

M.Sc. Zoology: 2023-24
Semester I (C.B.C. System)
MSZOOLE Practical - PG
Paper I: BIOSYSTEMATICS AND EVOLUTION

Marking Scheme

Time = 5 Hours

Total marks 100

1. Spotting Common (biosystematics and evolution) -Sorting samples (e.g., helminths, Annelids, arthropods, molluscs, or available vertebrates). Grouping selected samples into different morpho-species (e.g., insects, snails, fishes, amphibians, reptiles, birds, mammals etc.) and classifying. (10X2) = 20
2. Determination of population density of animals, species dominance, and frequency using the quadrant/plot method.

OR

- Estimating gene and genotype frequency in the light of Hardy Weinberg Law based on facial traits, blood group (ABO), and P.T.C. 10
3. Tools and techniques involved in museum preservation of specimens. / Construction of phylogenetic tree.

OR

- An exercise to demonstrate the role of natural selection in evolving adaptations.
 - An exercise to demonstrate the role of natural selection in fixing favoured adaptations and eliminating maladaptations.
 - An exercise to illustrate the concept of genetic drift.
 - Comparative study of prokaryotic and eukaryotic cells by staining and mounting (evolutionary significance). 10
4. Analysis of species diversity using diversity indices. / Study of fossil evidence. / Study of homology and analogy. 10
 5. Identification of various parasites of fishes /Taxonomy of economically important agricultural pests (at least five specimens). 10
 6. Writing a taxonomic report on collected and identified samples by the students / Field visit report 10
 7. Practical Records 10
 8. Viva – Voce 20

Course Contents

BIOSYSTEMATICS

1. Sorting samples (e.g., helminths, Annelids, arthropods, molluscs, or available vertebrates).
2. Grouping selected samples into different morpho-species (e.g., insects, snails, fishes, amphibians, reptiles, birds, mammals etc.) and classifying.
3. Cataloguing samples following teacher's guidelines, safe preservation and storing.
4. Finding characters and keys, description, and diagnosis
5. Writing a taxonomic report on collected and identified samples by the students.
6. Construction of phylogenetic tree.
7. Collection, identification, and submission of the following:
 - A. Insects (10nos) B. Fishes (5nos)

8. Identification of various parasites of fishes
9. Taxonomy of economically important agricultural pests (at least five specimens)
10. Collection and separation of soil organisms using Bearman's and Berlese apparatus and Identification (at least five specimens)
11. Keying out families of organisms of different major orders such as Odonata, Orthoptera, Blattodea, Mantodea, Isoptera, Hemiptera, Thysanoptera, Phthiraptera, Neuroptera, Coleoptera, Diptera, Lepidoptera, Hymenoptera, Arachnida, Crustacea.
12. Study of Orders of vertebrates and their identification using taxonomic keys.
13. Tools and techniques involved in museum preservation of specimens.
14. Demonstration of BLAST for sequence comparison and MEGA for phylogenetic analysis and phylogenetic tree construction

Compulsory Field visits (Prepare field study reports and submit them for evaluation (10 marks)) at least 3 days.

1. Visit the fish market/ fish landing centre, specimen collection morphometry data collection identification
2. Visit forests/wetland ecosystems to study birds, butterflies, and mammalian diversity.
3. Field visits to collect insects of different orders.
4. Field key characters of any amphibians and reptiles reported during field visits
5. Visiting museums (CDZ, NHM, NARC), learning preservation and storing techniques, and preparing reports on any one species or group of animals about the current situation of that group or species.

EVOLUTION

1. Estimating gene and genotype frequency in the light of Hardy Weinberg Law based on facial traits, blood group (ABO), and P.T.C.
2. Locating the hotspots and biosphere reserves on the world map.
3. Determination of population density of animals, species dominance, and frequency using the quadrant/plot method.
4. Analysis of species diversity using diversity indices.
5. Study of fossil evidence.
6. Study of homology and analogy.
7. To study the phylogeny of horse with diagrams/cutouts of limbs and teeth of horse ancestors.
8. Study of darwin's finches with diagrams/cutout beaks of different species.
9. An exercise to demonstrate the role of natural selection in evolving adaptations.
10. An exercise to demonstrate the role of natural selection in fixing favoured adaptations and eliminating maladaptations.
11. An exercise to illustrate the concept of genetic drift.
12. Comparative study of prokaryotic and eukaryotic cells by staining and mounting (evolutionary significance).

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Paper-II: INVERTEBRATES: STRUCTURE AND FUNCTION

Time = 5 Hours

	Total marks 100
1. Spotting – Classification and identification of various phylum.	(10X2) =20
2. One major dissection of various systems of invertebrates – Squilla, Sepia, Loligo.	18
3. One minor dissection- Grasshopper, Honeybee, Echinus, Starfish, Aplysia.	12
4. Mounting material - permanent mount	10
5 Assignment from Theory Paper	10
6. Practical record	10
7. Viva – Voce	20

Course Contents

1 STUDY OF MUSEUM SPECIMENS

(A) PROTOZOA : *Amoeba proteus w.m.*, *Paramecium .w.m.*, *Paramecium fission Paramecium conjugation*, *Plasmodium (signet ring)*, *Vorticella w.m.*, *Nyctotherus w.m.*, *Entamoeba histolytica w.m.*, *Radiolarian ooze*, *Ceratium w.m.*, *Volvox w.m.*, *Monocystis trophozites*

(B) PORIFERA: *Hyalonema*, *Euplectella*, *Leucosolenia*, *Cliona*, *Spongilla*, *Chalina*, *Euspongia*, *Sycon*, *Hircinia*, *Grantia Olynthus*

(C) COELENTERATA: *Physalia*, *Porpita*, *Gorgonia*, *Metridium*, *Aurelia*, *Corallium*, *Adamsia*, *Edwardsia*, *Cerianthus*, *Fungia*, *Pennatula*, *Madrepora*, *Vallela*, *Sagarita*, *Renilla*, *Zoanthus Favia*, *Virgularia*, *Millepora Alcyonium*.

(D) PLATYHELMINTHES AND ASCHELMINTHES: *Taenia*, *Fasciola*, *Echinococcus*, *Ascaris(male and female)*, *Dracunculus*, *Dugesia*.

(E) ANNELIDA: *Polynoe*, *Phoronis*, *Chaetopterus*, *Pontobdella*, *Nereis*, *Heteronereis*, *Hirudinaria*, *Glycera*, *Eunice*, *Terebella*, *Arenicola*, *Bonelia*, *Aphrodite*, *Eurythoe*

(F) ARTHROPODA: *Squilla*, *Palaemon*, *Scolopendra Julus*, *Queen termite*, *Papillio*, *Bombyx mori*, *Vespa*, *Sacculina on Crab*, *Locust*, *Carcinus*, *Limulus*, *Hermit crab*, *Balanus*, *Peripatus*, *Pediculus*, *Lepisma*, *Phyllum*, *Mantis religiosa*, *Palamnaeus*, *Cimex*, *Lepas*

(G) MOLLUSCA : *Sepia*, *Laviculus*, *Teredo*, *Chiton*, *Aplysia*, *Doris*, *Dentalium*, *Octopus*, *Ligula*, *Mytilus*, *Pila*, *Margertifera*, *Turbinella*, *Ostrea*, *Pinctada*, *Solen*, *Loligo*, *Limax*, *Pecten*, *Nautilus*, *Patella*.

(H) ECHINODERMATA: *Asterias*, *Ophioderma*, *Clypeaster*, *Echinus*, *Holothuria*, *Antedon*, *Ophiothrix*

2 STUDY OF PREPARED SLIDES

(A) PORIFEERA L.S. of *Grantia*, T.S. of *Sycon*, L.S. Of *Sycon*, *Leucosolenia* Spongin fibres, Gemmule, Spicules.

(B) (B) COELENTERATA Hydra with bud, T.S. of Hydra, L.S. of Hydra, T.S. of Testes Hydra, T.S. of Ovary of Hydra, *Obelia* colony. (C)

- (C) PLATYHELMINTHES AND ASCHELMINTHES: *Schistosoma* W.M., *Taenia* immature proglottid, *Taenia* mature proglottid, *Taenia* gravid proglottid, *Miracidium* larva W.M., *Sporocyst* larva W.M., *Cercaria* larva W.M., *Redia* larva W.M., T.S. of gonads of *Fasciola*, T.S. of *Planaria*, T.S. of *Ascaris* female, T.S. of *Ascaris* female, *Trichinella spiralis* cyst W.M., *Enterobius* W.M., *Ancylostoma* W.M.
- (D) (D) ANNELIDA: *Tubifex* W.M., septal nephridia of *Pheretima*, L.S. of anterior region of *Pheretima*, W.M. of jaw of *Hirudinaria*, T.S. of *Neries*, W.M. of *Glossiphonia*.
- (E) (E) ARTHROPODA W.M. of *Culex* male, W.M. of *Culex* female, W.M. of pupae of *Culex*, W.M. of pupae of *Anopheles*, W.M. of *Anopheles* male, W.M. of *Anopheles* female, Mouth parts of male *Culex*, Mouth parts of female *Culex*, Mouth parts of male *Anopheles*, Mouth parts of female *Anopheles*, Different types of mouth parts, Different types of legs: jumping, clinging, running, pollinating, W.M. of *Pediculus*, W.M. of *Xenopsylla*, W.M. of *Lucifer*, W.M. of *Zoea* larva, W.M. of *Nauplius* larva, W.M. of *Metanauplius*, W.M. of Mysis, W.M. of Caprella, W.M. of Cypris, W.M. of Alima larva, W.M. of trachea of *Periplaneta*, W.M. of salivary glands of *Periplaneta*, W.M. of larva of *Anopheles*.
- (F) (F) MOLLUSCA T.S. of *Lamellidens*, T.S. of *Lamellidens* through foot, T.S. gill of *Lamellidens*, *Glochidium* larva, *Valiger* larva, W.M. of radula *Pila*, T.S. of osphradium of *Pila*.
- (G) (G) ECHINODERMATA C.S. of arm *Asterias*, T.S. of tube feet of *Asterias*, W.M. of pedicellaria of *Asterias*, W.M., *Bipinnaria* larva, W.M. of *Echinopluteus* larva.

3 PERMANENT PREPARATIONS OF THE FOLLOWING

Protozoa: Preparation of culture of various protozoans, mounting of various protozoans including parasitic forms

Porifera : Gemmules, spicules, spongin fibres

Coelenterata : Obelia colony medusa, Pennaria, Sertularia, Pluniularia, Companularia, Hydra, Hydra with gonads

Helminthes Immature, mature and gravid proglottids, scolex of *Taenia* larval forms

Annelida *Pheretima*: Ovary, septal nephridium, seta (in situ) spermatheca. *Neries* and *Heteroneries*

Parapodia trochophore larva, *Hirudinaria*: Jaws and testicular nephridia.

Arthropoda *Apis*: Sting apparatus *Periplaneta*: Salivary glands testes, spermatheca. Mounting of various types of mouthparts. Mounting of various larval forms

Mollusca *Pila*: Mounting of gill, osphradium and radula, *Lamellidens*: Gill lamella Echinodermata

Mounting of larval forms

VIRTUAL DISSECTIONS/DRAWING AND LABELING

- 1 Mollusca: General anatomy and nervous system of: *Mytilus*, *Aplysia*, *Sepia* and *Loligo*
- 2 Arthropoda: Nervous system of *Squilla*, *Vespa* and *Apis*. General anatomy, alimentary canal nervous system and reproductive system of *Schistocerca*.
- 3 Echinodermata: *Holothuria*: Flag labelling of various organs. *Echinus*: Aristotle's lantern

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**Paper-III: BIODIVERSITY, WILDLIFE CONSERVATION, AND
QUANTITATIVE BIOLOGY**

Time = 5 Hours

Total marks 100

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|---|-------------|
| 1. Spotting – Identification, classification and comments on spots of endangered species and bird species. | (10X2) = 20 |
| 2. Locating the hotspots and biosphere reserves on the map of the world. | 10 |
| 3. Determination of population density of animals, species dominance, and frequency using the quadrant/plot method. | 10 |
| 4. Visit Rajasthan's natural habitats and protected areas and wetlands for a detailed study: Students should submit a report on the study covering major fauna, flora, and geography. | 10 |
| 5 Assignment from Theory Paper | 10 |
| 6. Exercise on mean, mode and Median | 10 |
| 7. Practical record | 10 |
| 9. <i>Viva – Voce</i> | 20 |

Course Contents

1. Study and calculation of the following biodiversity indices based on field data: (a) Shannon-Wiener Index
(b) Richness index
(c) Evenness index
(d) Simpson's Diversity Index
Using Excel or other software
2. Composition assessment of the taxonomic diversity/biodiversity in a habitat (e.g. Grassland, arid land, wetland)
3. Determination of population density of animals, species dominance, and frequency using the quadrant/plot method.
4. Field study and survey methods for various animal groups.
5. Assessment of Invertebrate and Vertebrate diversity in your locality (e.g., campus, ecologically important spots near the institution).
6. Analysis of species diversity in fields such as aquatic/grassland/forest/terrestrial/wetland ecosystems.
7. Study on the micro-habitats
8. Analysis of vegetation types in a specific area/ecosystem.
9. Analysis of habitat characteristics in a specific area/ecosystem.
10. Quantification of flora using vegetation sampling methods (Estimation of species dominance, frequency, and density using quadrat/plot methods).
11. Bird watching and identification of resident and migratory birds (minimum species) with their salient characteristics and use of different bird census techniques.

12. Visit Rajasthan's natural habitats and protected areas and wetlands for a detailed study: Students should submit a report on the study covering major fauna, flora, and geography.
13. Locating the hotspots and biosphere reserves on the map of the world.
14. Identification and comments on spots of endangered species: Leatherback Sea turtle, gharial, great Indian bustard, long-billed vulture, Siberian crane, Nilgiri langur, Royal Bengal tiger, Asian elephant, blue whale, Indian Rhinoceros.
16. Exercise on mean, mode and Median
17. Calculation of standard deviation, variance and standard error of the mean.
18. Calculate probability and significance between means using the Students t-test and Chi-square test.
19. Plotting the slope of a line on a graph; calculations of the slope of a line, coefficient correlation and regression.

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Paper-IV: Metabolism – Concepts and Regulation

Time = 5 Hours

	Total marks 100
1. Spotting –. Centrifugation, Chromatography, Spectrophotometer, Electrophoresis, Microtome, HPLC, ESR and NMR Spectrometer	(5X2=10)
2. Qualitative Analysis of – carbohydrates , protein, lipids	10
3. Quantitative estimation of glycogen of tissue, blood glucose, and serum protein.	10
4. Titration curve of acetic acid. Titration of a measured volume of acetic acid with sodium hydroxide (NaOH) to determine the amount of acid in the given solution and pKa of acetic acid	10
5. Demonstration of Starch Digestion by Salivary Amylase	10
6. Verification of Beer-Lambert's Law.	10
7. Assignment from Theory Paper	10
8. Practical record	10
9. <i>Viva – Voce</i>	20

Course Contents

1. Effect of pH and temperature on the rate of enzyme reaction
2. Separation techniques - Centrifugation, Chromatography (Gel permeation, Ion exchange, Electrophoresis)
3. **Qualitative and Analysis of – carbohydrates**, protein, lipid
4. Titration curve of acetic acid. Titration of a measured volume of acetic acid with sodium hydroxide (NaOH) to determine the amount of acid in the given solution and pKa of acetic acid.
5. Determination of the isoelectric pH of the given amino acid by titration method.
6. Estimation of DNA/RNA
7. Quantitative estimation of glycogen of a tissue.
8. Quantitative estimation of blood glucose.
9. Quantitative estimation of serum protein.
10. Determination of acid value of the given fat.
11. Determination of saponification value of the given fat.
12. Estimation of serum cholesterol using a standard protocol
13. Determination of the Michaelis constant (Km value) for the digestion of casein by trypsin.
14. Estimation of serum cholesterol using a standard protocol.
15. Estimation of acetylcholine content in tissue sample.
16. Sugar Fermentation by Microorganisms
17. Demonstration of Starch Digestion by Salivary Amylase
18. Isolation and Fractionation of Egg Lipids by TLC and their Estimation
19. Assay of Serum Transaminases
20. Estimation of Serum Urea
21. Verification of Beer-Lambert's Law.

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Paper-V: IMMUNOLOGY

Time = 5 Hours

Total marks 100

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| 1. Spotting – Different immune cells, thymus, spleen thymus, spleen and lymph and lymph nodes through slides/ nodes through slides/ photographs, Enzyme-linked immunosorbent assay, Immunoglobulins | (10x2) 20 |
| 2. Antigen-antibody interaction in vitro and identification of blood groups. | 10 |
| 3. ABO blood group determination. | 10 |
| 4. Enzyme-linked immunosorbent assay (ELISA) | 10 |
| 5. Demonstration of phagocytes in insect haemocytes. | 10 |
| 6. Assignment from Theory Paper | 10 |
| 7. Practical record | 10 |
| 8. Viva – Voce | 20 |

Course Contents

Immunology

1. Antigen-antibody interaction in vitro and identification of blood groups.
2. Blood film preparation and identification of cells.
3. Detection of pregnancy using kits.
4. Immunodiffusion and Immuno-electrophoresis
5. Demonstration of phagocytes in insect haemocytes.
6. Histological Study of histological study of thymus, spleen thymus, spleen and lymph and lymph nodes through slides/ nodes through slides/ photographs
7. Preparation of stained blood film to study differentiated leucocyte count (DLC)
9. ABO blood group determination
10. Cell counting and cell counting and viability test for splenocytes of farm bred splenocytes of farm-bred animals/animals/ animals/cell lines
11. Enzyme-linked immunosorbent assay (ELISA)
12. Demonstration of immune electrophoresis
13. Dot ELISA
14. Isolation of Leucocytes from Blood and Macrophages from Peritoneal Cavity or Spleen
15. Purification of Immunoglobulins
16. Assays Based on Precipitation Reactions