



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

**Syllabus  
M.Sc. 4<sup>th</sup> Semester  
(CBCS)  
Elective 1: Cell and Molecular Biology**

**Subject: Zoology**

**Approved by :**

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

**&**

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

# Elective 1: Cell and Molecular Biology

Code	Course	Credit	Contact hour	Total marks	Type
ZOO-4014	Molecular Cell Biology	4	60	40+10	Elective (Theory)
ZOO-4024	Membrane Biology	4	60	40+10	Elective (Theory)
ZOO-4034	Molecular Biology	4	60	40+10	Elective (Theory)
ZOO-4044	Genomics and Proteomics	4	60	40+10	Elective (Theory)
ZOO-4054	Immunology	4	60	40+10	Elective (Theory)
ZOO-4062	Practical 1 (Molecular Cell Biology)	2	60	20+5	Practical
ZOO-4076	Dissertation	6	90	60+15	Dissertation (Elective)

**M.Sc. 4<sup>th</sup> Semester**  
**Paper ZOO-4014**  
**(Molecular Cell**  
**Biology) (Marks**  
**40+10) Theory**  
**Credit: 4 Credits**

1. Nuclear structure and transport between the nucleus and cytoplasm.
2. Molecular structures of genes and chromosomes: molecular definition of a gene; chromosomal organization of genes and non-coding DNA; mobile DNA; organizing cellular DNA into chromosomes.
3. Chromatins and chromosomes; centromere and telomere
4. Genetics of cell cycle: genetic regulation of cell division in yeasts and eukaryotes; molecular basis of cellular checkpoints.
5. Somatic cell genetics: cell fusion and hybrids- agents and mechanisms of fusions: heterokaryons and selective hybrids.
6. Cancer: monoclonal origin; differences between normal and cancer cells; cell transformation and factors for cell proliferation; concepts of oncogenes and their role in cancer, tumour suppressor and apoptotic genes; chromosomal basis of cancer.
7. Ageing: cellular basis of aging; causes of aging; oxidative damage; genetic instability; mitochondrial genome damage; genetic aging programme.

**M.Sc. 4<sup>th</sup> semester**  
**Paper ZOO-4024**  
**(Membrane Biology)**

**(Marks 40+10) Theory Credit: 4 Credits**

1. Biomembranes: structural organisation and basic concepts.
2. Transport across cell membranes: diffusion of small molecules across phospholipid bilayer; facilitated diffusion; Active transport by ATP-powered pumps; co-transport; coupling active transport to existing ion gradients; uniports, symports, and antiports; co-transport by symporters and uniporters; transport across epithelia, osmosis, water channels, and the regulation of cell volume.
3. Membrane potential and nerve impulses.
4. Role of cyto-membrane in health and diseases with special reference to lipid peroxidation
5. Membrane-associated receptor proteins: cell surface receptors, endocytosis, and ligand formation.
6. An overview of the endomembrane system.

**M.Sc. 4<sup>th</sup> Semester**  
**Paper ZOO-4034**  
**(Molecular biology)**  
**(Marks 40+10)**  
**Theory Credit: 4**  
**Credits**

1. DNA replication: Basic idea of prokaryotic and eukaryotic DNA replication- mechanics of DNA replication, enzymes, and accessory proteins involved in DNA replication.
2. DNA repair system: Excision repair, Mismatch repair, DNA breaks repair, and Bypassing of DNA damage. Homologous recombination and site-specific recombination.
3. Gene expression: From Transcription to Translation. An overview of transcription in prokaryotic and eukaryotic cells. Synthesis and processing of ribosomal RNA, transfer RNA, and messenger RNA. Transcriptional and post-transcriptional gene silencing.
4. Post-transcriptional modification in RNA: 5' cap formation and 3' end processing and polyadenylation, Splicing-editing, Nucleus export of mRNA stability.
5. Translation: Genetic code, Wobble hypothesis, Prokaryotic and Eukaryotic translation, including the mechanism of initiation, Elongation, and Termination. Co and post-transcriptional modification of proteins.
6. Transcriptional and post-transcriptional control of Gene expression.

**M.Sc. 4<sup>th</sup> Semester**  
**Paper ZOO-4044**  
**(Genomics and Proteomics)**  
**(Marks 40+10) Theory Credit: 4 Credits**

1. Proteins and proteome: protein structure; the four levels of protein structure; 3D structure of proteins; Transcriptome: the link between the transcriptome and the proteome; protein interaction network.
2. Genome organization: The complexity of the genome; Nuclear genomes; genetic features of nuclear genomes.
3. Sequencing of genomes: methodology of DNA sequencing; Contiguous DNA sequence; Strategies of sequencing; recognition of coding and non-coding regions and annotation of genes; quality of genome sequence database calling and sequence accuracy.
4. DNA libraries: Genomic library; CDNA libraries.
5. Genome information reserves and DNA sequence analysis using software.
6. Metagenomics: Introduction- from genomics to metagenomics; next generation of DNA sequencing technologies and potential challenges.

**IMMUNOLOGY**  
**CODE: ZOO-**  
**4054 CREDIT:**  
**04**

**UNIT I**

1. Complement system: Classical and alternate pathways of complement activation
2. Complement and inflammation, formation of the membrane attack complex
3. Cytokine structure and function, cytokine receptor, Cytokine and immune response.
4. Genetic Basis of Ab Structure
5. Genetic organization of MHC, role of MHC in activation of T lymphocyte.
6. The T Cell Receptor: Structure and Genetic Basis, Antibody-Mediated Reactions, Cell-Mediated Reactions

## **UNIT II**

1. Immunology of HIV Infection
2. Infection and Immunity
3. Immune Regulation & Tolerance
4. Hypersensitive reactions
5. Autoimmunity
6. Immunology of Cancer
7. Immunoprophylaxis (Vaccines) & Immunotherapy, Transplantation immunology, Modern Antibody therapy

### **M.Sc. 4<sup>th</sup> semester**

#### **Paper ZOO-4062**

#### **(Molecular Cell Biology) PRACTICAL**

**(Marks 20+5) Theory Credit: 2 Credits**

1. Supravital staining of living cells, blood cells, and living protozoa
2. Staining of certain organelles in situ using specific stains (mitochondria, Golgi, etc)
3. Study of micronuclei in mice/fish
4. Preparation and study of polytene chromosomes
5. Study of Euchromatin and Heterochromatin C banding
6. Preparation of the mitotic chromosome in onion root tip cells
7. Meiotic chromosome preparation from rats or mice
8. Isolation of genomic DNA from Mammalian Tissue
9. Separation of DNA by Agarose Gel Electrophoresis
10. Demonstration of amplification of DNA by PCR
11. Viva-voce

### **M.Sc. 4<sup>th</sup> semester**

#### **Paper ZOO-4076**

#### **(Dissertation/Field report)**

**(Marks 60+15), Credit: 6**

1. **Dissertation – 60 marks**
2. **Field report - 15 marks**





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

## **Syllabus M.Sc. 4<sup>th</sup> Semester (CBCS)**

**Elective 2: Animal Ecology and Wildlife  
Biology**

### **Subject: Zoology**

**Approved by :**

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

**&**

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

**SEMESTER-4**  
**ELECTIVE 2: Animal Ecology and Wildlife Biology**

<b>Code</b>	<b>Course</b>	<b>Credits</b>	<b>Contact hours</b>	<b>Total Marks</b>	<b>Types</b>
<b>ZOO-4014</b>	<b>Ecosystem Functions and Stability</b>	<b>4</b>	<b>54</b>	<b>40+10=50</b>	<b>Elective(Theory)</b>
<b>ZOO-4024</b>	<b>Wildlife and Wildlife Habitat Relations</b>	<b>4</b>	<b>54</b>	<b>40+10=50</b>	<b>Elective(Theory)</b>
<b>ZOO-4034</b>	<b>Wildlife Population Ecology and Methods</b>	<b>4</b>	<b>54</b>	<b>40+10=50</b>	<b>Elective(Theory)</b>
<b>ZOO-4044</b>	<b>Wildlife Conservation</b>	<b>4</b>	<b>54</b>	<b>40+10=50</b>	<b>Elective(Theory)</b>
<b>ZOO-4054</b>	<b>Wildlife Management</b>	<b>4</b>	<b>54</b>	<b>40+10=50</b>	<b>Elective(Theory)</b>
<b>ZOO-4062</b>	<b>Practical</b>	<b>2</b>	<b>54</b>	<b>20+5=25</b>	<b>Practical</b>
<b>ZOO-4076</b>	<b>Dissertation</b>	<b>6</b>	<b>81</b>	<b>60+15=75</b>	<b>Dissertation</b>

**M. Sc. FOURTH SEMESTER  
SPECIAL PAPER: ANIMAL ECOLOGY & WILDLIFE BIOLOGY**

**PAPER- ZOO-4014**

**ECOSYSTEM FUNCTIONS AND STABILITY**

**Total credits: 4      Total Contact hours: 54**

**Total Marks: 40+10**

**Unit-I: Ecosystem Function (Credits 2)**

**Total Contact hours: 27**

Ecosystem Productivity, Measurements of Primary and secondary productivity, food chain and trophic level, Functional rules and guilds, Keystone species, Nutrient cycling, Nutrient Pools and exchange, Phosphorous cycle, Energy flow Models, Nutrient cycles in forests, Ecosystem developments, Restoration ecology and its relevance to present context, Bioenergetics of ecosystem development, relevance of Ecosystem development theory to human ecology. Ecological efficiencies, Ecological Niche, Niche overlap, Niche separation, Niche Relationship and community structures, Ecological equivalents, Parallel niche, Competitive Displacement, Principles of co-existence.

**Unit-II: 2 Ecosystem Stability (Credits 2)**

**Total contact hours: 27**

Meaning of Stability and Stability concept, Types of Stability; Resistance and resilience stability, Relationship of Species Diversity and Stability, Stability of Isolated Population, Stability of their steady state and Influence of random perturbations on population Stability, Ecosystem maturity and role of Natural selection, Natural and Artificial ecosystems, Theory of ecosystem succession, Climax concept and Significance of ecological succession, two views of community organizations. Ecological Principles of Management, Role of Ecologist in the management of Natural Ecosystem, Management Techniques, Significance of Planning of Ecosystem Management, Ecological Risk Assessment, Analytical methods for ecological risk assessment in terrestrial and Aquatic ecosystem and planning and strategies.

**M. Sc. FOURTH SEMESTER**  
**SPECIAL PAPER: ANIMAL ECOLOGY & WILDLIFE BIOLOGY**

**PAPER- PAPER- ZOO-4024**  
**WILDLIFE AND WILDLIFE HABITAT RELATIONS**

**Credits: 4**

**Total Contact Hours: 54**

**Total marks: (40+10) =50**

**UNIT-I: Wildlife Habitat (2 Credits)**

**Total Contact hours: 27**

Characteristics, Compositions and distribution of Grassland Ecosystem in India and NE India; Wetland definition, Ramsar Convention and criteria for inclusion, wetland formation and types; Types of forest in NE Region, Dominance species composition in different Forest types (Tropical, Temperate and Alpine forest), Canopy openness, closed Canopy and Open canopy forests, High altitudes habitat of wildlife and wildlife species compositions; Wildlife Habitat Assessment by Community Dominance Index (CDI), Canopy Area Coverage, Foliage Height Diversity (FHD), Similarity and Dissimilarity index and Association index, Changing patterns of environmental gradients of light, temperature and humidity in degraded forest and its impact on wildlife.

**Unit II: Wildlife Habitat Relations (2 Credits)**

**Total Contact hours: 27**

Succession of Wildlife Habitat within the Wildlife Sanctuaries and National parks of Assam (KNP, ONP, NNP, MNP & PWLS), Implication of habitat Succession in wildlife, Forest fragmentation & wildlife Habitat loss, Gap formation and their impact on wildlife, Gap dynamics, impact of climate changes on wildlife species, Island Factor and its relationship with present day wildlife conservation networks, Habitat utilization pattern of Rhino, Elephant, Greater Adjutant Stork, Golden Langur and Tiger. Habitat selections, Loss of wetland habitat and its relation to wildlife species. Ecological Role of Wetlands as a Wildlife Habitat, role of wetland ecosystem in Biodiversity conservation.

**M. Sc. FOURTH SEMESTER  
SPECIAL PAPER: ANIMAL ECOLOGY & WILDLIFE BIOLOGY**

**PAPER- ZOO-4034  
WILDLIFE POPULATION ECOLOGY AND METHODS**

**Total Credits: 4  
=50**

**Total Contact Hours: 54**

**Total marks: (40+10)**

**Unit-I: Wildlife Population Ecology (Credit 2)**

**Total Contact Hours: 27**

Wildlife Population Characteristics, Carrying capacity of wildlife, Characteristics and types of Carrying capacity; Carrying capacity of wildlife habitat and wildlife population sizes, Sign of wildlife habitat carrying capacity and population health, Competition and its types, Competition for resources, Dispersal, three mode of dispersal; concepts of ecological density and crude density; Evolutionary advantages of dispersal, vital statistics: life table and life table preparations, reproductive value; Causes of Migration, Migratory routes of birds associated with NE India, study of bird migration and local movement pattern using mist nets and colour banding pattern and metallic rings; Home range: Importance of Home range in species conservation, Territoriality among Mammals and Birds.

**Unit-II: Wildlife Study Methods (Credit 2)**

**Total Contract hours: 27**

Methods of Samplings & Sampling Design; Studies of terrestrial vegetation for Wildlife habitat, Why Sampling design has been prior to any study and its importance, differences between Random and stratified random sampling and systematic random sampling in wildlife habitat, Statistical analysis of wildlife data using computer software and circular statistics, Occupational survey methods and its necessity for the study of large vertebrates, research designed and statistical approach for hypothesis testing; Methods for Wildlife Population Survey, differences between population survey and census, Importance of Wildlife Census, Direct and Indirect methods of wildlife census, Mist netting techniques, Radio telemetry techniques, Modern Census Techniques of Rhino, Tiger, Elephant, Migratory and residential birds, terrestrial birds, Herpetofauna, butterflies, spiders & other invertebrates. Study of wildlife home range using modern and individual ID techniques.

**M. Sc. FOURTH SEMESTER  
SPECIAL PAPER: ANIMAL ECOLOGY AND WILD LIFE BIOLOGY**

**PAPER- ZOO-4044:  
WILD LIFE CONSERVATION**

**Total Credit: 4**

**Total Contact Hours: 54    Total Marks: (40+10) =50**

**Unit-I: Wildlife Conservation (2 Credits)**

**Total contact hours: 27**

Umbrella, Flagship species and edge species, Importance of Umbrella and flagship species and its species conservation; Distribution of Large Cats, Elephant, Rhino, Swamp Deer, Asiatic Wild Buffalos, Hoolock Gibbon and Globally endangered birds of NE Region, Endemic animals and Restricted Ranges species, Conservation needs, Economics and Ecological issues, Ecological Basis of Wildlife management, Identifying land for Nature Reserve, SLOSS debate, Wildlife Corridors, conservation prospects of urban wildlife and strategies. Metapopulation and metapopulation dynamics, concept of Island biogeography, Mammalian biogeography of Assam and India.

**Unit-II: Conservation Practices (2 Credit)**

**Total Contact hours: 27**

Wildlife Conservation Evaluation: Attributes, Criteria and Values; IUCN Criteria of Threatened Wildlife, Conservation and Preservation, Biodiversity and types of diversity, importance of biodiversity Conservation, prospects of biodiversity in economic development, biodiversity & human livelihood, Global biodiversity hot spots, DNA Finger Printing, Genetic Depression, Conservation Practices in NE Region, Reintroduction and Translocation, In- situ and Ex- situ conservation, Modern conservation tool: Camera trapping, Micro Chips, Radio Collar, PTT/ NTT, Scat/ Dung analysis.

**M. Sc. FOURTH SEMESTER  
SPECIAL PAPER: ANIMAL ECOLOGY AND WILD LIFE BIOLOGY**

**PAPER- ZOO-4054  
WILDLIFE MANAGEMENT & MANAGEMENT PRACTICES**

**Total Credit: 4                      Total Contact Hours: 60      Total Marks: (40+10) =50**

**Unit I: Wildlife Management (Credits 2)**

**Total contract hours: 27**

Wildlife Protection (Act) 1972, Wetland (Act) 2016, Biodiversity (Act) 2002, CITES, Wildlife Crime, Conservation Breeding and Economics, Breeding species in Captivity, Effective Population size, Genetic Management in Captivity, Cryopreservation, Importance of DNA bar coding, Molecular aspects of wildlife management, wildlife forensic, Role of Zoo in species Conservation, Wildlife conservation model and management objectives, management of wildlife based on habitat and species carrying capacity. The impact of human wildlife conflict on natural systems. Non-lethal techniques for reducing depredation. The impact of human- wildlife conflict on human lives and livelihoods. Techniques to reduce crop loss: human and technical dimensions in Africa. Bearing the cost of human-wildlife conflict: the challenges of compensation scheme. Increasing the values of wildlife through non-consumptive use? Deconstructing the myths of ecotourism and community-based tourism in the tropics.

**Unit II: Ecological Association & Wildlife Management (2 Credit)**

**Contact ours: 27**

Reasons of wildlife Taxonomic Diversity in NE Region, Historical, Evidence of species colonization in NE India, Utilitarian Values of Wildlife and species management, Pivotal linkages, in ecosystems, Wild mammals group, Linkage of Primates in Tropical ecosystem functioning, Importance of Wetland and Forests of NE region as complementary Habitat for Birds and Mammals, Important wildlife species composition in Kaziranga and Manas, Dehang- Debang, Nokrek and Namdapha NP. Extinction and Estimating the risk of extinction, Quantifying risk of extinction, colonization and species extinction.

**M. Sc. FOURTH SEMESTER  
SPECIAL PAPER: ANIMAL ECOLOGY AND WILD LIFE BIOLOGY**

**PAPER- ZOO-4062 PRACTICAL**

**Total Credit: 2      Total Contact Hours: 60      Total Marks: (20+5) =25**

**1. Community Analysis**

Measurements of species diversity and use of software; **(a)** Shannon Winner Index ( $H'$ ), **(b)** Evenness Index, **(c)** Equitability Index **(E)**, **(d)** Community Dominance Index (CDI), **(e)** Canopy area coverage, **(f)** Foliage Height Diversity (FHD). Association Index, Similarity & Dissimilarity index, Habitat classification, Point and Line transect techniques for wildlife and wildlife habitat data collection.

**2. Wildlife Census Techniques**

**(A)** Direct method (i) Line transect (ii) point transect (iii) Quadrature method (iv) Stratified & Random Sampling **(B)** Indirect Methods (i) Pellet Group counting methods/rate of defecation, scat/dung analysis (ii) Camera Trapping Method (iii) Pugmark Census and Analysis. Field base/ laboratory base studies of Bird, butterfly and herpetofauna; census techniques and species identification of birds & Butterfly.

**3. Wildlife Behavior**

**(A)** **Mammal's** (i) Scan animal sampling **(B) Bird's** (i) Time and Activity budgeting (ii) Foraging efficiency (iii) Habitat use pattern of wildlife species using Radio Telemetry, GPS, Compass bearing & GIS techniques, Identification of important food plant species of birds and mammals. Study of Edge index.

**4. Statistical Analysis of Wildlife Data**

ANOVA, t- test using equal variance assuming, Paired sample t- test; Principal, Component analysis (PCA) and Circular distribution of wildlife data (Circular Statistics),

**5. Viva voce & Practical note book.**

**M. Sc. FOURTH SEMESTER  
SPECIAL PAPER: ANIMAL ECOLOGY AND WILD LIFE BIOLOGY  
PAPER- ZOO-4076 (DISSERTATION)**

**Total Credits: 6    Total Contact Hours: 90    Total Marks: (60+15) =75**

The students will take up a project/survey/review/experimental work based on topics of relevance to the subject specialization and in consultation with their respective supervisor/guide to be completed within the period of the course. The work shall be based on proper methodology and protocols, and submitted in appropriate format to the department within stipulated time. The guidelines for the dissertation work may be notified by the department from time to time. The final submission of hard bound thesis, presentation and viva voce shall carry 60% marks, and 40% marks are to be evaluated internally by the supervisor which may consist of (but not necessarily restricted to) the following: rationality, scientific validity, methodology punctuality, timely progress, internal test/examinations etc.

ternal test/examinations etc.



# Darrang College (Autonomous), Tezpur-784001

## Syllabus M.Sc. 4<sup>th</sup> Semester (CBCS)

Elective:3 Fish biology & Fishery Science

### Subject: Zoology

**Approved by :**

Board of Studies meeting held on 19-12-2025  
&  
Academic Council vide Resolution no. 2, dated 29-12-2025

## Elective:3 Fish biology & Fishery Science

### Specialization: Fish Biology & Fishery Science

Code	Course	Credit	Contact hour	Total marks	Type
ZOO-4014	Fish Taxonomy & Study of Fish Growth & Population	4	54	40+10	Core (Theory)
ZOO-4024	Fish Physiology & Fish Genetics	4	54	40+10	Core (Theory)
ZOO-4034	Capture Fisheries & Ecosystem management	4	54	40+10	Core (Theory)
ZOO-4044	Aquaculture & Fish Biotechnology	4	54	40+10	Core (Theory)
ZOO-4054	Fish Pathology & Post harvest technology	4	54	40+10	Core (Theory)
ZOO-4062	Practical paper-I (Taxonomy, Fish Biology & Aquaculture)	2	54	20+5	Practical
ZOO-4076	Dissertation	6	54	60+15	Dissertation

**M. Sc. FOURTH SEMESTER  
FISH BIOLOGY & FISHERY SCIENCE  
PAPER-ZOO -4014 (Total Marks 40) 4 Credit  
(Fish Taxonomy and Study of Fish Growth & Population)**

**Unit-1: FISH TAXONOMY: 2 Credits (20 Marks)**

1. Taxonomic characterization: taxonomic keys; Taxonomic methods for identification of freshwater fishes.
2. Methods employed for phylogenetic studies and fish identification.
3. Modern Trends in Fish Taxonomy; Fish Barcoding.
4. Fish skeleton as a tool for identification of freshwater fishes.
5. 5. Types of scales and fins in fish and their modifications

**Unit-2: STUDY OF FISH GROWTH AND POPULATION: 2 Credits (20 Marks)**

1. Study of Growth curve: Absolute and relative Growth, Length-weight relationships, Condition factor, Relative condition factor — their significance.
2. Hepatosomatic index, Gonadosomatic index, Index of fullness, Ponderal index, Gastroscopic Index — their estimation.
3. Growth rate and ageing.
4. Study of Species Diversity Indices, Fish Species Richness, Relative abundance.
5. Stock assessment and management — Stock composition analysis, fecundity analysis.
6. Natural markers — morphological analysis, environmental signals, genetic analysis.
7. Applied Markers — marking and tagging.

**FISH BIOLOGY & FISHERY SCIENCE**  
**PAPER-Z -4024 (Total Marks 40) 4 Credit (Fish Physiology and Fish Genetics)**

**Unit-1: FISH PHYSIOLOGY: 3 credits (30 marks)**

1. Physiology of digestion in teleost — Digestive system: anatomical differentiation and modifications. Feeding behavior and feeding adaptation in fishes.
2. Respiratory system in Fishes — Gill structure, Mechanism of respiration, Counter-current principle, Exchange of gases. Accessory respiratory organs and respiratory epithelium, Physiological adaptation in air breathing fishes.
3. Forms and Functions of swim bladder and Weberian ossicles in teleosts.
4. Excretion in fishes — Excretion of nitrogenous wastes, Urea cycle.
5. Principles of osmoregulation in Freshwater and Marine Teleosts — Processes and functional aspects.
6. Endocrine system in Fish — Hypothalamo-hypophysial system; Neurosecretory system and Neuro-hypophysial hormones; Functional morphology of Pituitary gland; structure and function of Thyroid and Pancreas.

**Unit-2: FISH GENETICS: 1 credit (10 marks)**

1. Population Genetics: Individual vs. population; genetic structure of random mating populations.
2. Hardy-Weinberg principle: Test of equilibrium, application and properties of equilibrium populations.
3. Selection: Scope, application, role of genetics in fish selection and breeding; National and International scenario of selective breeding programmes in fish.
4. Stock improvement: sex-reversal, Hybridization, Gynogenesis, Polyploidy, hybrid vigour, introgression.

**M. Sc. FOURTH SEMESTER  
FISH BIOLOGY & FISHERY SCIENCE  
PAPER-ZOO -4034 (Total Marks 40) 4 Credit  
(Capture Fisheries & Post-harvest Technology)**

**Unit:-1 CAPTURE FISHERIES 3 credits (30 marks)**

1. Types of capture fisheries resources.
2. Fishery resources of the major river systems of India; Fish and Fisheries of River Brahmaputra.
3. Coldwater Fish & fisheries of India; Hill stream fisheries of North East India; Mahseer fisheries: prospects and problems with special reference to NE India.
4. Floodplain wetland (*beel*) fisheries: Fish resources, problems and management approaches.
5. Coastal fisheries of India (Sardine & Mackerel fisheries).
6. Fishing crafts and gears used in inland capture fisheries. Destructive fishing—its impact on fish diversity.
7. Estuarine fisheries (estuarine fisheries resources, problems confronting brackish water capture fisheries).

**Unit-2:- POST-HARVEST TECHNOLOGY: 1 credits (10 marks)**

1. Principles of preservation, handling and packaging of fish for marketing.
2. Importance and methods of Fish preservation (Refrigeration and freezing, Drying, Salting, Smoking, Canning, Pickling, pasting and spicing, Fermentation).
3. Fishery bi-products, their production and utilization (liver oils, Body oils, Fish meal, Fish flour, Fish Silage, Fish protein, Fish guano, Bone meal).

**M. Sc. FOURTH SEMESTER  
FISH BIOLOGY & FISHERY SCIENCE  
PAPER-ZOO -4044 (Total Marks 40) 4 Credits  
(Aquaculture)**

**Unit:-1 AQUACULTURE TECHNOLOGY: 2 Credits (20 marks)**

1. Aquaculture systems — Extensive, semi-intensive, intensive and super intensive culture of fish; Pen and Cage culture in lentic and lotic water bodies; Monoculture vs. Composite fish culture.
2. Fish Breeding Technology — Brood stock management, nutritional requirements, captive rearing, and maturation; induced breeding techniques: physical and chemical inducing agents.
3. Breeding and Culture of Air breathing fishes.
4. Non-conventional methods of fish farming — sewage fed fisheries, integrated fish farming.
5. Aquarium keeping — Design and construction of tanks; species-wise tank size requirement; heating, lighting, aeration and filtration arrangements; decorations used; common aquarium plants and their propagation.

**Unit:-2 AQUACULTURE NUTRITION: 2 credits (20 marks)**

6. Nutritional requirements in aquaculture — Protein, carbohydrate, fats, vitamins and minerals.
7. Feed formulation — General principles, different steps of feed formulation, classification of feed ingredients.
8. Maintenance of Natural Color of fishes in Aquarium.
9. Larval nutrition — Importance of live feed and artificial feed, Different types of feed available for larvae.
10. Aquaculture Management — Feed, health and water quality management; prophylaxes; quarantine measures.

**M. Sc. FOURTH SEMESTER  
FISH BIOLOGY & FISHERY SCIENCE  
PAPER-ZOO -4054 (Total Marks 40) 4 Credits  
(Fish Pathology, Ecosystem management and Fish Biotechnology) Unit: -1 FISH PATHOLOGY: 2  
credits (20 marks)**

**Unit:-1 FISH PATHOLOGY & ECOSYSTEM MANAGEMENT: 2 credits (20 marks)**

1. Fish disease — Types; symptoms; and prophylaxes.
2. Disease diagnostics tools: Histopathological methods; Immunoassay; Biochemical assay; Serological techniques.
3. Techniques for isolation and identification of fungi; Basics of mycological and virological techniques.
5. Impact of environment on aquaculture: Raw water source, physical and chemical characteristics, contaminants and pollutants (algae, pathogens, heavy metals, pesticides) and their effect on productivity.
6. Study of Algal blooms; Biological indicators and Microbial toxins.

**Unit:-2 BIOTECHNOLOGY: 2 Credit (20 Marks)**

10. Food biotechnology: Probiotics, single cell proteins, Nutraceuticals.
  11. Cell lines and cell culture; DNA markers and MAS.  
Application of biotechnological tools: Recombinant DNA, Development of hybridoma and production of monoclonal antibodies; Collection, handling and observation of gametes of finfish and shellfish.
  13. Cryopreservation technology; Transfer of gene and transgenic species formation.
- Impact of exotic fish species and GMOs on aquatic biodiversity  
Biotechnology in fish conservation.**

**M. Sc. FOURTH SEMESTER**  
**FISH BIOLOGY & FISHERY SCIENCE**  
**PAPER - ZOO-4062 (Total Marks 20) 2 Credit**  
**(Fish Taxonomy, Fish Biology & Aquaculture — Practical)**

1. Identification of commercially important freshwater fish species — Indigenous and exotic food and ornamental fishes.
2. Comparative biometric assessment (Morphometry and Meristics) of representative freshwater fish species (carp/catfish/murrel/perch/loach) following proper Taxonomic Keys and tools for their identification.
3. Age determination of fishes using scales.
4. Dissection — Comparative digestive system in herbivorous, carnivorous and omnivorous fish; nervous system (brain and cranial nerves - V, VII, IX, X); Urino-genital system (male/female); Weberian ossicle.
5. Identification and study of various types of fishing gears.
6. Determination of gonadosomatic index (GSI), hepatosomatic index (HSI), condition factor (CF), and Gastrosomatic Index.
7. Water chemistry — Estimation of DO, TA, TH, Ca and Mg in pond/river water.
8. Study of different Types of scales in fish.
9. Haematological studies in *Monopterusuchia/Clarias magur* — DLC
10. Demonstration of Induced breeding of Indian major carps/catfishes.
11. Viva-Voce

**M. Sc. FOURTH SEMESTER  
FISH BIOLOGY & FISHERY SCIENCE  
PAPER - ZOO-4076 (Total Marks 60+15) 6 Credit  
(DISSERTATION)**

The students will take up a project/survey/review/experimental work based on topics of relevance to the subject specialization and in consultation with their respective supervisor/guide to be completed within the period of the course. The work shall be based on proper methodology and protocols, and submitted in appropriate format to the department within stipulated time. The guidelines for the dissertation work may be notified by the department from time to time. The final submission of hard bound thesis, presentation and viva voce shall carry 60% marks, and 40% marks are to be evaluated internally by the supervisor which may consist of (but not necessarily restricted to) the following: rationality, scientific validity, methodology punctuality, timely progress, internal test/examinations etc.