



**PANDIT DEENDAYAL UPADHYAYA SHEKHAWATI
UNIVERSITY, SIKAR**

SYLLABUS

M.Sc ZOOLOGY

**(ANNUAL SCHEME)
SESSION 2022-23**

PREVIOUS EXAMINATION-2023

Paper-I: Biosystematics and Taxonomy

Paper-II: Structure & Function of Invertebrates

Paper-III: Molecular Biology and Biotechnology

Paper-IV: General Physiology

Paper-V: Biochemistry

Paper-VI: Biostatistics and Population Genetics

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SYLLABUS FOR THE SESSION 2022-23

EXAMINATION- 2023

M.Sc. Zoology Previous (Annual Scheme)

- Paper-1 Biosystematics and Taxonomy**
- Paper-2 Structure & Function of Invertebrates**
- Paper-3 Molecular Biology and Biotechnology**
- Paper-4 General Physiology**
- Paper-5 Biochemistry**
- Paper-6 Biostatistics and Population Genetics**

Note: - In M.Sc. Zoology Previous Examination the theory paper will have the following pattern.

- Question papers will have 5 (five) questions in all having equal marks
- (i) Question number 1 will be compulsory and will have 20 concise answer questions of mark 1 each.
- (ii) Question numbers 2 and 3 will consist of only short answer-type questions with 4 subdivisions of 5 marks each. There will be an internal choice in these questions.
- (iii) Question numbers 4 and 5 will be long answer-type questions with internal choice.

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PAPER 1: BIOSYSTEMATICS AND TAXONOMY

3 Hours duration

Max. Marks: 100

Periods: 80

UNIT-I

1. Definition and basic concept of biosystematics and taxonomy

- 1.1 Historical resume of systematic.
- 1.2 Importance and applications of biosystematics in biology.
- 1.3 Manual basis of histo-systematics-different attributes.

UNIT-II

2. **Trends in biosystematics: Concept of different conventional and newer aspects.**

- 2.1 Behavioral Taxonomy
- 2.2 Chemotaxonomy
- 2.3 Cytotaxonomy
- 2.4 Molecular taxonomy
- 2.5 Numerical taxonomy

3. A molecular perspective on the conservation of diversity.

4. Diversity and ecosystem process: Theory, achievements, and future directions.

UNIT-III

3. Dimensions of speciation and taxonomic characters.

3.1 Dimensions of speciation- Type of lineage changes; Production of additional lineage.

3.2 Mechanisms of speciation, Speciation in panmictic and apomictic species.

3.3 Species concept and species category, Different species concepts: Subspecies and other infra-specific categories.

3.4 Theories of biological classification: Hierarchy of categories.

3.5 Taxonomic characters of different kinds, origin of reproductive isolation, and biological mechanism of genetic incompatibility.

UNIT-IV

4. Procedure keys in taxonomy

4.1 Taxonomic procedures: Taxonomic collections, preservation, correct process of identification.

4.2 Taxonomic keys, Different kinds of taxonomic keys, their merits and demerits.

4.3 Systematic publications and different kinds of publications.

4.4 Process of Zoological types.

4.5 International Code of Zoological Nomenclature (ICZN) and its operative principles.

4.6 Interpretation and application of important rules Zoological nomenclature: formation of scientific names of various taxa.

UNIT-V

Evaluation of biodiversity indices

1. Shannon Weiner index, dominance index.
2. Similarity and dissimilarity index.
3. Association index.

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Paper-II: STRUCTURE & FUNCTION OF INVERTEBRATES

3 Hours duration

Max. Marks: 100

Periods: 80

UNIT-I

1. Organization of Coelom
 - 1.1 Acoelomates
 - 1.2 Pseudocoelomates
 - 1.3 Coelomates Protostomia and Deuterostomia.

UNIT-II

2. Locomotion:
 - 2.1 Flagellar and ciliary movement in Protozoa.
 - 2.2 Hydrostatic movement in Coelenterata.
3. Nutrition and Digestion.
 - 3.1 Patterns of feeding and digestion in lower metazoa.
 - 3.2 Filter feeding in Polychaeta, Mollusca, and Echinodermata.

UNIT-III

4. Respiration
 - 4.1 Organ of respiration: Gills, lungs, and trachea.
 - 4.2 Respiratory pigments.
 - 4.3 Mechanism of respiration.
5. Excretion
 - 5.1 Organs of excretion: Coelom, Coelomoducts, Nephridia, and Malpighian tubules.
 - 5.2 Mechanisms of excretion.
 - 5.3 Excretion and osmoregulation.

UNIT-IV

6. Nervous system
 - 6.1 Primitive Nervous system: Coelenterata and Echinodermata.
 - 6.2 Advance Nervous system: Annelida, Arthropoda (Crustacea and Insecta), and Mollusca (Cephalopoda)
 - 6.3 Trends of neural evolution
7. Invertebrate larvae
 - 7.1 Larval forms of free-living invertebrates
 - 7.2 Larval forms parasites
 - 7.3 Strategies and evolutionary signification of larval forms

UNIT-V

8. Minor Phyla
 - 8.1 Concept and significance (Mesozoa, Ctenophora, Rhyncocela, Protostomes, Deuterostomes.
 - 8.2 Organization and general characters.
 - 8.3 Criteria for the phylogenetic interrelationship between invertebrate phyla


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UNIT-I

1. DNA

- 1.1 DNA structure, Primary, Secondary and Unusual secondary structures (slipped and cruciform triple helix, tetraplex, and G-quadruplex)
- 1.2 Packaging of DNA: Nucleosome, solenoid and scaffold

UNIT-II

2. DNA replication

- 2.1 Prokaryotic & eukaryotic DNA replication.
- 2.2 Mechanics of DNA replication
- 2.3 Enzymes and accessory proteins are involved in DNA replication.

UNIT-III

3. Transcription

- 3.1 Prokaryotic transcription
- 3.2 Eukaryotic transcription
- 3.3 RNA polymerases
- 3.4 General and specific transcription factors
- 3.5 Regulatory elements and mechanisms of transcription regulation.
- 3.6 Transcription termination
- 3.7 Transcription and post-transcriptional gene-splicing

4. Post-transcriptional modifications in RNA

- 4.1 Cap formation
- 4.2 End Processing and polyadenylation
- 4.3 Splicing and editing
- 4.4 Nuclear export of mRNA.
- 4.5 RNA stability

5. Translation

- 5.1 Genetic code
- 5.2 Prokaryotic and eukaryotic translation
- 5.3 Translation machinery
- 5.4 Mechanisms of initiation, elongation and termination
- 5.5 Regulation of translation
- 5.6 Co and post-translation modifications of proteins

UNIT-IV

6. Recombination and repair

- 6.1 Holliday junction, gene targeting, gene disruption
- 6.2 FLP/FRT and Crelox recombination
- 6.3 RecA and other recombinases.
- 6.4 DNA repair mechanisms (Radiation damage, Direct reversal, Oxidative damage Alkylasion, Base excision repair, Nucleotide excision repair, Mismatch repair, ds break, SOS response, and Translesion DNA system)

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7. Molecular mapping of genome

- 7.1 Genetic and physical maps
- 7.2 Physical mapping and map based cloning
- 7.3 Southern and fluorescence, in-situ hybridization for genome analysis
- 7.4 Molecular markers in genome analysis. RFLP, RAPD, AFLP, DNA finger printing, single nucleotide polymorphism (SNPs), Sequence tagged site (STS)
- 7.5 Application of RFLP and forensic disease prognosis, genetic counselling, pedigree varietal, etc. Analysis, Animal tracking and poaching, germplasm maintenance and taxonomy.
- 7.6 Cancer & Apoptosis (MPF) Anaphase promoting factors, CDKs & cyclins, p53 gene and Tumor Suppressor gene.

UNIT-V

8. Human Genome Project. Flap map project, the encode project

- 8.1 Production and Recent Technologies of transgenic animals and Knock out and its applications
- 8.2 Embryonic stem cells and their applications.
- 8.3 Care and breeding of experimental animals including bioethics

9. Embryo technology

- 9.1 Super ovulation cryopreservation of spermatozoa.
- 9.2 In Vitro fertilization and embryo transfer.
- 9.3 Embryo sexing and cloning
- 9.4 Chimera formation
- 9.5 Gene transformation through embryo transgenesis
- 9.6 Surrogacy and ethics
- 9.7 Assisted Reproductive Technologies ICSI, GIFT, ZIFT, TET
- 9.8 Prenatal diagnosis and genetic counseling.


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PAPER –IV GENERAL PHYSIOLOGY

Duration: 3 Hours

Max. Marks: 100

UNIT-I

1. Thermoregulation and Cold Tolerance

1.1 Basic Principles of metabolism

1.2 Heat balance and exchange

1.3 Endotherms Vs Ectotherms

1.4 Counter-current heat exchanger

1.5 Torpor, Hibernation and aestivation

1.6 Adaptations to very cold environments.

2. Ionic and Osmotic balance

2.1 Osmoregulation vs. Osmoconforming

2.2 Osmoregulation in aquatic and terrestrial environments

2.3 Kidney function and diversity

2.4 Other osmoregulatory Organ

2.5 Nitrogenous waste excretion

UNIT-II

3. Gas Exchange and Acid-base Balance

3.1 Oxygen and carbon dioxide transport in blood

3.2 Role of hemoglobin

3.3 Responses to altitude and hypoxia

3.4 Regulation of body pH

3.5 Gas transfer in air and water. Gas exchanger design and function.

4. Muscle function and Movement

4.1 Regulation of contraction

4.2 Excitation-contraction coupling

4.3 Molecular theory of muscle contraction

UNIT-III

5. Nervous system

5.1 Anatomy of the nervous system

5.2 Neurons and membrane excitation

5.3 Electrochemical potentials

5.4 Action potentials

5.5 Transmission between neurons

5.6 Synapses and neurotransmitters

5.7 Memory & learning

6. Sensory Transduction

6.1 Sensing the environment

6.2 Auditory receptors

6.3 Chemoreceptors, taste, and smell. Homing in Salmon

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- 6.4 Mechanoreceptors: Tactile systems and escape responses
- 6.5 Vision and photoreception
- 6.6 Thermoreception and infrared detection: Prey detection in snakes.
- 6.7 Echolocation and bats.

UNIT-IV

7. Digestion and Metabolism

- 7.1 Nutritional and uptake distribution
- 7.2 Effect of starvation

8. Stress Biology

- 8.1 The basic concept of environmental stress and strain: the concept of elastic and plastic strain stress resistance. Stress avoidance and stress tolerance.
- 8.2 Adaptation, acclimation, and acclimatization
- 8.3 Concept of homeostasis
- 8.4 Physiological response to body exercise
- 8.5 Meditation yoga and their effect

UNIT-V

9. Endocrinology

- 9.1 Aim and scope of endocrinology
- 9.2 Discovery of hormones
- 9.3 Classification of hormones
- 9.4 Phylogeny of endocrine glands (Pituitary, pancreas, adrenal, thyroid, testis. Ovary.
- 9.5 Ontogeny of endocrine glands
- 9.6 Neuroendocrine system and neurosecretion
- 9.7 General principles, structure, and hormone action
- 9.8 Hormones growth and development
- 9.9 Hormones and reproduction.


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PAPER – V: BIOCHEMISTRY

Duration: 3 Hours

Max. Marks: 100

UNIT-I

Carbohydrate

1. Chemistry of carbohydrate: - Definition, General properties, classification (Mono, di, poly saccherides) sugar derivatives.
2. Metabolism of carbohydrates.

Covalent properties of proteins.

1. Structure and chemistry of amino acids
2. Protein sequencing
3. Peptide synthesis
4. Protein splicing

Protein secondary and tertiary structure

1. Protein tertiary structure and folding patterns.
2. Role of packing constraints in tertiary structure patterns.
3. Divergent vs convergent evolution of similar structure.

UNIT-II

Globular and fibrous proteins.

1. Water and hydrophobic effect.
2. Tertiary and quaternary effect.
3. Motifs in globular proteins
4. Properties of protein interiors and surfaces.
5. Fibrous proteins
6. Structure of bone.

Protein folding and thermodynamics

1. Protein folding and dynamics.
2. Folding overview Levinthal paradox.
3. Condensation and molten globules.
4. Ramachandran plots and amino acid propensities
5. Catalysis and assistance
6. Amino acid sequence variation and membrane protein-folding.
7. Chaperonin–assisted protein folding.
8. Allostery(Hemoglobin) Myoglobin structure and oxygen binding

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UNIT-III

Fats

1. Fatty acids: structure, nomenclature, acylglycerols, phospholipids. Sphingolipids. Glycolipids, lipoproteins.
2. Terpenoids and sterols : structure, properties, and functions.
3. The function of lipids.
4. Signal transducing molecules.

Vitamins

1. Classification, occurrence of soluble vitamins.
2. Classification occurrence and biological functions of thiamine. Riboflavin. Folic acid and B12
3. Phenolics and alkaloids: Structure, biological properties, and functions.

Covalent Properties of Nucleic Acids

1. Modified nucleosides.
2. Properties of polynucleotides.
3. Secondary and tertiary structure

UNIT-IV

Nucleic Acid Structure

1. Duplex stability
2. Hybridization
3. RNA structure
4. Hairpin and pseudoknot structures. tRNA
5. DNA and RNA helical geometrics (A-Z), banding, deformation
6. Nucleic acid analysis, DNA sequencing, and determination of modified nucleotides.

UNIT-V

RNA catalysis

1. Chemistry and structure of ribozymes
2. Evolutionary implications.

Enzyme mechanisms

1. Principle of enzyme catalysis
2. Protheses and polymerases.
3. Coenzymes and Cofactors
4. Inborn error of metabolism

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PAPER-VI BIOSTATISTICS AND POPULATION GENETICS

Duration: 3 Hours

Max. Marks: 100

Periods: 80

UNIT-I

Biostatistics

1. Definition Scope and application of biostatistics
2. Collection organization and representation of data (graphical- Bar, histogram, Frequency Polygon, line diagram & diagrammatic)
3. Basic statistic- Arithmetic mean. Harmonic mean. Geometric mean, Mode, Mean deviation (Direct short-cut and step-deviation for all).

UNIT-II

1. Statistics of dispersion. Coefficient of variation
2. Standard error: Confidence limit
3. Probability distributions (binomial. Poisson and Normal)
4. Testing of Hypothesis, level of significance: Type I and II errors
5. Tests of statistical significance (Student's t-test Z- test, Chi-square test).
6. Correlation and regression
7. Analysis of Variance (One way and two way ANOVA)

UNIT-III

Population Genetics

1. Concept of evolution and theories of organic evolutions with an emphasis on Darwinism. Neo Darwinism
 - 1.1 Hardy Weinberg's law of genetic equilibrium
 - 1.2 A detailed account of destabilizing forces;
 - (i) Natural selection
 - (ii) Mutation
 - (iii) Genetic drift
 - (iv) Migration
 - (v) Meiotic drive
 - 1.3 Genetic structure of natural populations
 - 1.4 Variations – including transgressive variations
 - 1.5 Models explaining changes in the genetic structure of populations.
 - 1.6 Factors affecting human disease frequency


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UNIT-IV

Molecular population genetic

1. Pattern of change in nucleotide and amino acid sequences.
2. Ecological significance of molecular variations
3. Emergence of Non-Darwinism –Neutral sequences.

Genetics of Quantitative traits in populations

1. Analysis of quantitative traits.
2. Quantitative traits and natural selection.
3. Estimation of heritability.
4. Genotype environment interactions.
5. Inbreeding depression and heterosis.
6. Molecular analysis of quantitative traits.
7. Phenotype plasticity

UNIT-V

1. Phylogenetic and biological concept of species.
2. Pattern and mechanisms of reproductive isolation.
3. Modes of speciation (allopatric, sympatric, parapatric & peripatric).

Molecular Evolution

1. Gene evolution.
2. Evolution of gene families molecular drive.
3. Assessment of molecule drive.
4. Micro-and macro-evolution.

Molecular Phylogenetics

1. Construction of phylogenetic trees.
2. Phylogenetic inference-distance methods, parsimony method maximum like hood method.
3. Immunological techniques.
4. Amino acid sequence and phylogeny.
5. Nucleic acid phylogeny –DNA-DNA hybridizations, restriction enzyme sites nucleotide sequence comparisons, and homologies.
6. Molecular clocks.


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M.Sc.(Previous) Zoology
PRACTICAL EXERCISE

1. Biosystematics and Taxonomy :
 - 1.1 Identification, Classification, and study of the animals from major invertebrate groups (Protozoa to Hemichordate including minor phyla using museum specimens, microscopic, slides, models or charts or photography
 - 1.2 Problems based on Shannon Wiener index. Dominance index. Estimation of population density of given sample by Mark recognition recapture method.
Determination of population density by the quadrat method.
2. Anatomy:-
 - a. Leech Reproduction, excretory nervous: and haemocoelomic systems
 - b. Crab Nervous system
 - c. Scorpion: Nervous and reproductive system.
 - d. Mollusca: General anatomy and Nervous system of Patella. Lamellidens.
Mytilus Sepia and Aplysia.

Minor:

 - a. C.S. of arm of Starfish.
 - b. General anatomy of Holothurians.
 - c. Aristotle's lantern urchin.

3. **Museum Specimens:** Identification, classification, and distinguishing features of important representatives from various groups (Protozoa to Hemichordata):
4. Study of permanent Preparations (Protozoa to Hemichordata)
Amoeba entamoeba Polystomella, Actinophryx, Euglena, Noctiluca, Volvox colony
Trypanosoma, Giardia, Oplina, Nyctiotherus. Balantidium Vorticella, Monocystis,
Plasmodium. Sycon T.S. and L.S. Gemmule, Obelia colony, Obelia medusa, Aurelia
reticulocytes, T.S. Fasciola hepatica sections through various regions of the body.
Hirudinaria body sections through various regions Daptimia Cypris, Cyclop
larva

Aurelia –planula. Redia, Cercaria, Metacercaria, Onchosphere. Cysticercus
Trochophore, Nauplius. Zoea, Mysis, Megalopa. Phyllosoma, Veliger, Glochidium,
Bapinnaria Ophiopluteus. Echinopluteus, Auricularia, Tornaria.
5. Biological Chemistry:
 - (i) Verification of Beer Lambert's Law
 - (ii) Quantitative : estimation of the following in various tissues:
 - (a) Carbohydrates: Glycogen, glucose


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- (b) Proteins: Total proteins- Lowry et al method
 - (c) Lipids: Phospholipids and cholesterol.
 - (d) Nucleic acid: DNA and RNA
 - (e) Enzymes: Acid and alkaline phosphatases
6. Photosiology:
- (i) Study of the following with the help of Computer Assisted Learning (CAL) (Please see E-pharm program)
 - A. The effect of K⁺ Ca acetylcholine and epinephrine on the isolated heart of the frog and conclude your data with the graphic representation Computer Assisted Learning (CAL) be included.
 - B. The effect of various doses of acetylcholine and Nor-epinephrine on blood pressure heart rate and respiratory rate of the rabbit.
 - C. The effects of Atropine, Epinephrine, Ephedrine, and Eserine on Rabbit's eyes other such exercises can be framed from the E-Pharm software.
 - (ii) Determination of pressure, and pulse rate. Heartbeat and respiration rate.
 - (iii) Photometric determination hemoglobin in blood sample.
 - (iv) Determination of MCV, MCH, MCHC, and color index of the given sample of blood.
 - (v) Determination of the following in blood: Clotting time, erythrocyte sedimentation rate, hemolysis, and crenation.
 - (vi) Determination of the Urea in urine/blood.
 - (vii) Determination of the glucose in urine.
 - (viii) Test of digestive enzymes in different parts of the alimentary canal.

Note: - Indicates use of Computers soft wares;

7. Cell and molecular biology & Biotechnology:

- (i) Squash and smear Preparations of testis of cockroach and grasshopper using aceto-orexin. Fielgen and Giemsa stains.
- (ii) Study of onion root tip;
- (iii) Study of giant chromosomes in the salivary gland of Chironomus or Drosophila larva.
- (iv) Vital and super vital staining (with Neural Red and Janus Green B) of the cell of the testis of any insect or mammal to study the mitochondria.
- (v) Chromosome study in cells of the testis of an insect/ mammal/cells of the bone marrow of a mammal.
- (vi) Paper chromatography: Unidimensional chromatography, using amino acids from purified samples and biological materials Ascending and Descending.
- (vii) Electrophoresis : paper/Horizontal/Vertical-Proteins/DNA/RNA

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- (viii) Study of prepared microscopic slides, including those showing various cell types. Mitosis, meiosis, and giant chromosomes.

Note: Compulsory to submit prepared slides from each exercise for examination.

8. Population Genetics:

- (i) Numerical problem based on Hardy Weinberg's law, calculation of allelic frequencies. Inbreeding phenotypic frequencies and estimation of heritability.
- (ii) Problems based on the syllabus.

9. Biostatics :

- (i) Preparation o frequency tables and graphs/line diagrams/ bar diagrams/histogram/Pie charts,
- (ii) Exercise on Arithmetic means, Harmonic mean Geometric mean. Median, Mode (Direct –short cut and step-deviation).
- (iii) Calculation of standard deviation, variance, and standard error of the mean.
- (iv) Calculation of probability and significance between mean using Students test and Chi-square test.
- (v) Plotting the slope of a line on a graph: calculations of the slope of a line. Coefficient correlation and regression.

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M.Sc. (Previous) Zoology PRACTICAL

Scheme of Practical Examination

Total Marks-200

Total Duration: 2 days (5 hrs. per day)

I Day (I, II and III Paper) Times 5 hrs.

Max. Marks: 100 Marks

1. Anatomy	
a. Major	10
b. Minor	6
2. Population Genetic	10
3. Cell & Molecular Biological and Biotechnology	10
4. Spotting No. 1-8	24
5. Record	10
6. Viva-Voce	10
7. Seminar & Submission of slides	5+5
	Total:- 100

II Day(IV,V &VI Paper)

Time: 5 hrs.

Max. Marks: 100 Marks

1. General Physiology	20
2. Biochemistry	20
3. Biostatistics	15
4. Spotting (1-5)	15
5. Record	10
6. Viva-Voce	10
7. Seminar	10
	Total: - 100

Note:-

1. With reference to anatomy (dissection, black papering, and labeling) and type study candidates must be well versed in the study of various systems.
2. With reference to permanent preparations and microscopic slides. The exercise may be substituted with diagrams/photographs/models/charts etc.
3. The candidate must keep a record of all work done in the practical class and submit the same for inspection at the time of the practical examination.
4. The candidate may be asked to write detailed methodology wherever necessary and separate marks may be allocated for the same.
5. Mounting material for permanent preparations would be as per the syllabus as well as available through collection and culture methods.
6. It should be ensured that animals used in the practical exercise are not covered under the Wildlife Act 1972 and amendments made subsequently.
7. There are unlimited amounts of alternative practices that can be carried out using observational and other works in the field. Fieldwork also may be encouraged for the students to recognize their social and environmental responsibility. Non-invasive and Non-harmful practical exercise for the study of anatomy, Physiology, Etiology, Epidemiology, and Ecology may be designed.


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