, DLCs, Hb etc. along with the blood group.

MZO1T03

3. General Fish Biology

Course Outcomes (COS)

- Students will be able to explain and describe the evolutionary significance of fishes through the concepts of origin, classification and general characters of *Ostracoderms*, *Placoderms* and *Chondrichthyes*.
- Explain, describe and compare general characters and classify different ranks of Superorder Pisces. Identify different marine and freshwater fishes.

- Explain and describe peculiarities and affinities of Dipnoi, comparative account of accessory respiratory organs and different systems in fishes.
- They could estimate CO₂, dissolved O₂ and chloride of water and protein, sodium and potassium content of blood sample in fish.

MZO1T03

4. General Entomology

Course Outcomes (COS)

- Students will be able to identify, classify and differentiate the various insects belonging to different ranks.
- Describe, explain, and analyse insect social organization and its peculiarities.
- They could describe and explain structure of reproductive system, specialized reproductive mechanism, embryogenesis and metamorphosis in insects.

MZO1T04-Research Methodology

Course Outcomes (COs)

- Students will be able to learn, describe and imbibe animal ethics in research, as well as various guidelines provided by IAEC and CCSEA.
- Students will be able to compare the model organisms used in biological science.
- They will be able to discuss and determine the animal facilities to laboratories, transportation, hygiene, environment, maintenance, ethical, legal and policy issues. Encourage students to pursue

their interests in research and to investigate selecting appropriate methodology of scientific research.

- Students could design the experiments properly.
- They will be able to write scientific reports, research proposals, patents, review articles, and will be aware of major funding agencies. Improve the knowledge of computer skills. They will be able to use basic computer programmes such as MS-Office, Coral Draw, and Photoshop.
- Students will analyse and use statistics to analyse data in biological research. They will be able acquainted with AI and its use in Life Science as well as to apply various statistical tools like central tendency, dispersion, skewness, and kurtosis measures to analyze results in the research work.
- They also learn measures of relationship tests of hypothesis testing of significance and know about statistical software. Students will also be able to learn and acquainted with IPR and Patent registration.

M.Sc. Zoology Semester II

MZO2T05-Biology of Chordata

Course Outcomes (COS)

- Students will be able to describe and recognize unique characters, life functions, connecting link between non-chordates and chordates and the diversity of urochordates, cephalochordates, cyclostomes and fish.
- Describe the structural, physiological and evolutionary correlation of different vertebrates; elaborate how kidneys represented successful evolutionary responses to the surrounding environmental pressures. List some migratory bird species,

conduct bird tracking and watching activity. Facilitate students to explore the world of cetaceans and the marine environment. Gain a better understanding of the forces that drive evolution, speciation and the diversity of life on our planet. Identify, describe and differentiate the basic structure and functions of the central and peripheral nervous systems and define learning and memory.

- Compare and contrast the organization and evolution of the vertebrate circulatory system and heart. Describe specialized sensory organs of vertebrates and relate their role to their habitat.
- Comprehend the gradual development and evolutionary history of man. Identify, classify, describe and explain vertebrate specimen in the field as well as maintain and organize museum specimen.
- Develop a skill to demonstrate and explain different anatomical systems of vertebrate, and perform whole mount preparations of given vertebrate materials, different steps of microtomy and staining procedure.
- They could use, handle and maintain the instruments like microtome and oven. Students will able to identify, demonstrate, explain and compare the histological structure and functions of internal organs of vertebrates.

MZO2T06 - Advanced Developmental Biology

Course Outcomes (COS)

- Students will be able to differentiate and explain the basic developmental concept of insects, cast differentiation in insects,

amphibian metamorphosis and aves with its hormonal control and regeneration process in vertebrates.

- Illustrate and classify the type, structure, function and hormones of the placenta, analyse the cell differentiation, organ formation, cell death, and multiple physiological levels of aging.
- They will be able to analyse the process of advanced cattle breeding with the help of MOET, cloning techniques, acquire knowledge about embryonic sexing to diagnose the genetic disorder, the economic and clinical significance of embryonic stem cells.
- Comprehend birth control method that uses the body's immune response and classical contraceptive techniques to prevent pregnancy.
- Explain different anti-androgen and anti-spermiogenic compounds and also discuss transgenic animals that elevated the potential of biological research for human welfare.
- They will be able to demonstrate the development of Lymnea and mounting of Chick embryo.

MZO2T07-Electives

1. Mammalian Reproductive Endocrinology

Course Outcomes (COS)

- Students will be able to comprehend the structural and functional aspect of hypothalamus. Illustrate regulations and feedback mechanism of various neurohormones, neurotransmitters and neural signals, structural and physiological role of pituitary. Elucidate the histological organization of endocrine glands, gonads and correlate it with the health issues.

- Describe and explain the non-steroidal regulators of reproduction, the hypothalamic-pituitary axis with the help of gonads, adrenal and thyroid gland, the mechanism of biosynthesis, mode of action and function of reproductive hormones such as estrogen, progesterone, androgen and inhibin that are involved in sexuality and fertility.
- Prepare, identify, differentiate and explain the histological slides of endocrine gland.

2. Brain and Muscle Physiology

Course Outcomes (COs)

- Students will be able to differentiate and classify the various morphological differentiation and analysis of the mammalian brain, brain stem and cerebellum.
- Elaborate on the physiology and mechanism of learning, memory and sleep. Classify and illustrate the ultrastructure of neurons and synapses, functional and bioelectrical properties of the neurons, molecular mechanism of synaptic transmission and mechanism of neurotrophins and growth factors affecting the neuronal growth.
- Classify and analyse the biosynthesis, storage, release and mechanism of the action of various neurotransmitters and neuropeptides.
- Differentiate between the structure and physiology of various organs involved in photoreception and phonoreception.
- Analyse the various causes, symptoms, mechanism of pathogenesis, diagnosis and treatment of neurodegenerative disorders. Explain and describe the classification, ultrastructure, properties and structural proteins of muscle.

- Illustrate the molecular mechanism of muscular contraction, ultrastructure of the neuromuscular junction and types, causes, symptoms and treatment of various neuromuscular disorders. They could able to demonstrate and estimate liver and muscle glycogen, protein and lipid.

3. Aquaculture Economy

Course Outcomes (COS)

Students will be able to describe, explain and compare different water bodies of India, basic techniques used for fish breeding, concepts of fish culture, culture of air breathing fishes.

4. Insect Morphology and Physiology

Course Outcomes (COS)

- Students will able to explain, describe and compare morphology of integument, head, thorax, abdomen, appendages and wings.
- They could describe, explain and differentiate structure and physiology of systems like digestive, circulatory, respiratory, nervous and neuroendocrine system etc.
- Students will be able to describe, explain and compare the sensory organs like visual organs, sound and light producing organs, bioluminescence, different mechanoreceptors and chemoreceptors.
- Describe, explain and compare mechanism of communication, colour change, mimicry and camouflage.

MZO2P03-On Job Training

Course Outcomes (COS)

Students will gain hands on training of any activity associated with Zoology.

Semester-II MZO2PO4

Skill based practical course in M. Sc. SEM-II

Zoology, Biology of Chordata

1. Study of museum specimens using already available specimens in the museum/charts/ models/photographs/ digital alternatives etc. Classification of vertebrates up to order and comments on the specimens representing all phyla.

Anatomical Observations

2. Anatomical observations, demonstration and detailed explanation of the following with the help of ICT tools/models/charts/photographs etc.

a) Brain and cranial nerves- Fish/ Rat. b) Arterial and venous systems- Fish/Rat c) Urinogenital system Fish/Rat. d) Reproductive systems Fish/Rat. e) Internal ear in fish, Weberian ossicles in fish, accessory respiratory organs in fish.

Mounting: Study of Stained Permanent preparation of scales, ampullae of Lorenzini, otolith, striated muscles and cartilage of fish using animal wastes from local recognized fish markets or with the help of already available permanent slides/ ICT tools/ charts/ photographs etc.

M.Sc. Zoology Semester-III

MZO3T08 - Parasitology and Immunology

Course Outcomes (COS)

- Students will be able to illustrate and differentiate life cycle, mode of transmission, infection and treatment of various bacterial infection and viral infections such as covid, dengue, and hepatitis.

- Describe, explain, classify and differentiate organs of immune system, innate immunity, adaptive immunity, antigen, antibodies, toxin anti-toxin and their cellular target.
- Demonstrate antigen-antibody interaction with the help of ODD. Illustrate the maturation, activation, differentiation of T and B cell, inheritance of MHC molecules and various pathways of complement system. Classify, describe and differentiate various types of cytokines, hypersensitivity, autoimmunity and immunodeficiency diseases. Explain and describe activation and migration of leucocyte, mast cell, transplantation, tumor immunology, various infectious diseases and vaccines. Illustrate and differentiate working principle and significance of immunotechniques such as RIA and ELISA.

MZO3T09 - Wild Life and Avian Biology

Course Outcomes (COS)

- Students will explain, describe and analyze importance of wildlife and its conservation, international conservation bodies, predator-prey relationship, population dynamics of ungulates and carnivores.
- They could also explain, describe and analyze morphology, morphometry of birds, birds' diversity, techniques of bird counting, bird breeding population and breeding group maps, bird hotspots, bird sanctuaries and role of birds in ecosystem.

MZO3T10- Comparative Endocrinology

Course Outcomes (COS)

- Students will be able to identify, classify, differentiate, describe and explain different types of cells and organs of neuroendocrine system of invertebrates.
- Illustrate the role of hormones in the regulation of various physiological processes in invertebrates such as metamorphosis, reproduction and colour change mechanisms.
- Describe, explain, and differentiate the hypothalamo-hypophysial system, structure, hormones, functions and feedback mechanisms of pituitary, thyroid, parathyroid, pancreas, gastrointestinal tract and adrenal gland.
- Comprehend the role of hormones in pharmaceuticals, including contraception, sex hormones, cancer, immune system and immune regulating hormones (IRH).
- Raise awareness about the significance of pharmaceutical applications. Students could demonstrate compare the preparation of histological slides of endocrine glands.

MZO3T11-Electives

1. Mammalian Reproductive Physiology -Female

Course Outcomes (COS)

- Students will be able to understand and evaluate the different processes and hormonal control of ovarian cycle.
- Describe and specify the mechanism and hormonal control of uterine cycle in different mammalian species.
- Comprehend the structure, function, regulation, anomalies and disease of female reproductive tract. Discuss the physiological and hormonal reasons behind bodily changes at puberty, the importance of prostaglandins in reproduction.

- Recognize the anatomical structure and development of breasts, mechanism of synthesis, secretion and ejaculation of milk via hormonal influence.
- They could detect and confirm the pregnancy by using female urine sample.

2. Blood and Cardiac Physiology

Course Outcomes (COS)

- The students will be able to illustrate the structure, properties and function of cardiac muscle along with the anatomy, histology, nerve innervations and valves of the heart.
- They will further be able to classify and compare the pacemakers and conducting fibers present in the heart, and illustrate various types, causes, symptoms, diagnosis, and factors affecting blood pressure and treatment.
- Illustrate and compare the mechanism of the cardiac cycle, heart sound, working principle of ECG, cardiac output, haemodynamic, haemorrhage, cardiac murmur, circulatory shock and cardiac failure.
- Describe, explain and compare the cellular composition and functions of blood, blood groups, blood transfusion, bone marrow aspiration and pathological conditions of blood glucose and lipids along with blood coagulation.
- Compare and illustrate the transport of gases by blood, diagnosis, symptoms and treatment of bleeding disorders and blood cancer.
- Illustrate the mechanism of formation, composition, transport and functions of lymph.

- Differentiate, describe and explain anaemia and polycythemia, platelets and Blood substitute. Students will be able to demonstrate the components of the blood such as RBCs, WBCs, DLCs, Hb etc. along with the blood group.

3. Fish Physiology

Course Outcomes (COS)

- Students will be able to describe, explain and compare structure and physiology of associated system like digestive, sensory organs, osmoregulation, nervous system and reproductive system of teleost.
- They could explain and describe different mode of migration in fishes with respect to periodicity and role of hormones.
- They could also explain, describe and analyse hormonal control via hypothalamo-hypophysial system and neuroendocrine system of gametogenesis and reproductive behavior in fishes. Students could also able to demonstrate and explain ablation of gonad in fishes.

4. Insect Pest Management

Course Outcomes (COS)

- Students will study about life cycle, host plants, damage and control measures of various insect-pests of field crops.
- Identify common insects and insect pest of different orders available in local area and could form local or regional insect diversity register as well as demonstrate different pathogen in insect tissues.

- Students will be able to illustrate and compare the properties, mode of action and uses of inorganic insecticide, chlorinated hydrocarbons, organophosphates and botanical insecticides.
- Explain and describe biological control measure, nano-biopesticide pathogenic viruses, bacteria, parasitoids and predators of insect pests techniques used in pest control programmes such as use of radiation, chemosterilants, hormones and pheromones

MZO3P07, Research Project (RP) Minor Work

Course Outcomes (COS)

- After completion of minor research project, the student will be able to search research articles online and offline, Draft scientific write up and submit in the form of report.
- They will be able to check the script for plagiarism. Discuss particular topic and could arrange it in a proper manner.
- Learn and write bibliography by various styles.

MZO3P07, Research Project (RP) Minor Work

In this minor research project, the student shall be required to carry out exhaustive literature survey and prepare a review covering a literature survey of last 20 years in the area specific to students/supervisors chosen research area and prepared review has to be checked for plagiarism with the plagiarism policy of University. The evaluation of this minor project will be done at departmental level by the approved internal and external examiners.

M.Sc. Zoology Semester-IV

UNIT-IV

Course Outcomes (COS)

- Students will be able to describe, explain and compare different water bodies of India, basic techniques used for fish breeding, concepts of fish culture, culture of air breathing fishes, Plant rout fish culture, Ornamental fish culture, integrated fish farming, sewage fed fisheries and cultivation of Indian major carp's. Describe, explain and compare advanced techniques used in aquaculture-based organisms such as pearls, crab, prawn, and oyster.

MZO4T12 - Biotechniques, Biostatistics, Toxicology and Bioinformatics

Course Outcomes (COS)

- Students will be able to elaborate, discuss and describe sterilization, animal cells, tissue culture, primary culture, cell lines, cell quantification, and growth kinetics and cryopreservation technique.
- Describe, demonstrate and explain the principle and working mechanism of sedimentation, centrifugation, TLC, Gas chromatography and electrophoretic technique. Illustrate and explain the biostatistical measures such as central tendency, dispersion, and probability sampling types, methods and significance test.
- Describe and explain neuronal genetics, environmental components in the development of animal behaviour, organization and functions of animal ethics. Illustrate and explain about the significance of toxicity test in the projects and research.

- Describe and explain the importance and scope of bioinformatics, various biological databases such as BLAST and FASTA, PSI- BLAST etc. and various program runs for the construction of phylogenetic tree like MEGA.
- Students could construct, analyze and interpret phylogenetic tree.

MZO4T13- Radiation and Chronobiology

Course Outcomes (COS)

- The students will be able to define and explain the scope and significance of radiobiological scope in human welfare, Identify ionizing radiation, linear energy transfer, radiation dose and units and conceptualize the radiation types.
- Describe, explain and analyze application of radiology and gainful and harmful effects of radiation. Comprehend the concept of circadian rhythm, central clock system and peripheral clock system. Students will describe, explain and analyze centers of biological clock, relevance of biological clock in human welfare, mechanism of regulation of biological clock and effects of irregularity of biological clock and its remedies.

MZO4T14-Molecular Biology and Biotechnology

Course Outcomes (COS)

- Students will be able to analyse the basics of cellular genome, organization of genetic material, fundamental process of duplication of genetic material in prokaryotes and eukaryotes important for cell division. Evaluate the different types of DNA damage and repair mechanism.

- Illustrate the fundamentals of various mobile DNA elements useful in horizontal gene transfer, evolutionary process and gene expression in prokaryotes and eukaryotes. Explain the mechanisms and regulation of operon models significant in regulation of gene expression in prokaryotes.
- Illustrate the fundamental process of protein synthesis with explanation of antisense and ribozyme technology.
- They could differentiate and distinguish DNA sequencing and gene amplification methods, cloning by different cloning vectors for recombinant DNA technology.