M.Sc. (Zoology) Syllabus

2-year Semester System

(4 Semester course)

[CHOICE BASED CREDIT SYSTEM]

Session: 2023 -2025

Department of Zoology, Murshidabad University

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Murshidabad University

Master of Science (M.Sc.)

CHOICE BASED CREDIT SYSTEM (CBCS)

Syllabus in Zoology (2023)

Semester wise distribution of courses:

	Courses	**No. of Courses**	**Marks**	**Credits**
1st Semester	Core courses	03	225	**18**
	Field/ institutional visit	01	25	**02**
2nd Semester	Core courses	03	225	**18**
	Seminar	01	25	**02**
3rd Semester	Core courses	02	150	**12**
	Elective course	01	75	**06**
	Choice based credit course	01	50	**04**
4th Semester	Core course	01	75	**06**
	Elective course	01	50	**04**
	Choice based credit course	01	50	**04**
	Dissertation	01	50	**04**
			1000	**80**

MURSHIDABAD UNIVERSITY

SYLLABUS STRUCTURE FOR M.Sc. (ZOOLOGY)
SEMESTER COURSE (Session 2023-2025)

1st Semester

Course Code	Subject	Marks	Credits	Hours/ week
ZCT 101	Fundamentals of Non-chordate and Chordate biology	50	**4**	**4**
ZCP 101	Fundamentals of Non-chordate and Chordate biology practical	25	**2**	**4**
ZCT 102	Cell biology and Inheritance biology	50	**4**	**4**
ZCP 102	Cell biology and Inheritance biology practical	25	**2**	**4**
ZCT 103	Ecology and Toxicology	50	**4**	**4**
ZCP 103	Ecology and Toxicology practical	25	**2**	**4**
ZFS 104	Institutional / Field visit report	25	**2**	**-**
Total		**250**	**20**	**24**

An institutional / Field visit report (2 credits) during the course of 1st semester is to be prepared and submitted.

- **Institutional visits encompass visit to sericultural institute / fishery farms / Bee keeping centers etc.**
- **Field visits encompass visit to any national park / wildlife sanctuary / reserve forest / marine ecosystem / wetland area etc.**

2nd Semester

Course Code	Subject	Marks	Credits	Hours /week
ZCT 201	Biostatistics and Taxonomy	50	**4**	**4**
ZCP 201	Biostatistics and Taxonomy practical	25	**2**	**4**
ZCT 202	Evolution and Animal behaviour	50	**4**	**4**
ZCP 202	Evolution and Animal behaviour practical	25	**2**	**4**
ZCT 203	Biochemistry and Animal physiology	50	**4**	**4**
ZCP 203	Biochemistry and Animal physiology practical	25	**2**	**4**
ZSM 204	Seminar presentation	25	**2**	**-**
Total		**250**	**20**	**24**

A seminar presentation (2 credits) will be given by the students at the end of 1st semester about any topic from the 1st semester curriculum. The topic of seminar shall be selected by the students during the course.

3rd Semester

Course Code	Subject	Marks	Credits	Hours/ week
ZCT 301	Developmental biology and Endocrinology	50	4	**4**
ZCP 301	Developmental biology and Endocrinology practical	25	2	**4**
ZCT 302	Immunology and Molecular biology	50	4	**4**
ZCP 302	Immunology and Molecular biology practical	25	2	**4**
ZET 303-306	Elective theory	50	4	**4**
ZEP 303-306	Elective practical	25	2	**4**
CBCC A	CBCC A	50	4	**4**
Total		**275**	**22**	**28**

- **Elective paper selection after the end of 2nd Semester for commencement of project work, theory and practical classes.**
- **The students will be assigned specific dissertation project/review during 4th semester. Elective paper selection of the students based on the cumulative score obtained in graduation and 1st semester.**
- **A choice-based credit course (4 credits each semester) shall be opted by the students at semester 3 and semester 4 other than zoology.**

4th Semester

Course Code	Subject	Marks	Credits	Hours/ week
ZCT 401	Applied biology and Methods in biology	50	4	**4**
ZCP 401	Applied biology and Methods in biology practical	25	2	**4**
ZET 402-405	Elective theory	50	4	**4**
ZEP 406	Dissertation/ Review work	50	4	**-**
CBCC B	CBCC B	50	4	**4**
Total		**225**	**18**	**16**

Name of Elective papers:

1. **ZET/ZEP – 303/402** **Aquaculture**
2. **ZET/ZEP - 304/403** **Ecology and environmental biology**
3. **ZET/ZEP - 305/404** **Wildlife and conservation biology**
4. **ZET/ZEP - 306/405** **Entomology**

Division of theory and practical marks:

Core practical of **25** marks - **20** (semester end) + **05** (Internal Assessment)
Core theory of **50** marks - **40** (semester end) + **10** (Internal Assessment)

The students will submit a Dissertation (50 marks) following laboratory internship on their Elective paper opted. The Review or Dissertation report will be evaluated by external examiner along with internal examiners.

Examination pattern

Course	**Internal assessment (20%)**	**End term (80%)**	**Total**
Theory (Core)	10	40	50
Practical (Core)	05	20	25
Field report	-	25	25
Seminar presentation	-	25	25
Theory (CBCC)	10	40	50
Theory (Elective paper)	10	40	50
Practical (Elecctive paper)	05	20	25
Dissertation/ review work	-	50	50

Question Pattern

Internal assessment	**Semester end term**
For written tests **10 marks** 5 x 2 marks (out of 8)	For written tests **40 marks** 5 x 2 marks (out of 8) 2 x 5 marks (out of 4) 2 x 10 marks (out of 4)
For Practical tests **05 marks** Experiment/ viva - 05 marks	For Practical tests **20 marks** Experiment - 15 marks LNB + Viva voce – 2+3= 5 marks
-	Field visit **25 marks** Field report - 20 marks Viva - 05
-	Seminar **25 marks** Seminar presentation – 15 marks Viva – 10 marks

Course Structure:

A] **Core Subjects** **:** Compulsory for all

B] **Elective Subjects** **:** Student will choose any one of the Elective subjects being offered by the department

C] **Choice Based Credit Course** **:** Student will choose any two of the CBCCs being offered, apart from own subject.

	MARKS/CREDIT							
	MARKS				**CREDIT**			
	Theory	**Practical**	**Seminar / Field Study**	**TOTAL**	**Theory**	**Practical**	**Seminar / Field Study**	**TOTAL**
SEMESTER I	**150**	**75**	**25**	**250**	**12**	**6**	**2**	**20**
SEMESTER II	**150**	**75**	**25**	**250**	**12**	**6**	**2**	**20**
SEMESTER III	**200**	**75**	**-**	**275**	**16**	**6**	**-**	**22**
SEMESTER IV	**150**	**75**	**-**	**225**	**12**	**6**	**-**	**18**
GRAND TOTAL				**1000**				**80**

Paper: ZCT 101 (Group A) **Non-chordate biology** **Marks 25 Credit 02**

Course objectives: The non-chordate and chordate biology are the fundamental and very important parts of the subject to be taught to every student of Zoology. This paper starts with evolution of the metazoans and the course is aimed to provide the students knowledge about different structural and functional insights of the non-chordate life. This paper is designed to describe distinctive features and important biological processes in both non-chordates and chordates, important concepts in non-chordate organization including body symmetry, body cavity and segmentation, locomotion, body support, feeding and digestion, excretion and osmoregulation, respiration, circulation, sensory perception, behavior, reproduction and development of different non-chordates and chordates.

1. **Origin and evolution of metazoans:** Symmetry, coelom, segmentation and cephalization.
2. **Nutrition and digestion:** Types and structure of invertebrate feeding organs; feeding patterns in non-chordates.
3. **Respiration:** Structural organizations of respiratory organs in Arthropoda and Mollusca.
4. **Excretion:** Structure of excretory organ and mechanism of excretion in Annelida; osmoregulation in Protozoa.
5. **Locomotion:** Locomotory system in Protozoa and Annelida; flight-mechanism in insects.
6. **Nervous system:** Structural evolution of nervous system in non-chordates; special sensory organs (chemoreception, photoreception and mechanoreception.)
7. **Non-chordate larva:** Types, structure and organization of non-chordate larval forms with their evolutionary significance.

Paper: ZCT 101 (Group B) **Chordate biology** **Marks 25 Credit 02**

1. **Proto-chordata:** Fine structure of notochord in Amphioxus; modern interpretation of origin of early chordates.
2. **Skeletal system and muscular system:** Mechanics of body support and movement; aerodynamics of flight; modification and functions of jaw bones in across different vertebrate classes; types of muscles in vertebrates; flight muscles in birds.
3. **Circulatory system:** Heart and circulation in Mammals; structure and evolution of aortic arch.
4. **Nervous system:** Gross anatomy of brain and spinal cord; Functional associations of central nervous system; sensory receptors and classification.
5. **Thermoregulation:** Ectothermic and endothermic mode of life.
6. **Osmoregulation and excretory system:** Osmoregulatory adaptation in aquatic and terrestrial animals, structure and function of kidney in Mammals.

Paper: ZCP 101: Non-chordate and chordate biology practical **Marks 25 Credit 02**

Non-chordate:

1. Preparation of key to different categories of non-chordate specimens up to class (preferably considering one typical specimen of each class)

2. Mounting of:

a) Protozoans: *Gregarina*, *Paramoecium*, *Nyctotherus*, *Opalina*

b) Helminthes: Soil nematodes, gut nematode of fish/toad.

c) Annelids: *Tubifex*, setae of earthworm, septal nephridia of earthworm and spermatheca of earthworm.

d) Arthropods: *Cyclops*, *Daphnia*, mouth parts of mosquito/ housefly.

3. Dissections / demonstration of

a) Reproductive system of Cockroach

b) Nervous system of Cockroach / *Pheretima*

Chordate:

4. Preparation of key to different categories of chordate specimens up to orders (preferably considering one typical specimen of each order)

5. a) Location and extraction of pituitary gland of a carp

b) Accessory air-breathing organs of *Anabas* / *Clarias* / *Heteropneustes* (market specimen)

c) *Rattus* (Laboratory bred): Arterial system and nerves of the neck region.

Learning outcome: The course is designed to prepare the students with knowledge and skills of non-chordate and chordate life. The paper has made the students enriched in view of knowledge about the morphological, physiological and evolutionary aspects of Non chordates and Chordates. It provides a working knowledge of fundamental principles in Zoology that will provide a foundation for their later advanced course work in more specific biological subjects. As functional biology is a basic course, students have become familiar with the diagnostic characteristics and morphological diversity among different animal group as well as developing an understanding and ability to apply basic zoological principles.

Paper: ZCT 102 (Group A) **Cell biology** **Marks 25 Credit: 02**

Course objective: The curriculum in cell biology aims to introduce the students of the course to the building

blocks of living organisms, the cells. The course is designed to give the students the opportunity to learn about cell signalling, cellular communication, cell cycle, cellular organization and cancer biology. The curriculum also includes inheritance biology which includes Mendelian inheritance and its extension, microbial genetics, recombination, mutation, gene mapping, molecular diagnosis and genetic screening.

1. **Cell communication and signalling**

   1.1 **Cell signaling:** Hormones and their receptors, cell surface receptor, signaling through G-protein coupled receptors, signal transduction pathways, second messengers, regulation of signaling pathways, bacterial chemotaxis and quorum sensing.

   1.2 **Cellular communication:** General principles of cell communication, cell adhesion and roles of different adhesion molecules, gap junctions, extracellular matrix, integrins, neurotransmission and its regulation.

   1.3 **Cell division and cell cycle:** Mitosis and meiosis, their regulation, steps in cell cycle, and regulation of cell cycle.

2. **Cellular organization**

   2.1 **Membrane structure and function:** Structure of model membrane, lipid bilayer and membrane protein diffusion, osmosis, ion channels, active transport, membrane pumps, mechanism of sorting and regulation of intracellular transport, electrical properties of membranes.

   2.2 **Structural organization and function of intracellular organelles:** Cell wall, nucleus, mitochondria, golgi bodies, lysosomes, endoplasmic reticulum, peroxisomes, plastids, vacuoles, chloroplast, structure & function of cytoskeleton and its role in motility.

3. **Cancer biology**

   3.1 Genetic rearrangements in progenitor cells, oncogenes, tumor suppressor genes, cancer and the cell cycle.

   3.2 Virus-induced cancer, metastasis, interaction of cancer cells with normal cells.

   3.3 Apoptosis, reactive oxygen species (ROS).

Paper: ZCT-102 (Group B) **Inheritance biology** **Marks 25 Credit 02**

1. **Mendelian principles and its extensions:** Dominance, segregation, independent assortment, co-dominance, incomplete dominance, gene interactions, pleiotropy, genomic imprinting, sex limited and sex influenced characters.
2. **Microbial genetics:** Transformation, conjugation, sex-duction, transduction and mapping genes by interrupted mating.
3. **Recombination:** Concept of homologous recombination; Site specific recombination; FLR-FRT system; Cre-lox system
4. **Mutation:** Types, causes and detection, mutant types – lethal, conditional, biochemical, loss of

function, gain of function, germinal verses somatic mutants, insertional mutagenesis.

5. **Gene mapping:** Three-point test cross; Somatic Cell hybridization and gene mapping; Molecular Marker (RFLP, RAPD, AFLP, SNP)
6. **Molecular diagnosis and genetic screening:** Genetic disorders; Pedigree analysis; Sickle-cell anaemia; Cystic fibrosis.

Paper: ZCP-102: Cell biology and inheritance biology practical Marks 25 Credit 02

1. Study of meiosis from grasshopper testes.
2. Barr body preparation and staining.
3. Temporary squash preparation of polytene chromosomes from salivary glands of *Drosophila* larvae/ *Chironomous* larvae.
4. Study of common mutants in *Drosophila*.
5. Karyotype preparation (Human)
6. Detection of ABO Blood groups and determination of gene frequencies in human population
7. Pedigree analysis of common human dominant/recessive traits.
8. Genomic DNA extraction. Quantification and estimation of DNA by UV-spectrophotometer.

Learning outcomes: Successful completion of the curriculum of cell biology and inheritance biology, the students should have a comprehensive idea on structural and functional aspects of the cellular components and genome which would help them to pursue research in the field of cell biology and genetics which are amongst the most promising fields of biological researches.

Paper: ZCT 103 (Group A) **Ecology** **Marks 25 Credit: 02**

Course objectives: Understanding on the ecology and ecosystem is important to make the human society sustainable on earth. The course aims to provide the students with an understanding on i) Environment and ecology and their roles ii) Concepts on population, its growth and control mechanisms, iii) Community structure, feature and dynamics, iv) Applications of ecological knowledge and v) Economical aspects of ecology.

Toxic substances are released to the environment by natural process and some developmental activities. This leads to hazards and pose risk on the human society. To minimize the toxicity related risk an understanding on the toxicity pathways, their metabolism and tolerance limits is required. The course aims to provide the students with an understanding on i) Body processes and their response to toxic substances ii) Toxic effects of heavy metals and exposures of different toxicants on our health.

1. **Ecosystem structures**
   - 1.1 Physical environment, biotic environment.
   - 1.2 Concept of habitat and niche, niche width and overlap, fundamental and realized niche, resource partitioning.
2. **Population ecology**
   - 2.1 Population growth models- mathematical interpretations.
   - 2.2 Life history strategies (r and K selection)
   - 2.3 Meta-population concept.
3. **Community ecology**
   - 3.1 Understanding community structure,
   - 3.2 Species coexistence – maintenance of species diversity; Island biogeography theory; Biodiversity and ecosystem function.
   - 3.3 Interspecific interactions – competition, predation, mutualism
   - 3.4 Ecological modeling - predator-prey models, epidemiological models, harvest models, foraging models.
4. **Applied ecology**
   - 4.1 Bioremediation, phytoremediation, natural degradation process; Eco-restoration – theories and applications
   - 4.2 Biodiversity: status, monitoring and documentation; Major drivers of biodiversity change; Biodiversity management approaches.
5. **Ecological economics**
   - 5.1. Ecosystem services, types and valuation,
   - 5.2. Ecological footprint analysis.

Paper: ZCT 103 (Group B) **Toxicology** **Marks 25 Credit: 02**

1. **Xenobiotics**

   1.1 Types of toxicology, toxicity, hazards, risks, benefit-to-risk-ratio, tolerance limits, acceptable daily intake, threshold value.

   1.2 Types of exposure, absorption, distribution, metabolism and excretion of toxicants (Phase I and Phase II reaction)

2. **Ecotoxicology**

   2.1 Biomarkers; Bioaccumulation; Biomagnification; Bioconcentration factor

   2.2 Toxicity of heavy metals (Pb, Cd, Hg and As).

3. **Reproductive toxicology**

   Teratology; Reproductive toxicity; In-vitro fertilization.

4. **Occupational hazards**

   Health consequences of different occupations: Anthracosis, silicosis, asbestosis; concept of stress, stress related diseases, stress management, stress, strain and general adaptive syndrome.

Paper: ZCP 103 Ecology & Toxicology Practical **Marks 25 Credit: 02**

1. Study of the biotic and abiotic components of any simple ecosystem- natural pond or terrestrial ecosystem or human modified ecosystem.
2. Determination of species richness, density, abundance, frequency, diversity etc. in a terrestrial community or a hypothetical community by quadrate method and calculation of the Simpson's and Shannon-Weiner diversity index for the same community.
3. Biochemical analysis of pond or river water for alkalinity, pH, dissolved O_2/ CO_2, Chloride, Nitrate, Phosphate and sulphate.
4. Determination of LC_{50} / LD_{50} of toxicants.

Learning outcome: On completion of the course, the candidate will be able to understand a) the concept of ecosystem and ecological processes, b) concept of population and population attributes c) concept of community structure, features, important models of community structures d) application and e) economic aspects of ecosystem. On completion of the course in toxicology, the candidate will be able to understand a) Basic concepts about toxicology and xenobiotics b) Bioaccumulation of toxic substances and heavy metal toxicity. c) absorption, distribution and excretion of toxic substances d) effects of different toxicants on reproductive health and development. e) different occupational hazards associated with the working environment and exposure to different toxic substances.

Kankana Basu Prasanta Saha Kakali Bhadra

01.11.23