

MURSHIDABAD UNIVERSITY

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Memo No.- MU(R)/1/C/259/24

Date: 14/05/2024

NOTIFICATION

It is notified for information of all concerned that in terms of the provision of the Murshidabad University Act, 2018, and, in existing of his powers, of the said Act, the Vice-Chancellor has, by and order dated 14.05.2024 approved the structure and syllabi of the subject Zoology for semester wise programme of PG Course of study under this university, as laid down in the accompanying pamphlet.

Place: Berhampore

Date: 14.05.2024

Rajib Mukherjee
Registrar

Murshidabad University

Registrar
Murshidabad University



M.Sc. (Zoology) Syllabus

2-year Semester System

(4 Semester course)

[CHOICE BASED CREDIT SYSTEM]

Session: 2023 -2025



Department of Zoology, Murshidabad University

**1, Sahid Surya Sen Road, Gora Bazar, Murshidabad, Berhampore,
West Bengal 742101**

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
1 st Semester	Core courses	05	250	20
2 nd Semester	Core courses	05	250	20
3 rd Semester	Core courses	03	150	12
	Discipline Specific Elective course	01	50	04
	Choice based credit course	01	50	04
4 th Semester	Core course	02	75	06
	Discipline Specific Elective course	02	100	08
	Add on Course	01	25	02
	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
PG-ZOO-CC-T-101	Fundamentals of Non-chordate and Chordate biology	50	4	4
PG-ZOO-CC-T-102	Cell biology and Inheritance biology	50	4	4
PG-ZOO-CC-T-103	Ecology and Toxicology	50	4	4
PG-ZOO-CC-P-104	Fundamentals of Non-chordate and Chordate biology practical & Cell biology and Inheritance biology practical	50	4	8
PG-ZOO-CC-P-105	Ecology and Toxicology practical & field/institutional visit	50	4	4
Total		250	20	24

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

- 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
PG-ZOO-CC-T-201	Biostatistics and Taxonomy	50	4	4
PG-ZOO-CC-T-202	Evolution and Animal behaviour	50	4	4
PG-ZOO-CC-T-203	Biochemistry and Animal physiology	50	4	4
PG-ZOO-CC-P-204	Biostatistics, Taxonomy, Evolution and Biochemistry practical	50	4	8
PG-ZOO-CC-P-205	Animal Behaviour, Animal physiology & seminar presentation	50	4	4
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
PG-ZOO-CC-T-301	Developmental biology and Endocrinology	50	4	4
PG-ZOO-CC-T-302	Immunology and Molecular biology	50	4	4
PG-ZOO-CC-P-303	Developmental biology and Endocrinology & Immunology and Molecular biology practical	50	4	8
PG-ZOO-DSE-T-304-307	Discipline Specific Elective course (Theory)	50	4	4
PG-ZOO-CBCC-T-01	CBCC (for other than Zoology PG students)	50	4	4
Total		250	20	24

- Elective paper selection after the end of 2nd Semester for commencement of project work, theory 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) shall be opted by the students at semester 3 other than zoology.

4th Semester

Course Code	Subject	Marks	Credits	Hours/week
PG-ZOO-CC-T-401	Applied biology and Methods in biology	50	4	4
PG-ZOO-CC-P-402	Applied biology and Methods in biology practical	25	2	4
PG-ZOO-DSE-T-403- 406	Discipline Specific Elective course (Theory)	50	4	4
PG-ZOO-DSE-P-407- 410	Discipline Specific Elective course (Practical)	50	4	8
PG-ZOO-AO-T-01	Add on course	25	2	2
PG-ZOO-DIS-01	Dissertation/ Review work	50	4	-
Total		250	20	22

Name of Elective papers:

- | | |
|---|--|
| 1. PG-ZOO-DSE-T-304/ PG-ZOO-DSE-T-403/P-407: | Aquaculture |
| 2. PG-ZOO-DSE-T-305/ PG-ZOO-DSE-T-404/P-408: | Ecology and environmental biology |
| 3. PG-ZOO-DSE-T-306/ PG-ZOO-DSE-T-405/P-409: | Wildlife and conservation biology |
| 4. PG-ZOO-DSE-T-307/ PG-ZOO-DSE-T-406/P-410: | Entomology |

Division of theory and practical marks:

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

4th Semester 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)	10	40	50
Practical (Core) 4 th Sem	5	20	25
Theory (CBCC)	10	40	50
Theory (DSE paper)	10	40	50
Practical (DSE paper)	10	40	50
Dissertation/ review work	-	50	50

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 10 marks Experiment/ viva - 10 marks 05 marks Experiment/ viva - 05 marks	For Practical tests 40 marks Experiment - 30 marks LNB + Viva voce – 5+5= 10 marks 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

Question Pattern

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 one of the CBCCs being offered, apart from own subject.

	MARKS/ CREDIT					
	MARKS			CREDIT		
	Theory	Practical	TOTAL	Theory	Practical	TOTAL
SEMESTER I	150	100	250	12	8	20
SEMESTER II	150	100	250	12	8	20
SEMESTER III	200	50	250	16	4	20
SEMESTER IV	125	125	250	10	10	20
GRAND TOTAL			1000			80

Course objective: The objective of the curriculum in Biostatistics and taxonomy is to introduce the students with basic statistics and taxonomy. The module will help the students to learn about different concepts and practices about biostatistics and taxonomy like data dispersion, parametric and non-parametric statistics, regression and correlation, hypothesis testing, species concept, classification, molecular taxonomy etc. Along with that this curriculum also gives the opportunity to develop some practical biological knowledge and skills.

PG-ZOO-CC-T-201: (Group A) Biostatistics

Marks 25 Credit 02

- 1. Introduction to Biostatistics:** Definition and utility of biostatistics in biological studies.
- 2. Basic concepts of biostatistics:** Data, Variable, attribute, Population, Sample, Arrangement of data, Frequency distribution.
- 3. Measures of Central Tendency:** Mean; Mode; Median.
- 4. Measures of data dispersion:** Variance; Standard deviation; Noise and Error: Standard error, Kurtosis, Skewness, interquartile range.
- 5. Parametric and non-parametric statistics**
- 6. Graphical representation of data:** Line diagram; Bar diagram; Pie chart; Histogram.
- 7. Probability Distribution:** Concept of Probability, Binomial Distribution and Poisson Distribution.
- 8. Simple Linear Regression and Correlation.**
- 9. Testing Hypothesis:** level of significance, p value, Students' 't' distribution, Paired t-test, Chi-Square Test (goodness of fit and contingency chi square)
- 10. Analysis of Variance.** (One way ANOVA)

PG-ZOO-CC-T-201: (Group B) Taxonomy

Marks 25 Credit 02

- 1. Taxonomic characters:** Concept of character, qualitative and quantitative, homology
- 2. Species concepts:** Biological, Evolutionary and Phylogenetic
- 3. Species taxon:** Polytypic; Linnean hierarchy, Category, Supra and infra-specific categories, intra-population variations, delimitation criteria
- 4. Classification:**
 - Phenetics: Concept, phenograms
 - Cladistics: Concept, homology, homoplasy, cladograms
 - Evolutionary: Concept of monophyly, paraphyly & polyphyly
- 5. Molecular taxonomy:**
 - Genomics and Proteomics in taxonomy: Concept and applications
 - Molecular basis of taxonomy: nuclear DNA, mitochondrial DNA, ribosomal
 - RNA, cytochrome-C, α globin polypeptide chain
 - Phylogenetic trees: Cluster (UPGMA), Neighbor joining method & cladistic methods, parsimony and maximum likelihood method
 - DNA barcoding, Barcode gap, Barcode databases

Learning outcome: The course is designed to prepare the students with knowledge and skills of biostatistics and taxonomical aspect of the subject. The paper has made the students enriched in view of knowledge about real life sampling methods, modern approaches in data handling along with the classical and newest trends of taxonomy studies like classification and molecular taxonomy.

Course objectives: The first group of the paper has been designed to explain how life originated on earth and then how the simplest life form gradually evolved throughout geological eras to give rise to more and more complex form of life. The course topics also gives knowledge about how genetic variations evolved in natural population and how species has evolved. Finally, the course will have an insight of patterns and trends in evolution which is an essential tool for studying human population. Second group of the paper deals with behaviour biology of animals. The topics include the background of behavioural study, development of behaviour in animals, social behaviour, learning behaviour, communication, orientation and navigation.

PG-ZOO-CC-T-202: (Group A) Evolution

Marks 25 Credit 2

1. Origin and early history of life:

- Origin of basic biological molecules, Abiotic synthesis of organic monomers and polymers
- Evolution of Prokaryotes and unicellular Eukaryotes; Origin of multicellular organisms, RNA world.

2. Molecular evolution:

- Concepts of neutral evolution
- Molecular divergence and molecular clocks
- Protein & Gene evolution, Evolution of Multigene Family
- Acquisition of new genes: Mechanisms and Exon Theory

3. Paleontology and evolutionary history:

- The evolutionary time scale, Major events in the evolutionary time scale and extinction
- Stages of Hominid evolution
- Tools of studying evolution

4. Population genetics:

- Origin of Genetic variation in the natural population
- Hardy-Weinberg law Assumption, Derivation & application in population genetics,
- Destabilizing forces influencing allele frequencies: Mutation, Natural Selection, Migration and Genetic drift.
- Inbreeding: Measure of inbreeding, inbreeding depression, Heterosis

5. Speciation:

- Patterns and Mechanisms of reproductive isolation; genetic basis of reproductive isolation.
- Modes of Speciation
- Evolution of interaction among species

PG-ZOO-CC-T-202: (Group B) Animal behaviour

Marks 25 Credit 02

1. Introduction and history of behavioural ecology.

2. Development of behaviour:

- Genetic, Environmental and Neural influences.
- Imprinting, food choices.
- Bird song.
- Play behaviour.

3. Social behaviour:

- Sexual selection, Altruism, Kin selection, social structures in primates, territoriality; Mating systems, conflicts.

4. Biological rhythms:

- Basic components, types, centers (suprachiasmatic nuclei, pineal gland, optic lobes), factors

influencing biological rhythms (environmental, photoperiod, temperature, other Zeitgebers), molecular basis of circadian rhythms.

5. Learning behaviour:

- Classical conditioning, Instrumental conditioning, Acquisition, Extinction and Habituation, Sensitization, Generalization, Reinforcement.

6. Communication:

- Signals and Channels of communication.

7. Orientation and navigation:

- Migration in birds and mammals.

- Compass orientation – Sun, star, moon, olfactory cues, magnetic field, ambient pressure, infrasound.

- Homing behaviour, pilotage, true navigation.

Learning outcome: On completion of the course, the students have the understanding of the history of life. They are knowledgeable about the major events earth has encountered in its geological time period. The course has offered a wide array of knowledge and insights about the evolution of species and animal behaviour. The deeper understanding about the animal behaviour and origin of life will inspire the students to pursue further studies in these fields.

Course objectives: The objective of the curriculum in biochemistry and animal physiology is to extend the knowledge of the students about these courses which they have learned in their UG courses. The biochemistry part of the paper includes the basic molecular and chemical properties of biological organisms and their components. It also includes the structures, properties and metabolism of different biological macromolecules. The objective of the curriculum in Animal physiology is to explain the fundamental mechanisms of different systems including digestive, circulatory- respiratory, excretory, nervous and muscular system that operate in a living organism.

PG-ZOO-CC-T-203: (Group A) Biochemistry

Marks 25 Credit 02

- 1. Structure of atoms, molecules and chemical bonds.**
- 2. pH and Buffers:** Concept of acids and bases, buffers, biological buffer systems: the phosphate buffer system, the bicarbonate buffer system.
- 3. Carbohydrates and metabolism:** Overview of classification, structure and functions; Glycolysis and its regulation, Citric acid cycle and its regulation, Oxidative and substrate level phosphorylation, Basic concept of Electron-transfer reaction in mitochondria and ATP synthesis; Gluconeogenesis; Hexose monophosphate Shunt; Glycogenesis and Glycogenolysis.
- 4. Protein and metabolism:** Overview of classification, structure and functions of Amino acids; Conformation of proteins structure and function; General reactions of amino acid metabolism - Transamination, decarboxylation, oxidative & non-oxidative deamination of amino acids; Acetyl CoA, alpha ketogutarate, acetoacetyl CoA, succinate, fumarate and oxaloacetate pathway; Urea cycle and its regulation; Ammonia excretion.
- 5. Lipids and metabolism:** Storage lipids, Structural lipids in membranes, Lipids as signals, cofactors and pigments; Hydrolysis of tri-acylglycerols; α -, β -, ω - oxidation of fatty acids; Energetics of beta oxidation
- 6. Enzymes:** Classification, kinetics, function, examples of inhibitions & inhibitors; Ribozymes and deoxyribozymes.

1. Digestive system:

- Digestion and absorption. Neuroendocrine regulation of gastro – intestinal movements and secretions. Energy balance, BMR
- Neural regulation of thirst and hunger, Events of absorptive and post absorptive states and their neural and endocrine regulation
- Physiology of starvation and obesity

2. Circulation:

- Concepts of haemodynamics, blood volume and its regulation
- Cardiac cycle and cardiac output, Neural and chemical regulation of cardiac activity, blood pressure and its regulation, ECG - its principle and significance.

3. Respiration:

- Lung ventilation, lung volumes in human, pulmonary surfactants
- Neural and hormonal control of breathing. Respiratory acidosis and alkalosis and regulation of blood PH.
- Respiration in unusual environment – foetal and neonatal respiration, high altitude, diving.

4. Excretion:

- Urine formation, urine concentration and its hormonal regulation, micturition, Role of kidney in maintaining homeostasis.
- Osmolar Clearances and Free Water Clearances, regulation of water balance, electrolyte balance and acid-base balance.
- Formation of nitrogenous excretory products NH₃, Urea & Uric acid.

5. Sensory system:

- Neurotransmitters: Classification, distribution and functions.
- Genesis of membrane potential, transmission through synapse, excitatory and inhibitory post-synaptic potential
- Classification of somatic senses and somatic receptors
- Mechanoreceptors: Mechanism of hearing and Equilibrium, Photo receptors: Structure of vertebrate eye. Physiology of vision, Pain receptors: Headache, pain suppression (analgesia), Tactile receptors: Mechanism of transmission of signals.

6. Muscular system:

- Skeletal muscle- ultra structure and molecular organization. Red and white muscles
- Mechanism of muscle contraction and relaxation. Energetics of muscle contraction.
- Neural control of muscle tone and posture.

7. Stress and adaptation:

- Basic concept of environmental stress and strain, concepts of elastic and plastic strain, stress resistance, stress avoidance and stress tolerance.
- Adaptation: The nature and levels of adaptation, Fundamental mechanisms of adaptation.

Learning outcome: The course helps to understand how separate biochemical pathways and physiological systems interact among themselves to perform different chemical reactions and to yield integrated physiological responses to challenges and stresses. Along with that this curriculum also gives the opportunity to develop some practical biological knowledge and skills which is included in the practical part of the course.

PG-ZOO-CC-P-204:

Marks 50 Credit 04

Biostatistics, Taxonomy, Evolution and Biochemistry practical

1. Preparation and interpretation of line diagram, bar diagram, pie charts and histogram from hypothetical/real data in computer software.
2. Basic knowledge and use of SPSS software for statistical analysis.
3. Chi square, Unpaired and paired t-test and one way ANOVA.
4. Specimen collection and preservation techniques.
5. Preparation of key-dichotomous key based on invertebrates (insects).
6. Sampling methods (including diversity assessment) for invertebrates (insects) and vertebrates (birds).
7. Statistical assessment of morphological features (morphometry) using software.
8. Problems based on gene frequency – Hardy-Weinberg Law; Calculating gene frequencies and genotype frequencies.
9. Polygenic inheritance – height in men.
10. Problems based on multiple alleles – Blood groups, Rh factor.
11. Multifactor inheritance – Fingerprint analysis.
12. Study of fossils from models/ picture.

PG-ZOO-CC-P-205:

Marks 50 Credit 04

Animal behaviour, animal physiology practical & seminar presentation

1. Behaviour sampling methods.
2. Study of different stresses in humans.
3. Territoriality in dogs.
4. Estimation of fasting and PP blood Sugar in human by GOD-POD method.
5. Biochemical estimation of blood Cholesterol.
6. Action of digestive enzymes.
7. Oxygen consumption and estimation in an aquatic or terrestrial animal.
8. Demonstration of the unconditioned reflex action.
9. BMI estimation.
10. Body fat percentage calculation.
11. Pulse rate and Blood pressure measurement.

Seminar presentation on any topic from the 2nd semester syllabus.



Kakali Bhadra

Prasanta Saha



Kankana Barua

