

UNIVERSITY OF NORTH BENGAL

M.Phil. Syllabus in ZOOLOGY

(To be implemented from Session 2018-19)

University of North Bengal
M. Phil. Syllabus in Zoology
CBCS-2018-19

Semester-I					
Core Course Theory	Course Name	Marks		Credit	Hrs/Week
		End Term Exam	Total		
MZCT-101	Advanced course in Zoology	100	100	4	4
MZCT-102	Course 1: Review of Literature	50	50	2	4
	Course 2: Research Ethics, Biometry, IPR, Bioinformatics, Computer applications and data processing	50	50	2	4
Semester-II					
MZET 201	Course 1: Students have to opt any one course (Group A, B, C, D, E, F, G, H)	100	100	4	4
	Course 2: Study of Research Articles	50	50	2	
	Course 3: Seminar presentation	50	50	2	4
Semester-III and Semester-IV					
MZCC-301	Dissertation	400	400	16	32
Total marks and credit in M. Phil Course			800	32	

- At the end of 3rd Semester a progress report has to be submitted to the Head, Department of Zoology and to be presented in a Seminar Organized by the Department. The submission will be evaluated through question answering during open presentation and promotion to fourth semester may be granted.

M. Phil. in Zoology

MZCT-101: Advanced course in Zoology

FM=100

1. Principles and applications of UV-VIS spectrophotometry, IR, NMR, Mass Spectroscopy.
2. Principles and applications of Paper, Thin-layer and Column Chromatography.
3. Electrophoresis: PAGE, SDS-PAGE, IEF, 2-D, Proteomics, Immunoelectrophoresis and Immunodiffusion
4. Microscopy: Principles and applications of light, Phase-contrast, Electron and Fluorescent microscopy.
5. Immunological techniques: ELISA, Western Blot, Dot Blot, Immunofluorescence and Immunocytochemistry.
6. Nomenclature: Classification of name; Typification and priority concept, Documentation; Conservation strategies of Hotspots, Ramsar sites and Megadiversity countries.
7. Basic principles of PCR and other molecular techniques- RAPD, AFLP, RFLP, ISSR, SSR.

MZCT-102: Review of published Research

FM=50

MZCT-103: Research Ethics, Biometry, IPR, Bioinformatics, Computer applications and data processing

FM=50

1. Plagiarism, sampling and collection, Animal ethical committee and ethics for animal handling, biohazards and biosafety, IPR- Breeder's Right, Ethics and regulation on germplasm exchange mechanism, Ethical issues of GM crops and environmental concerns of transgenic animals.
2. Determination of critical difference, correlation coefficient matrix and regression analysis through SPSS software; Awareness about other statistical software; Basic concepts of computer application-Word, office, Excel, Publisher, Linux; Bioinformatics database and softwares.

MZET: 201 (Optional Course)

FM=100

Group A: Cellular and Molecular Immunology

1. Antigen: Physical and chemical nature, structure, antigenic determinants.
2. Antibody: Three dimensional structure, subclasses, binding forces of antigen and antibody.
3. Innate Immunity: Cell – associated pattern recognition receptors including TLRs of innate immunity, Recognition of microbes of and damaged self by the innate immune system.

4. Organization of MHC in mouse and human, Polymorphism, Antigen presentation and MHC restriction
5. Differentiation and maturation of B, Generation of receptor diversity.
6. Differentiation and maturation of T cell, positive and negative selection, Generation of receptor diversity.
7. Tolerance
8. Autoimmunity.
9. Tumor immunology.
10. Monoclonal antibody, and usage

Group B: Biology of Cancer and Genotoxicity

1. Cell biology of Cancer: Classification, characteristics, monoclonal origin, chromosomal changes tumor/cancer evolution of cancer ,cancer stem cells and tumor microenvironment, mechanism of metastasis, angiogenesis , Multicolor FISH and Spectral Karyotyping in Cancer.
2. Genetics of Cancer: Cancer as a genetic disease, mutation and regulation of tumour suppressor gene, oncogene, caretaker and gate keeper genes, micro-RNA and cancer, Developmental Pathways in cancer, Cell cycle dysregulation in cancer, Genome instability: Chromosomal instability, Microsatellite instability, telomere and telomerase.
3. Epigenetic regulation in cancer.
4. Mutagens, Carcinogens, Environmental factors, DNA repair and cancer.
5. Therapeutic approaches: gene therapy, pro-drug therapy, immunotherapy, personalised medicine.
6. Tissue culture and genotoxicity assessment for carcinogenesis.

Group C: Insect Pest and Vector Biology and their Management:

1. Insect Classification – Major order with characters and examples.
2. Concept of pest status and classification of Pesticides.
3. Vector biology: Mode of transmission of pathogens by vectors to major crop, man and livestock and their Control strategies.
4. Concept of Economic levels:
 - a. Pest surveillance, sampling methods and forecasting
 - b. Economic threshold and injury level
 - c. Determination of EIL and Calculation of economic decision level
5. Introduction to major pests and vectors of medical, veterinary and agricultural importance from India.
6. Influence of climate and environment change on insect and mite pests.
7. Pest Forecasting, Assessing of Crop damage and Protection.
8. Methods of insect pest control: Conventional and Non-Conventional.
9. Integrated Pest Management (IPM) and Integrated Resistance Management (IRM).

10. Host plant resistance to insects and Molecular biology of insect Biotypes.
11. Case histories of successfully implemented IPM.
12. Quarantine and legislative measures for preventing spread of pests.

Group D: Fish Biology and Aquaculture Techniques

1. Growth rate and aging in fishes; Length-weight relationship; Gonadosomatic Index.
2. Osmoregulation in fish; Fish migration; Hormonal regulation of gonadal development; Activity of gonadotropin releasing hormone.
3. Types of Diseases- viral, bacterial, fungal, protozoan and other parasitic diseases; Mode of disease transmission; Diagnosis and control measures.
4. Nutrition, Feed formulation, Feed additives, Alternative feed ingredients; Fish products and by-products.
5. Concept of probiotics and prebiotics in aquaculture; Feed microbes and their impact on aquatic environment; Application of hormones in aquaculture.
6. Comet Assay; Micronuclei Test; Fish Cell Culture
7. Sex differentiation and sex reversal in fishes,; sex control and its role in aquaculture
8. Ploidy induction methods- triploidy and tetraploidy; advantages and disadvantages of polyploids; androgenesis and gynogenesis

Group E: Molecular Virology

1. General concepts: virus history, diversity, shapes, sizes, and components of genomes; consequences of virus infection to animals and human.
2. Isolation and purification of viruses and viral genomes.
3. Positive strand RNA viruses, picornaviruses; flaviviruses; togaviridae, coronaviruses;
4. Negative strand RNA viruses, paramyxoviruses; orthomyxoviruses: influenza pathogenesis and bird flu; rhabdoviruses: rabies pathogenesis; Filoviridae: Ebola
5. Double strand RNA viruses, reoviruses; retroviruses: structure, classification, and life cycle: HIV, viral pathogenesis, and AIDS.
6. Small DNA viruses: parvo- and polyomaviruses.
7. Large DNA viruses: herpesvirus, adenovirus, and poxviruses.
8. Biology, infection/entry and replication strategy of DNA and RNA human viruses.
9. Gene expression and Regulation: SV40, HBV, Polyomaviruses, Influenza and HIV.
10. Antiviral counter attack strategies.

Group F: Mitochondrial Biology and Diseases

1. Mitochondrial structure, Compartmentalization and Transport systems: Gross morphology of mitochondria, Subfractionation of mitochondria, Distribution of mitochondrial enzymes.
2. Composition of membranes; current views on structure of inner and outer membranes; mitochondrial transport systems - substrate transport and coordination of mitochondrial and cytoplasmic metabolism.

3. Oxidative pathways of mitochondria, Electron Transfer Chain and Mitochondrial Genetics : Conversion of pyruvate to Acetyl Co A; beta-oxidation of fatty acids;TCA Cycle; Electron transfer chain - carriers of ETC; redox potentials; properties of respiratory complexes; Chemiosmotic model; inhibitors of electron transfer.
4. Concept of coupling; Ionophores, beta-oxidation of fatty acids, Mitochondrial genetics- basic concept on mt DNA; genetic criteria for distinguishing Nuclear and mt mutations.
5. Mitochondrial Diseases : Mitochondrial disorders of the nervous system: Alzheimer's Disease, Parkinson's Disease, Multiple Sclerosis, brain ischemia, Prion diseases, Huntington's diseases; Rheumatoid Arthritis; Mitochondrial disorders of the Gastrointestinal tract - Inflammation in GIT, Inflammatory Bowel Disease (Chron's Disease, Ulcerative Colitis) etc.
6. Techniques for detection of mitochondrial dysfunction: Assessment of impact of oxidative stress on mitochondrial proteins (protein carbonylation, thiol group loss), lipids (Lipid peroxidation - MDA and HNE) and DNA (8-hydroxyguanine); Assessment of mitochondrial respiratory enzyme complexes by spectrophotometric methods, Immunohistochemistry of mitochondrial respiratory enzyme complexes, Detection of mitochondrial ATP generation and mitochondria membrane potential; Mitochondrial imaging using common fluorescent probes/dyes (mitochondrial tracker green, red; JC-1 and JC-9; Annexin V; TMRE, Rhodamine B etc.).

Group G: Fish Endocrinology and Chronobiology:

1. Functional anatomy of endocrine glands in fish.
2. Morphology and histology of testis and ovary.
3. Hormonal regulation of spermatogenesis and oogenesis.
4. Vitellogenesis: Nature of vitellogenin, mechanism of synthesis and incorporation of vitellogenin in developing oocyte.
5. Hormonal control of maturation and ovulation of oocyte.
6. Role of GnRH and GtH on gonadal function.
7. Fish breeding technique: Breeding with hormone analogs.
8. Endogenous sources of melatonin and its role in the regulation of fish reproduction.
9. Basic concept and definitions in chronobiology: Mesor, Acrophase, Amplitude, Biorhythm, Circadian, Circaseptan, Circavigintan, Cosinor cycle, Diurnal, Free-running, Infradian, Frequency, Phase, Phase angle, Phase shift, Rhythm, Synchronization, Ultradian, Zeitgeber etc.
10. Characteristics and example of: (a) Circadian and (b) Circannual cycles.

Group H: Animal Development and Regeneration

1. Basic concepts of development: Cellular commitment, specification, induction, competence, determination and differentiation; Morphogenetic gradients; Cell fate and cell lineages; Genomic equivalence; Cytoplasmic determinants and imprinting; Model organisms; Cellular basis of differentiation; Trans-differentiation and cell lineages.

2. Morphogenesis and organogenesis during animal development: Cell-cell interaction; Differential gene expression; Cell signalling during morphogenesis in early embryo; Fate maps and gastrulation in invertebrate and vertebrate models; Molecular mechanisms of pattern formation in *Drosophila*; Neurulation and fate of neural crest cells; Development of brain and limb in vertebrates; Differentiation of neurons.
3. Metamorphosis and Regeneration in animals: Metamorphosis; Distribution of regenerative capacity in animal groups; Modes of regeneration; Cellular and molecular basis of epimorphosis, morphallaxis and compensatory regeneration; Gene regulation during regeneration and their implication in future regenerative therapies with special emphasis to central nervous system and cardio-vascular system.
4. Implications of developmental biology in regenerative medicine: Stem cells and their role in development; Stem cell self-renewal and pluripotency; Cell cycle regulation in stem cells; Stem cell niches; Analysis of mutants and transgenics in development; Gene therapy and therapeutic application of stem cells; Genetic Manipulation of stem cells.