



**Darrang College  
(Autonomous),  
Tezpur-784001**

**Syllabus  
M.Sc. 1<sup>st</sup> Semester  
(CBCS)  
Subject: Zoology**

**Approved by :**

**Board of Studies meeting held on 19-12-2025**

**&**

**Academic Council vide Resolution no. 2, dated 29-12-2025**

# M.Sc. Zoology Syllabus(CBCS) Semester-1

Code	Course	Credit	Contact hour	Total marks	Type
ZOO-1014	<b>Biosystematics and Biostatistics</b>	4	54	40+10	Core (Theory)
ZOO-1024	<b>Bioinformatics and Instrumentation</b>	4	54	40+10	Core(Theory)
ZOO-1034	<b>Evolution and Chronobiology</b>	4	54	40+10	Core (theory)
ZOO-1044	<b>Genetics and Cytogenetics</b>	4	54	40+10	Core (Theory)
ZOO-1054	<b>Ecology and Environmental biology</b>	4	54	40+10	Core (Theory)
ZOO-1064	<b>Biochemistry</b>	4	54	40+10	Core (Theory)
ZOO-1072	<b>Biosystematics, Biostatistics and Bioinformatics</b>	2	54	20+5	Practical
ZOO-1082	<b>Genetics, Cytogenetics, Evolution and Chronobiology</b>	2	54	20+5	Practical

## **M.Sc. FIRST SEMESTER**

**PAPER: ZOO-1014 (Total Marks 40):4 Credits**

### **(BIOSYSTEMATICS AND BIOSTATISTICS)**

#### **UNIT1: 2Credits**

1. Concept of species: Species, Polytypic species, Importance of recognition of Polytypic species taxa.
2. Intraspecific categories, subspecies, temporal subspecies, race and cline
3. Population taxonomy, the new systematic and super species.
4. Speciation: Sympatric, Parapatric and allopatric speciation, Speciation in time, sibling species.
5. Taxonomic characters: Molecular, Behavioral, Ecological and Geographical characters, weighing of characters, characters with low and high taxonomic weight.
6. Intrapopulation variations: Non-genetic and Genetic variations.
7. Interpretation and application of important rules.

#### **UNIT 2: 2Credits**

1. Applications of Biostatistics, Sampling methods: Random sampling, Stratified sampling and Sub-sampling
2. Measurement of variations: Standard error, standard deviation and co-efficient of variation, Quartile and percentiles, probability and distribution, Binomial, poisson and normal distributions.
3. Correlation and regression: Linear regression equation and line of best fit, Coefficient of correlation, Coefficient of regression
4. Chi-square test value of statistics, Confidence limit, t-test, Introduction to one way and two ways Anova and F-test.
5. Kruskal-Wallis test, Man-Whitney U test

#### **Referred Books:-**

1. Introduction to Biostatics. Dr. Pranab Kumar Banerjee, S. Chand & Company.
2. Systematics and the Origin of Species by Ernst Mayr

**PAPER: ZOO-1024 (Total Marks 40): 4 Credits**

**(BIOINFORMATICS AND INSTRUMENTATION)**

**UNIT1: 2Credits**

1. Theoretical aspects of sequence analysis. Needleman-Wunsch and Smith-Waterman methods of global and local alignments for a pair of sequences.
2. Molecular phylogeny and evolution: Properties and types of phylogenetic trees; Tree building methods- Distance based: UPGMA (Unweighted pair group method using arithmetic mean), Neighbor-joining, minimum evolution and least square methods; Character-based: Maximum parsimony, maximum likelihood.
3. Levels of protein structures and visualization: Protein secondary and tertiary structures prediction methods (Description of machine learning methods for secondary structures, homology/comparative modeling, fold recognition or threading and ab initio methods for tertiary structure prediction)
4. Overview of protein-protein and protein-ligand interactions (use of Cluspro and Autodock)

**Referred books:**

1. Bioinformatics, Sequence and Genome analysis. Second Ed. By David W. Mount
2. Bioinformatics and Functional genomics. Third Ed. By Jonathan Pevsner

**UNIT2: 2 Credits**

1. Microscopy: Principles and applications of phase contrast, Fluorescence, confocal and electron Microscopy.
2. Principles and application of tracer techniques- autoradiography and radio immunoassay.
3. Immunological techniques: Immunodiffusion, Immunoelectrophoresis, Enzyme linked Immuno-absorbant assay (ELISA)
4. Centrifugation: Density gradient and unit gravity centrifugation, tissue processing and separation of various sub-cellular organelles by centrifugation
5. Molecular separation Techniques: Ion-Exchange, absorption, partition, gel filtration, and affinity chromatography and HPLC.  
Electrophoresis- Principle and applications, Agarose, SDS, SDS-PAGE, Pulsed gel and Disc electrophoresis, determination of molecular weight by SDS-gel electrophoresis
6. Cryopreservation: Methods and applications
7. Southern, Northern and Western Blotting
8. Principle and application of Nick-translation, in situ-hybridization
9. Chromosome banding, FISH-chromosome painting technique

**PAPER: ZOO-1034 (Total Marks: 40) 4Credits**

**(EVOLUTION AND CHRONOBIOLOGY)**

**UNIT1: 2 Credits**

1. Theories of organic evolution, prebiotic molecules (Amino acid and Nucleic acid bases).
2. Evolution of Prokaryotes and Eukaryotes
3. Human Evolution –History of Human evolution
4. Modern theories of Origin of life
5. Notion of selectively neutral mutations, evolutionary gene duplication, the founder principle, bottleneck effect of genetic drift.
6. Factors and forces of evolution: Mutation, Genetic variation, Isolation mechanisms and their role in speciation.
7. Theory of Neo-Darwinism and Neo-Lamarckism
8. Molecular evolution : Concept of neutral evolution (Kimura), molecular divergence and molecular clock, molecular tools in phylogeny, classification and identification, Origin of new genes and proteins, gene duplication and divergence

**UNIT2: 2 Credits**

1. Biological clocks
2. Significance of Biological time keeping
3. Biological rhythms: Types of rhythms- Circadian, Circatidal, Circalunar, Circannual; Centres of biological rhythms- Supra chiasmatic nuclei, Pineal gland, Optic lobes; Factors influencing biological rhythms- Environmental, Photoperiod, Temperature, Other Zeitgebers.
4. Methods of measurement: Entrainment, Re-entrainment, Phase angle difference, Free-run, Phase shift, Phase response curve, Arrhythmia.
5. Molecular bases of circadian rhythms: Clock genes: *Drosophila* and Mouse.
6. Applied Chronobiology: Human circadian rhythms, Application of circadian rhythms and principles; Jet-lag/shift work; Depression and sleep disorders; Chronopharmacology and Chronotherapy.

**Referred Books:-**

1. Nelson, R.J.(2000). An introduction to behavioral Endocrinology, 2<sup>nd</sup>edition.
2. Binkley,S.(1990).The clock work sparrow: time, clocks and calendars in biological organisms.
3. Chadrashekar, M.K.(1985).Biological rhythms. Madras science foundation, Chennai.
4. **Evolution** – Monroe W. Strickberger, Jones & Bartlett / Tata McGraw-Hill

**PAPER: ZOO-1044**

**(Total Marks 40):4Credits**

**(GENETICS AND CYTOGENETICS)**

**UNIT 1: 3 Credits**

1. Eukaryotic chromatin structure and chromosome organization: Classes of DNA Chromosomal proteins: histones and their modifications, non-histone proteins, scaffold/matrix proteins, levels of chromatin condensation at interphase and metaphase stage.
2. Organization and functions of mitochondrial DNA
3. Microbial genetics: bacterial chromosomes, transformation, transduction, conjugation
4. Bacteriophage: Type, structure and morphology
5. Chromosome anomalies and diseases: chromosomal anomalies in malignancy (chronic myeloid leukemia, Burkitt's lymphoma, retinoblastoma and Wilm's tumor)
6. Genetics and Cancer: oncogenes-tumour inducing retroviruses and viral oncogenes, chromosome rearrangements and cancer, tumour suppressor genes, cellular roles of tumour suppressor genes, P<sup>RB</sup>, P<sup>53</sup>, P<sup>APC</sup>, genetic pathways to cancer.
7. Goals and values of human genome project, organization and distribution of human genes.
8. Gene action: from genotype to phenotypes- penetrance and expressivity, gene interaction, epistasis, pleiotropy.
9. Methods of gene mapping: 3 point test cross in *Drosophila*, gene mapping in human by Linkage analyses in pedigrees.
10. Basic concept of molecular disorders and gene therapy.

**UNIT 2:-1 Credit**

1. Giant chromosome: models for studies on chromosome organization and gene expression.
2. Sex determination: Role of Y chromosome, sex mosaics, sex chromosome anomalies, sex influenced alleles, sex limited genes and hormonal influence.
3. Sex determination and dosage compensation gap of X-linked genes, hyperactivation of X linked genes in *Drosophila*, Inactivation of X-linked gene in female mammals, Hypoactivation of X-linked genes in *Caenorhabditis elegans*.
4. Human genetics: Karyotype and nomenclature of metaphase chromosome bands.

**Referred Books:-**

1. **Genetics: A Conceptual Approach** – Benjamin A. Pierce, W.H. Freeman (Macmillan Learning)
2. Alberts B., Johnson, A., Lewis, J., Raff, M., Roberts, K., and Walter, P.(2014)Molecular Biology of the Cell .
3. Rooney, D.E.,& Czepulkowski, B.H. (2013). Human Cytogenetics: Constitutional Analysis (4<sup>th</sup> ed.), Oxford University Press

**PAPER: ZOO-1054 (Total Marks 40):4Credits**

**(ECOLOGY AND ENVIRONMENTAL BIOLOGY)**

**UNIT1: 2Credits**

1. Structure of ecosystem-variations in physical environment and adaptations, Homeostasis, stability concept
2. Biodiversity of ecosystem – Salient features of aquatic and terrestrial ecosystem and their biotic communities
3. Biotic community concept and community analysis – organization, population density, relative abundance, frequency, dominance, carrying capacity, species richness and species diversity.  
Community development: Types of community changes, causes and examples of ecological succession, Climax community and stability
4. The Niche concept, ecological niche, niche overlap and separation
5. Population ecology- growth pattern, life tables & survivorship curve and density dependent & independent factors.
6. Life history strategies: K-or r-selection, Age and sex ratio.
7. Trophic structure, Lindeman's trophic dynamics concept, Food web pattern and measurement in ecosystem energy flow model, concept of productivity and measurement of primary productivity.

**UNIT 2: 2Credits**

1. Environmental issues, environmental regulations and biodiversity management approaches.
2. Environmental concerns—green house effect, global warming and environmental pollution.
3. Biogeochemical cycles- carbon, nitrogen and sulphur cycles; impact of human activity on nutrient cycles.
4. Human and Environment: Anthropogenic Impact on Environment, Environmental Impact assessment.
5. Environmental monitoring and documentation.
6. Major drivers of biodiversity changes in environment and principles of biodiversity Conservation.

**Referred Books:-**

1. Concept of Ecology, Kormondy Edward J.4<sup>th</sup> Edition
2. Erach Bharucha — Textbook of Environmental Studies for Undergraduate Courses Universities Press (India). 2nd / later editions. ISBN examples: 9788173718625 (2nd ed.), 9789393330901 (4th ed., 2025). ([universitiespress.com](http://universitiespress.com))
3. R. Rajagopalan — Environmental Studies: From Crisis to Cure Oxford University Press (India). Recent editions (e.g., 3rd ed./latest). ISBN example: 9780199459754 / ISBN-13 9789354978944

4. Anubha Kaushik & C. P. Kaushik — Perspectives in Environmental Studies  
New Age International (multiple editions). ISBN example: 9789386418630
5. Martha J. Groom, Gary K. Meffe & C. Ronald Carroll — Principles of Conservation  
Biology (3rd ed.) Sinauer Associates (now an imprint of Oxford University Press).  
ISBN: 9780878935970 (3rd ed., 2006).
6. W. H. Schlesinger & Emily S. Bernhardt — Biogeochemistry: An Analysis of Global  
Change (3rd/4th eds.) Academic Press / Elsevier. ISBN (4th ed.): 9780128146088  
/ (3rd ed.) 9780123858740 (2013).
7. Janick F. Artiola, Ian L. Pepper & Mark L. Brusseau — Environmental Monitoring  
and Characterization Elsevier / Academic Press, 2004. ISBN: 9780120644773 (1st ed.).
8. Peter Morris & Riki Therivel — Methods of Environmental Impact Assessment  
Routledge / Distributed editions; classic reference on EIA methodologies.
9. Daniel B. Botkin & Edward A. Keller — Environmental Science: From Theory to  
Practice Wiley

**PAPER: ZOO-1064 (THEORY)  
(BIOCHEMISTRY)**

**(Total Marks40):4Credits**

**UNIT1: 2 Credits**

1. Energy rich compound, role of ATP/ADP cycle in transfer of high energy phosphate
2. Important respiratory complex of ATP synthesis and oxidative phosphorylation, chemiosmotic hypothesis
3. Secondary structure:  $\alpha$ -helix,  $\beta$ -pleated sheet & bends, Prediction of secondary structure, Ramachandran plot
4. Tertiary structure: Forces stabilizing tertiary structure, Domains and motifs, Quaternary Structure of proteins.
5. Enzyme kinetics, lowering of activation energy, Derivation of Michaelis-Menten equation and determination of  $K_m$  and  $V_{max}$  using MM & LB plots, Concepts of regulation of enzyme activity.
6. Concept of metabolic pathways, Glycolysis and Gluconeogenesis, Glycogenesis and Glycogenolysis; Krebs cycle.

**UNIT 2: 2Credits**

1. Hexose monophosphate shunt pathway and its significance;  $\beta$ -oxidation of fats and synthesis of fatty acids.
2. Intermediary metabolism: inter-conversion between lipids, carbohydrate and proteins.
3. Amino acid: Structure and chemistry of amino acid, Amino acid catabolism:
4. Transamination, Transdeamination and oxidative deamination, Urea cycle
5. Nucleic acids : Structure, folding motifs, conformational flexibility and supercoiling,
6. DNA replication, DNA polymerases, Origin of replication and formation of primosome
7. Replication fork and replisome, Termination of replication, Transcription unit, split genes
8. Mechanism of transcription: RNA polymerases, Formation of pre-initiation complex at
9. RNA pol II promoter, Capping, Poly(A) tailing, Splicing  
Mechanism of translation: Role of ribosomes and tRNA, Formation of initiation complex.
10. Elongation and termination.

**Referred Books:-**

1. **Principles and Techniques of Biochemistry and Molecular Biology** – Keith Wilson & John Walker, Cambridge University Press

**PAPERZOO-1072 (PRACTICAL)**

**(Total Marks20):2 Credits**

**(BIOSYSTEMATICS, BIOSTATISTICS AND BIOCHEMISTRY)**

1. Identification of invertebrates, larval forms of invertebrates, protista, and vertebrates.
2. Determination of biodiversity indices: Shannon-Weiner Index, Similarity and Dissimilarity index and association index.
3. Calculation of Standard deviation, standard error, analysis of variation, Coefficient of variation, t-test, chi-square test and two way ANOVA.
4. Extraction of biomolecules (carbohydrates, proteins, lipids) from fish liver.
5. Estimation of protein extracted from fish liver by Biuret/Lowry/Bradford method.
6. Estimation of glycogen extracted from fish liver by Anthrone reagent method.
7. Estimation of blood glucose by Folin-Wu method.
8. Effect of substrate concentration on enzyme activity and determination of  $K_m$  and  $V_{max}$  by plotting Michaelis-Menten and LB plot.
9. Estimation of DNA
10. Estimation of RNA
11. Determination of molecular mass of proteins by SDS-PAGE.

**PAPERZOO-1082 (PRACTICAL)**  
**(Total Marks 20):2 Credits**

**(GENETICS,CYTOGENETICS,EVOLUTION, CHRONOBIOLOGY AND  
BIOINFORMATICS)**

1. Study of mutant phenotypes of *Drosophila*.
2. Study of sex chromatin in buccal smear and hair bud cells (Human).
3. Preparation and study of metaphase chromosomes from mouse bone marrow.
4. Chromosome banding(C-and G-banding).
5. Study the difference in number, shape and size of chromosomes in normal vs. tumor cells and normal vs. irradiated cells.
6. Preparation of human karyotype and study of chromosomal aberrations with respect to number, translocation, deletion etc from the pictures provided.
7. Study of Hardy-Weinberg equilibrium in human population by taking the example of blood group system (ABO).
8. Use of search engines like Scopus, Science Direct for reference material collection management.
9. Nucleic acid and protein sequence data bases
10. Data mining for sequence analysis
11. Web based tools for sequence searches and homology screening
12. Construction for phylogenetic trees for proteins using UPGMA or Neighbor joining method (no software to be used)
13. Reproduction of the same phylogeny using MEGA software for the given set of sequences
14. Finding possible genes in a given nucleotide sequence(ORF finder)
15. Prediction and validation of protein structure using homology modeling (use of Swiss model)
16. Determination of binding modes of a given ligand in the active site of a protein(use of Autodock)