

**PROGRAM OUTCOME AND COURSE OUTCOMES OF**  
**POSTGRADUATE COURSE M.Sc ZOOLOGY**

**AIMS AND OBJECTIVES**

The course curriculum of the department has been designed and developed, giving due importance to both classical components of the subject Zoology and its different ramifications in tune with the modern scientific development across the world. The classical aspects of Zoology include essential structural-functional organization of the Non-Chordates and Chordates, Taxonomy, Biosystematics, Histology, Animal physiology, Evolution and Adaptation. In contrast, the modern dimension of the course curriculum has attached the most significant aspects of Molecular biology, Genetics, Biotechnology, Bioinformatics, Biochemistry, Biostatistics, Immunology, and Parasitology. The effort appears to be very fruitful to the results and academic performance of the existing and former students, reflected in their success in different national and state-level competitions. The department offers four special papers (Fishery, Ecology, Genetics & Molecular biology and Parasitology) which also enabled rural-based students of the University to get proper recognition nationally and different subject-based services. Moreover, the outreach and extension program involving the students in their practical curriculum has contributed significantly to the livelihood generation of the region's marginalized people. All the courses in the program are carefully designed to equip the students for competitive examinations like CSIR NET, SET, etc., and to write research proposals for grants. The expected outcome of the syllabus:

- To know the scope and importance of Zoology.
- To develop scientific temper among students.
- To inculcate interest in nature and living forms and their conservation.
- To make the students eco-friendly by creating a sense of environmental awareness in them.
- To give better exposure to the diversity of life forms.
- To give awareness about natural resources and their importance in sustainable development.
- To study different ecological sites for animals in their natural habitats by field study.
- To provide opportunities for the application of the acquired knowledge in day- to - day life.
- To develop skills in doing experiments, familiarizing equipments and biological specimens.
- To undertake scientific projects which help to develop research aptitude in students.
- To expose students to various fields in biological sciences and to develop interest in related disciplines.
- To attain interdisciplinary approach to understand the application of the subject in daily life.
- To familiarize the emerging areas of Zoology and their applications in various spheres of biological sciences and to appraise the students of its relevance in future studies.

## **Programme Outcomes (POs) for Postgraduate Programme**

**PO1. Critical Thinking:** Take informed actions after 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.

**PO2. Problem Solving:** Understand and solve the problems of relevance to society to meet the specified needs using the knowledge, skills and attitudes acquired from humanities/sciences/mathematics/social sciences.

**PO3. Effective Communication:** Speak, read, write and listen clearly in person and through electronic media in English and in one Indian language, and make meaning of the world by connecting people, ideas, books, media and technology.

**PO4. Effective Citizenship:** Demonstrate empathetic social concern and equity centered national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.

**PO5. Environment and Sustainability:** Understand the issues of environmental contexts and sustainable development.

**PO6. Self-directed and Life-long Learning:** Acquire the ability to engage in independent and life-long learning in the broadest context of sociotechnological changes.

### **Programme Specific Outcomes (PSOs)**

PSOs are specific to a programme and are to be attained at the time of post-graduation from the programme. They are to be identified by a committee with representation from all stakeholders.

#### **M.Sc. Zoology Programme PSOs Program Specific Outcomes**

**PSO1** Understand the biological diversity and grades of complexity of various animal forms through their systematic classification and process of organic evolution.

**PSO2** Understand the roles of plants, animals and microbes in the sustainability of the environment and their interaction among themselves and deterioration of the environment due to anthropogenic activities.

**PSO3** Understand the concepts and principles of biochemistry, immunology, physiology, ethology, endocrinology, developmental biology, cell biology, genetics, molecular biology and microbiology and develop technical skills in biotechnology, bioinformatics and biostatistics.

**PSO4** Perform laboratory procedures as per standard protocols in the areas of animal diversity, systematics, cell biology, genetics, biochemistry, molecular biology, microbiology, physiology, immunology, developmental biology, environmental biology, ethology, evolution and science methodology.

### **Course Outcomes (COs)**

Course outcomes are statements that describe significant and essential learning that the learners have achieved and can reliably demonstrate at the end of the course. Course outcomes are what the student should be able to do at the end of the course

## **SEMESTER – I M.Sc. ZOOLOGY PROGRAMME**

### **1) ZOOLOGY CORE COURSE- ZOO 101 Non- Chordate Biology and Chordate Biology**

#### **Course Outcome Statements**

- CO101.1 The students will be acquainted with non-chordate biology at the end of the course.
- CO101.2 Students will be able to identify the invertebrates and classify them.
- CO101.3 Non-chordates (Metazoa), representing the largest group of the animal kingdom, are characterized by several unique features and display various phenomena (Cyclomorphosis, filter feeding, hydrostatic skeleton, metamorphosis etc.), based on which an array of theories, hypotheses, scientific principles have been advocated in the gamut of the subject of Zoology.
- CO101.4 The syllabus has provided more stresses on three different aspects: 1) Evolution based on existing theories and hypotheses explaining non-chordate, especially metazoans origin and evolution; 2) Phylogenetic relationships among metazoans based on superphyletic concepts; 3) some unique biological phenomena with functional roles and 4) Conservation strategies of metazoans for the ecological and economic benefits.
- CO101.5 Through the course, the students will be accustomed to chordate biology. Students will be able to identify the chordates and classify them.

### **2) ZOO 102 Histochemistry and Animal Physiology**

#### **Course Outcome Statements**

- CO102.1 Students will understand the Scope and importance of histology and histochemistry.
- CO102.2 General principles for the preparation of tissue for histological studies and histochemical localization of various cellular components would be another significant aspect of the course
- CO102.3 The course will provide detailed knowledge of the various physiological organ systems and the importance of the integrative functions of the human body.
- CO102.4 To have enhanced knowledge and appreciation of mammalian physiology; to understand the processes of critical physiological systems, including the cardio-respiratory, renal, reproductive, and metabolic systems; to know how these separate systems interact to yield integrated physiological responses to challenges such as exercise, fasting and ascent to high altitude, and how they can sometimes fail; to be able to perform, analyze and report on experiments and observations in physiology; to be able to recognize and identify principal tissue structures.

### **3) ZOO 103 Immunology and Methods in Biology**

#### Course Outcome Statements

- CO103.1 This course will describe the immune systems of vertebrates that enable them to recognize and respond specifically to foreign substances.
- CO103.2 The students will be able to comprehend the roles of the lymphoid organ, immune system cells, antigens, antibodies, MHC, antigen presentation and immunity to infectious diseases.
- CO103.3 Upon completing this course, students will be able to address a research problem in biotechnology, Provide examples of current applications of biotechnology and advances in different areas like medical, microbial, environmental, and bioremediation.
- CO103.4 After getting theoretical knowledge, students would be acquainted with some modern instruments and methods indispensable to pursuing advanced research in the biotechnology field.

### **4) ZOO 104 Cell Biology and Cytogenetics**

#### Course Outcome Statements

- CO104.1 Students will be well informed about the membrane structure and composition, transport and trafficking of protein, the cytoskeleton, cell movement, and extra cellular matrix.
- CO104.2 The mechanism of cell division and its regulation through different checkpoints will be thoroughly understood.
- CO104.3 Cell cycle, apoptosis, signal transduction, and cancer biology are vital parts of the course.
- CO104.4 The course will provide an understanding of genetic analysis at the gene, genome and population levels. Understanding Drosophila genetics.
- CO104.5 Evaluation of the various aspects of structural, functional and comparative genomics.
- CO104.6 Designing and development of experiments using Drosophila and their assessment through genetic analysis and interpretations

## **SEMESTER II M. Sc. ZOOLOGY PROGRAMME**

### **ZOO 201 Biosystematics and Ecological Principles**

#### **Course Outcome Statements**

- CO201.1 This course will describe the importance of taxonomy in biology, the historical resume of systematics and the stages of taxonomy.
- CO201.2 The course would be dealt with biological classification, basic principles and rules for the classification of organisms.
- CO201.3 The course would enlighten the students with modern trends in biosystematics concepts of different conventional and newer aspects.
- CO201.4 The subject ecology dealing with the relationship among different life forms in respect of their environment is a blend of concepts and contents (information).
- CO201.5 To understand the applicability of this subject, the students must have an acquaintance with the different definitions, terminologies, scientific principles, hypotheses, theories, etc., with proper examples.
- CO201.6 The contents of this syllabus have been identified to make the students understand the basics of ecology, putting more emphasis on the system ecology, habitat ecology, population and community ecology and evolutionary ecology so that ecology students can not only understand the ongoing ecological processes but also can contribute to the proper eco-management.

### **ZOO 202 Biophysics & Biochemistry**

#### **Course Outcome Statements**

- CO202.1 At the end of the course, the student will be able to understand fundamental concepts in biophysics that underlie biological processes through knowledge of membrane biophysics and thermodynamics laws.
- CO202.2 The system would be dealt with the principle of thermodynamics, electromagnetic and ionizing radiation, and principles of biophysical chemistry.
- CO202.3 The course will provide an understanding of fundamental biochemical principles such as biomolecules, metabolic pathways, and regulation of the biological process.
- CO202.4 Upon completion of the course, students can: Understand the agencies responsible for producing various products using biochemistry.
- CO202.5 Understand the term pH, Buffer. Understand the structure and function of carbohydrates, amino acids, proteins, and lipids.
- CO202.6 The students will understand the fundamental energetic biochemical processes and metabolic pathways' chemical logic.
- CO202.7 The course also integrates metabolic processes in cellular systems and organizes cellular pathways.

## **ZOO 203 Molecular Biology and Parasitology**

### Course Outcome Statements

CO203.1 The course will explain the fundamentals of genetics and the Mendelian laws, the concept of alleles, and the idea of linkage and crossing over of genes.

CO203.2 The course will open an avenue to become familiar with various types of genetic data (genotyping, expression, and sequence data), chromosomal mapping, the genetic composition of the biological population, and evolutionary factors that explain the variation.

CO203.3 In-depth knowledge of chemical and molecular processes between cells, including the central dogma, will be assured at the end of this course.

CO203.4 The course will provide an understanding of the diversity and biology of parasites, besides the epidemiological aspects of different parasitic diseases will be explored and students will be able to gain knowledge regarding the mode of transmission of parasitic diseases and its preventive measures.

## **ZOOC-204 Wildlife and Eco-Management and Aquaculture**

CO204.1 The syllabus of this subject includes some pertinent aspects on biodiversity dealing with identifying the threats and conservation of biodiversity alongside highlighting some fundamental elements of wildlife and its conservation with special reference to the diversity, distribution and conservation of wildlife of South West Bengal, India.

CO204.2 This course is expected to generate interest in the students across the disciplines so that they can become a part of wildlife and biodiversity conservation.

CO204.3 Aquaculture is now viewed as a strong option to increase fish production as it plays a vital role in providing food security in India.

CO204.4 Aquaculture informatics can be described as the scientific application of Information technology in biological concepts that enhance the productivity and economic viability of aquaculture sectors.

CO204.5 Advances in electronic communication, combined with specific cooperative efforts, should be used to increase the information exchange in the region.

CO204.6 It is nation's part to educate the fish farmers through community based organization and to provide an information system, in low cost, to fulfill their requirements.

## **THIRD SEMESTER M. Sc. ZOOLOGY PROGRAMME**

### **ZOO 301 Entomology and Ecotoxicology**

#### Course Outcome Statements

- CO301.1 The subject of entomology deal with the study of different aspects of insects, the largest animal taxa of the world has been included in the general syllabus of Zoology for the third semester mainly to give the students an understanding on three different aspects of entomology— morphology and classifications.
- CO301.2 Some relevant aspects of insects' physiology and some unique phenomena in the insects life such bioluminescence, pheromones, secondary adaptation aquatic insects, insects-plants interactions, integrated management of insects pats etc.
- CO301.3 The students can develop not only the interest on this interesting and important faunal component but also can undertake measures for the conservation of beneficial insects and control of the harmful ones.
- CO301.4 The purpose of toxicity testing is to generate information about a substance's toxic properties so that its health and environmental risks can be adequately evaluated.
- CO301.5 In the aquatic sector, the toxicological study may ensure the health of the local aquatic organism and related to human health.

### **ZOO 302 Molecular Evolution and Microbiology**

#### Course Outcome Statements

- CO302.1 The curriculum in evolution includes modern aspects of evolution and molecular phylogenetic tree.
- CO302.2 DNA and amino acid sequences study by genomics and proteomics data analysis and find out the similarities and dissimilarities between different species of the same or diverse group.
- CO302.3 Nearest neighbor analysis and by the principle of parsimony, a gene tree could be made.
- CO302.4 PG students are benefitted from the study of genome analysis and by finding the sequences, they may be able to find out the molecular systematic position.
- CO302.5 To gain knowledge on the importance of microorganisms as primary decomposers, produce food products, produce Antibiotics, synthesize chemicals that our body needs, as test organisms, prevent potential pathogens, Insect Pest Control, Bioremediation, and Genetic Engineering.
- CO302.6 With this exposure, students can be employed in testing/pathology laboratories alternatively.

## **ZOO303B Biodiversity and Conservation Ecology and Aquatic Ecology**

### **ZOO 304 Genetics and Basic and Applied Immunology (CBCS)**

#### Course Outcome Statements

CO304.1\_The course will provide an understanding of genetic analysis at the gene, genome and population levels.

CO304.2 Understanding Drosophila genetics and evaluating the various aspects of structural, functional and comparative genomics.

CO304.3 Designing and developing experiments using Drosophila and their evaluation through genetic analysis and interpretations.

CO304.4 This course will describe the immune systems of vertebrates that enable them to recognize and respond specifically to foreign substances.

CO304.5 The students will be able to comprehend the roles of the lymphoid organ, immune system cells, antigens, antibodies, MHC, antigen presentation and immunity to infectious diseases



## **SEMESTER IV M. Sc. ZOOLOGY PROGRAMME**

### **ZOO 401 Environmental Pollution, Management and Biodiversity and Biostatistics**

#### **Course Outcome Statements**

- CO401.1 The students would be provided with the current status of environmental pollution and global environmental change.
- CO401.2 The course would cover biodiversity: status, monitoring and documentation, significant drivers of biodiversity change, and management approaches.
- CO401.3 To learn about critical biostatistical concepts and efficient tools for summarizing and plotting data and making decisions in the presence of uncertainty.
- CO401.4 The student will be acquainted with parametric and nonparametric statistics, samples and data.
- CO401.5 They will be able to understand t-test, Chi-square, correlation, regression, and Anova.

### **ZOO 402 Developmental Biology and Neuroendocrinology**

#### **Course Outcome Statements**

- CO402.1 The course will provide a broad area from embryology to developmental biology.
- CO402.2 The students will be able to understand embryonic development, reproductive function and fertilization.
- CO402.3 The course will provide an understanding of basic concept of the neural system.
- CO402.4 Students would be acquainted with electrical signaling and mechanism.
- CO402.5 The course will cover the evolutionary perspective nervous system, functional organization of the CNS and endocrine disorder

### **ZOO 403B System Ecology & Human Ecology**

#### **Course Outcome Statements**

- CO403B.1 Both theory and practical learning processes are to acquaint students with both the essential traditional/conventional components of ecological science in order to develop proper knowledge base to tackle the ongoing ecological changes in and around human settlements, with special emphasis to the landscapes & ecosystems of the south West Bengal.
- CO403B.2 The entire syllabus has four dimensions- Systems Ecology, Human Ecology, and Aquatic Ecology & Wildlife Ecology.
- CO403B.3 The major emphasis was laid on developing the syllabus to cover not only traditional aspects of Ecological but also modern developments in the sphere of ecological sciences: system, mathematical, molecular, urban, restoration and aquatic ecology.

## **ZOO496 PROJECT/DISSERTATION**

### Course Outcome Statements

- C0496.1 The project report should include an introduction, methodology, techniques, results, discussion and bibliography.
- C0496.2 Institutional and study tour reports emphasizing theoretical aspects should be included.
- C0496.3 Evaluation of the project report and viva-voce will be open defense through PowerPoint presentation and evaluated by the external examiners.

	P01	P02	P03	P04	P05	P06	PS01	PS02	PS03	PS04
C0101.1	✓	✓			✓	✓	✓		✓	
C0101.2	✓					✓	✓			
C0101.3	✓	✓		✓	✓	✓	✓			
C0101.4	✓	✓		✓	✓	✓				✓
C0101.5	✓		✓	✓	✓	✓	✓			
C0102.1	✓	✓				✓	✓	✓		
C0102.2	✓		✓			✓	✓			
C0102.3	✓						✓	✓		
C0102.4	✓		✓	✓		✓				
C0103.1	✓					✓	✓			
C0103.2	✓		✓			✓	✓		✓	
C0103.3	✓			✓		✓				
C0103.4	✓	✓				✓	✓		✓	
C0104.1	✓					✓	✓			
C0104.2	✓			✓		✓	✓			
C0104.3	✓					✓	✓			
C0104.4	✓		✓			✓			✓	
C0104.5	✓			✓		✓	✓			
C0104.6	✓					✓	✓			
C0201.1	✓	✓				✓	✓			✓
C0201.2	✓			✓			✓			
C0201.2			✓			✓			✓	

CO201.3	✓		✓				✓		
CO201.4		✓			✓		✓		✓
CO201.5			✓				✓		
CO201.6	✓			✓					
CO202.1					✓			✓	
CO202.2	✓						✓		✓
CO202.3			✓						
CO202.4	✓			✓			✓	✓	
CO202.5				✓			✓		
CO202.6		✓						✓	
CO202.7		✓				✓	✓		
CO203.1				✓					
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CO204.1		✓					✓		
CO204.2		✓			✓		✓		✓
CO204.3									
CO204.4	✓		✓		✓		✓		
CO204.5	✓			✓			✓		
CO204.6	✓		✓		✓		✓		✓
CO301.1		✓		✓		✓	✓		✓
CO301.2			✓				✓		

C0301.3			✓			✓			✓	
C0301.4	✓			✓			✓			
C0301.5		✓				✓			✓	
C0302.1	✓			✓			✓			
C0302.2		✓		✓						
C0302.3			✓		✓				✓	
C0302.4	✓		✓			✓		✓		
C0302.5		✓			✓					
C0302.6									✓	
C0303A.1		✓				✓				
C0303A.2	✓			✓						
C0303A.3								✓		
C0303A.4		✓		✓		✓				
C0303A.5	✓		✓		✓		✓			✓
C0303A.6		✓		✓			✓		✓	
C0303A.7										
C0303B.1	✓			✓					✓	
C0303B.2		✓			✓		✓			
C0303B.3			✓						✓	
C0303C.1		✓		✓		✓		✓		
C0303C.2					✓					
C0303C.3	✓		✓			✓			✓	
C0303C.4		✓			✓		✓			

CO303C.5	✓					✓			✓	
CO303D.1		✓	✓	✓				✓		
CO303D.2						✓				
CO303D.3	✓		✓		✓					✓
CO304.1								✓		
CO304.2	✓		✓				✓		✓	
CO304.3			✓		✓				✓	
CO304.4	✓	✓		✓	✓		✓			✓
CO304.5				✓		✓			✓	
CO401.1		✓								
CO401.2	✓			✓		✓		✓		
CO401.3					✓					
CO401.4		✓		✓				✓		
CO401.5	✓		✓		✓		✓			✓
CO402.1		✓		✓		✓			✓	
CO402.2	✓	✓	✓			✓		✓		✓
CO402.3		✓		✓						
CO402.4		✓		✓		✓		✓		
CO402.5	✓	✓		✓		✓	✓		✓	
CO403A.1			✓	✓		✓				
CO403A.2	✓		✓		✓		✓		✓	
CO403A.3			✓							✓✓
CO403A.4		✓			✓		✓		✓	

CO403A.5	✓		✓	✓						
CO403B.1	✓	✓			✓	✓		✓		
CO403B.2	✓		✓		✓	✓	✓		✓	
CO403B.3		✓		✓		✓				✓
CO403C.1	✓		✓			✓		✓		
CO403C.2	✓	✓			✓	✓				
CO403C.3			✓				✓		✓	
CO403C.4	✓	✓		✓		✓				
CO403C.5							✓	✓		
CO403D.1	✓		✓		✓	✓				✓
CO403D.2	✓	✓		✓				✓		
CO403D.3					✓	✓	✓			
496.1	✓		✓	✓						✓
496.2	✓	✓			✓	✓		✓		
496.3	✓		✓	✓			✓			✓