



**RAM KRISHNA DHARMARTH FOUNDATION UNIVERSITY, BHOPAL**

Airport Bypass Road, Gandhi Nagar, Bhopal - 462033

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## **Scheme for M.Sc. Zoology NEP 2020**

### **For 2 Year PG programme**

#### **First Year**



## Scheme for M.Sc. Zoology NEP 2020

### For 2 Year PG programme

#### Scheme sem-1: (For the course of science having major practicum components)

#### M.Sc. Zoology I Semester

| S.No | Course Code | Course Name                       | Total Mark | Credit (s) | End Semester Exam Marks |      | Internal Marks |      |
|------|-------------|-----------------------------------|------------|------------|-------------------------|------|----------------|------|
|      |             |                                   |            |            | Max                     | Min. | Max            | Min. |
| 1.   | MSZ2-511    | Biosystematics & Animal Diversity | 100        | 6          | 60                      | 24   | 40             | 16   |
| 2.   | MSZ2-512    | Molecular Cell Biology & Genetics | 100        | 6          | 60                      | 24   | 40             | 16   |
| 3.   | MSZ2-513    | Practical - I                     | 100        | 4          | 60                      | 24   | 40             | 16   |
| 4.   | MSZ2-514    | Practical – II                    | 100        | 4          | 60                      | 24   | 40             | 16   |
| 5.   | MSZ2-515    | Internship/Seminar /Field Project | 100        | 2          | -                       | -    | 100            | 40   |
|      |             | Grand Total                       | 500        | 22         |                         |      |                |      |



| BRANCH           | Subject                                      | Subject Code    |
|------------------|----------------------------------------------|-----------------|
| M.Sc. (Zoology ) | <b>Biosystematics &amp; Animal Diversity</b> | <b>MSZ2-511</b> |

**Course Learning Outcomes (CLO) -**

1. To Understand Indigenous Zoological Terminologies and Nomenclature.
2. Identify and classify animals across all major phyla based on structural and functional features.
3. Understand the evolutionary relationships and ecological roles of various animal groups.
4. Apply biosystematics principles in taxonomy and species identification.
5. Develop skills in observation, documentation, and scientific communication.
6. Students will become Zoologist/Taxonomist

**UNIT-1**

**Principles of Systematics & Species Concept-** Sanskrit, Palj, and Prakrit terins for animal species, Role of language Indigenous Zoological Terminologies and Nomenclature Study of in taxonomic traditions.

Deflaitas, History and basic concepts of biosystematies Alfa, Beta, Gamma Taxonomy Newer trends in Taxonomy (Molecular taxonomic details).

Trends in hiosystematics: Chemotaxonomy, cytotaxonomy and molecular taxonomy

Speciation. Types and Cause

Species concepts: Typological, Nominalistic and Biological species

Concepts. Subspecies and other infra-specific categories.

**UNIT-2**

**Taxonomic Characters and different kinds.**

Origin of reproductive isolation, biological mechanism of genetic scorapatibility.

Tha ottoons procedures: Taxonomic collections, preservation, curetting, process of identification.

Taxonomic keys, different types of keys, their merits and demerits.

International code of Zoological Nomenclature (ICZN): Operative peinciples, interpretation and application of important rules: Formation of Scientific names of various Taxa.

**UNIT-3**

**Basies of Animal Classification and Non-Chordates (Protozoa to Annelida)**



Basics of taxonomy and classification Concepts of symmetry, body plans, coelom types, germ layers.

Protozoa General characters, classification, locomotion, Nutrition and Reproduction in protozoa

Porifera - Canal system, types of spicules.

Coelenterata (Cnidaria) - Polymorphism, coral reefs, Life cycle of Obelia.

Platyhelminthes - Parasitic adaptations in Taenia and Fasciola.

Aschelminthes (Nematoda) - General features, parasitism in Ascaris.

Annelida Life history of Neries and Pheretima (earthworm), Metamerism in Annelides.

## **UNIT-4**

### **Non-Chordates and Minor Phyla**

#### **(Arthropoda to Echinodermata)**

Arthropoda - Segmentation, respiration, and sensory structures in insdets and crustaceans, Larval form of Arthropoda.

Mollusca Shell diversity, radula, torsion in gastropods.

Echinodermata - Water vascular system, larval forms, regeneration.

Minor Phyla General features and significance of Rotifera, Hemichordata, Ectoprocta, and Chaetognatha.

## **UNIT-5**

### **Phylum Chordata(From Protochordates to Mammals)**

Protochordates - Balanoglossus, Herdmania, Branchiostoma

Pisces Types of scales, accessory respiratory organs, Parental care and migration.

Amphibia - Neoteny, parental care.

Reptilia-Adaptive features in reptiles.

Aves Flight adaptations, types of beaks, feathers and feet, migration.

Mammalia - Dentition, skin derivatives and its functions, aquatic adaptations.



| BRANCH           | Subject                           | Subject Code |
|------------------|-----------------------------------|--------------|
| M.Sc. (Zoology ) | Molecular Cell Biology & Genetics | MSZ2-512     |

**Course Learning Outcomes (CLO) -**

1. To know about Ancient Indian Concepts of the Cell
2. Understand Genetic Disorders and Their Interpretation in Ancient Texts.
3. Understand cell structure, function, and communication.
4. Explain molecular mechanisms of DNA replication, transcription, and translation.
5. Analyze gene regulation in prokaryotes and eukaryotes.
6. Discuss genetic disorders and applications of biotechnology.
7. Integrate cell and genetic knowledge to understand diseases like cancer.
8. Students will become biomedical research, genomics, biotechnology, diagnostics, teaching, and Ayurgenomtes, in both academic and industrial sectors.

**UNIT-1**

**Ancient Indian Concepts of the Cell.**

Philosophical parallels to cellular structure, function.

**Membrane-structure and Function**

Plasma Membrane: Membrane uansport mechanism; transport of macromolecules, Electrical properties of membranes.

Protein Sorting and Intravellular transport.

Electrical properties of Membrane.

**Structural organization of intracellular organelles**

Structure and Function of Nucleus, Cytoskeleton, Endoplasmic reticulum, Mitochondria, Golgi apparatus, Lysosomes.

**UNIT-2**

**Cell signaling and Communication**

- Hormones and their receptors, Extracellular signal and cellular response

Cell surface receptors, highly conserved components of intracellular signal transduction pathways.

G Protein coupled receptor systems: Regulation of ion channels; Activation or inhibition of adenyl cyclase, activation of phospholipase.



Cell signaling pathways that control gene activity: TGFB receptors and Smad transcription factors, Cytokine receptors; Tyrosine kinase receptor.

Cell Junctions: Types and functions; Cadherins mediated adhesion, Catenin, actin mediated contraction, role of Desmosomes for mechanical strength, tight junctions and transmembrane adhesion, scaffold proteins, Gap junctions: Membranic and Electrical activity; Plasmodesmata.

Cancer: Oncogenes, Tumor Suppressor Genes, Cancer and cell cycle, virus induced cancer, metastasis, therapeutic intervention of uncontrolled cell growth.

### **UNIT-3**

#### **The cellular and molecular basis of inheritance.**

Nucleus, Human Chromosome structure, DNA and its type.

Cell divisions: chromosomal segregation during mitosis and meiosis.

Inheritance: Mendelian Laws (law of segregation, law of independent assortment, law of segregation and independent assortment). Non mendelian Inheritance

Gene Interaction, multiple allele, Sex linked Inheritance.

Linkage, Crossing over.

### **UNIT-4**

#### **Genome Replication and Replication Associated Errors: DNA**

replication (Bacterial & Eukaryotic chromosomal replication), Replication associated errors

DNA Damage and Repair: DNA damages (Oxidative damages, Depurinations, Depyrimidinations, Cytosine deamination, single and double strand breaks), Repair mechanisms (Photo reactivation, excision repair, mismatch repair, post replication repair, SOS repair).

Genetic code

### **UNIT-5**

#### **Pedigree analysis:**

Family history, pedigree symbols, construction of pedigrees, Complications to the basic pedigree patterns.

#### **Human genetic disorders**

Overview of Mendelian inheritance and diseases.

Sickle cell, hemochromatosis, cystic fibrosis, Duchenne muscular dystrophy



Huntington's disease, achondroplasia, phenylketonuria.

Turner syndrome, Down Syndrome, Patau syndrome, Klinefelter syndrome.

Structural aberration of chromosomes.

Genetic Disorders and Their Interpretation in Ancient Texts: Descriptions of congenital conditions (Janma dosha) in Ayurvedic and astrological texts.



| <b>BRANCH</b>           | <b>Subject</b>       | <b>Subject Code</b> |
|-------------------------|----------------------|---------------------|
| <b>M.Sc. (Zoology )</b> | <b>Practical – I</b> | <b>MSZ2-513</b>     |

**List of practical**

**UNIT-1**

**Identification & Classification (Museum/Model Specimens):**

Protozoa: Amoeba, Paramecium, Trypanosoma

Porifera: Sycon, Spongilla

Cnidaria: Obelia, Aurelia, Hydra

Platyhelminthes: Fasciola, Taenia

Aschelminthes: Ascaris

Annelida: Nereis, Pheretima, Leech

Arthropoda: Palaemon, Periplaneta, Limulus

Mollusca: Pila, Unio, Sepia

Echinodermata: Starfish, Sea Urchin

Chordata: Herdmania, Amphioxus, Scoliodon, Rana, Calotes, Columba, Oryctolagus

**UNIT-2**

**Permanent Slides & Microscopy**

Protozoan locomotion (e.g., cilia, pseudopodia)

Spicules (Porifera). Nematocysts (Cnidaria)

T.S. of body wall (Annelida, Ascaris)

Larval forms; trochophore, nauplius, echinoderm larvae

Chordate histological slides (e.g., muscle, skin, nerve)

**UNIT-3**

**Virtual Dissection/Models / Simulations**



Earthworm: Digestive and reproductive systems

Cockroach: Nervous and reproductive systems

Fish/Amphibian: Circulatory system

## UNIT-4

### **Biosystematics & Taxonomy Tools**

Use of Dichotomous keys

Construction of taxonomic hierarchy

Online taxonomy databases: EOL, ITIS, ZSI, GBIF

Observation and documentation of local fauna (birds, insects, amphibians, etc.)

## UNIT-5

### **Field Study & Project Work**

Local biodiversity survey (college campus/pond/forest/park)

Preparation of Field Note Book: common name, scientific name, features

Submission of field report with photographs/drawings

Optional mini project: "Animal Diversity in My Locality"



| <b>BRANCH</b>           | <b>Subject</b>        | <b>Subject Code</b> |
|-------------------------|-----------------------|---------------------|
| <b>M.Sc. (Zoology )</b> | <b>Practical – II</b> | <b>MSZ2-514</b>     |

## **List of Practical**

### **UNIT-1**

Observation of Mitosis and Meiosis in plant or animal tissues (eg. onion root tips, grasshopper testis).

Preparation and Staining of Human Metaphase Chromosomes (karyotyping).

Identification of Chromosome Structures and types of DNA sequences using prepared slides or chromosome models.

### **UNIT-2**

DNA Isolation from plant (e.g., spinach) or animal cells.

using bacterial cultures (e.g., UV irradiation effect).

Demonstration of DNA Repair Mechanisms through literature-based simulations or experimental design discussions.

### **UNIT-3**

Pedigree Chart Construction from given family data.

Case Studies on Genetic Disorders (sickle cell anemia, cystic fibrosis, etc.).

Simulation or Analysis of Mendelian and Non-Mendelian Ratios using seeds, beads, or software.

### **UNIT-4**

Model-Based Demonstration of Cell Signaling Pathways (e.g., GPCR and tyrosine kinase pathways).

Study of Hormonal Effects on Plant Growth (e.g., auxin and phototropism).

Cancer Cell Morphology through microscopic observation of cell cultures or images.



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| BRANCH           | Subject                                 | Subject Code    |
|------------------|-----------------------------------------|-----------------|
| M.Sc. (Zoology ) | <b>Internship/Seminar/Field Project</b> | <b>MSZ2-515</b> |

Project /Dissertation work (Six weeks) in the form of small thesis based upon the topic related to the M.Sc. Zoologysyllabus . The topics of the dissertation with synopsis will be decided by the

Departmental Research Advisory Committee (DRAC).



## M.Sc. Zoology II Semester

| S. No | Course Code | Course Name                                         | Total Mark | Credit (s) | End Semester Exam Marks |      | Internal Marks |      |
|-------|-------------|-----------------------------------------------------|------------|------------|-------------------------|------|----------------|------|
|       |             |                                                     |            |            | Max                     | Min. | Max            | Min. |
| 1.    | MSZ2-521    | biostatics, ecology and behavioural science         | 100        | 6          | 60                      | 24   | 40             | 16   |
| 2.    | MSZ2-522    | Tool & Techniques, Biophysics And Bioinformatics    | 100        | 6          | 60                      | 24   | 40             | 16   |
| 3.    | MSZ2-523    | Practical - I                                       | 100        | 4          | 60                      | 24   | 40             | 16   |
| 4.    | MSZ2-524    | Practical – II                                      | 100        | 4          | 60                      | 24   | 40             | 16   |
| 5.    | MSZ2-525    | Value-added course (VAC) from /MOOCS, SWAYAM, NPTEL | 100        | 2          | -                       | -    | 100            | 40   |
|       |             | Grand Total                                         | 500        | 22         |                         |      |                |      |



| BRANCH           | Subject                                        | Subject Code |
|------------------|------------------------------------------------|--------------|
| M.Sc. (Zoology ) | biostatistics, ecology and behavioural science | MSZ2-521     |

**Course Learning Outcomes (CLO) -**

1. Understand and apply basic statistical methods in biology
2. Know ecological systems and population dynamics.
3. Understand Indigenous Data Systems and Observational Methodologies
4. Explain organism-environment interactions.
5. Describe key concepts in animal and human behaviour.
6. Evaluate biological data to draw scientific conclusions
7. Students will become ecological research, wildlife conservation, data analysis, environmental consultancy, and behavioural science in academia and NGOs.

**UNIT-1**

**Basic concept of Biostatistics**

Preliminary concept of development of Biostatistics (scope, statical method and experimental problem)

Central tendency, characteristic and measures with statistical problem.

Calculation of mean median and mode by different method.

Measures of variation co-variation and analysis of variance by ANOVA technique

Test method: Z- test, F-test, T-test, standard deviation (SD), standard error(SE), and experimental problem

**UNIT-2**

**Graphical representation of data**

Theoretical distribution monomial and binomial

Correlation, Regression. Tabulation statical table

Presentation of data tine diagram graphs histogram per diagram pictogram cartogram

Chi square test, Probability, Indigenous Data Systems and Observational Methodologies

Ancient Indian methods of systematic observation (eg, in Ayurveda, Jyotisha).

Use of metrics in Ayurveda, e.g.. Nadi pariksha, dosha quantification, and other semi-quantitative models.

**UNIT-3**



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## Ecology

**Definition:** Ecology, landscape, habitat, ecozone, biosphere reserve and ecosystem

Habitat Ecology Introduction to Habitat Ecology: Ecological concept of habitat. Ecological niche: niche overlap, niche separation. Ecology of major habitats: Grasslands (characteristics, composition, grassland ecosystem and its distribution in central India), Forests (types of forest, canopy cover, species composition in different forest types).

Wetland Ecology Wetlands: Wetland definition, characteristics and distribution in northeast India, Wetland formation, Ecological role of wetland as wildlife habitat with special reference to Central India

Forest Ecology Forest and forest environment: Structure of forest ecosystem, Forest fragmentation, Characteristic of tropical trees, phenology of trees, forest seed dormancy and germination; regeneration of Forest trees.

## UNIT-4

### Foundations and Mechanisms of Animal Behaviour.

Introduction to Ethology and Behavioural Science

historical Perspectives: Tinbergen's Four Questions

Neural and Hormonal Control of Behaviour

Genetic Basis of Behaviour: Heritability and Gene-Environment Interactions

Learning and Cognition: Classical & Operant Conditioning. Habituation, Insight Learning

Communication: Signals, Modalities, Evolution of Language

Circadian Rhythms, Biological Clocks, and Navigation

## UNIT-5

### Ethology. Evolution & Applications of Behaviour

Behavioural Ecology: Optimal Foraging Theory, Mating Systems, Territoriality.

Reproductive Strategies and Parental Care.

Altruism, Cooperation, and Kin Selection.

Social Organization in Insects, Birds, Mammals (Case Studies: Ants, Wolves, Primates).

Human-Wildlife Conflict and Behavioural Adaptation in Urban Ecology.

Applied Behavioural Science: Conservation, Captive Animal Welfare, and Etho-tourism

Ethical and Legal Aspects in Behavioural Research (Wildlife Protection Acts, IUCN guidelines).



| BRANCH           | Subject                                                         | Subject Code    |
|------------------|-----------------------------------------------------------------|-----------------|
| M.Sc. (Zoology ) | <b>Tool &amp; Techniques, Biophysics<br/>And Bioinformatics</b> | <b>MSZ2-522</b> |

**Course Learning Outcomes (CLO) -**

1. To understand the structure and function of microscope.
2. To know the different principles of working of microscope.
3. To understand the different cytological lab techniques
4. Know about Panchamahabhuta Biophysical States of Matter according to ancient test.
5. To know about the different systematic pathways of biomolecules.
6. To have an idea of new branches of Zoology their importance.
7. Prepares students for careers in biotechnology research, biomedical Instrumentation, computational biology, and data-driven life science research in academia and industry.

**UNIT-1**

Basic principles of microscopy:

Types of microscopes and their biological applications, Bright-field, microscope, numerical aperture, limit of resolution, types of objectives, ocular and stage micrometers, Dark-field, Phase-contrast, Differential interference contrast, Fluorescence, Confocal, Atomic force, Transmission and scanning electron microscopy.

Centrifugation: Basic principle, Types of rotors, Clinical, high speed and ultracentrifuge

**UNIT-2**

Electrophoresis: Agarose- and polyacrylamide gel, Two-dimensional, Isoelectrofocussing

Spectroscopy: Beer-Lambert's Law, molar extinction coefficient and calculation, Spectroscopy, Colorimeter and UV-Vis, Spectrophotometer, CD, Fluorescence, NMR, Spectrofluorometry

Chromatography. Paper and thin layer chromatography, Column chromatography, Gel filtration, Ion-exchange, HPLC, FPLC, MALDI (TOF), Affinity purification

**UNIT-3**

Panchamahabhutas & Biophysical States of Matter: Earth (solid), Water (liquid), Fire (thermal/energy), Air (gaseous), Ether (space): traditional descriptors of physical and physiological states.

Bioenergetics: Laws of thermodynamics, Concept of free energy. Standard free energy, ATP as energy currency and its hydrolysis.

Water: Hydrogen bonding and structure of water molecule, Ionization of water, Concept of pH, pK and pOH, Colligative properties.

Carbohydrates: Classification and structure, glycosaminoglycans and proteoglycans, Glycolysis, TCA cycle, Electron transport system.



#### **UNIT-4**

Amino acids: Structure, Classification, Zwitter ionic properties, and titration curves.

Proteins: Various levels of structural organization of proteins, Peptide bonds, disulphide and other types of cross-links,  $\alpha$ -helix and other helices, Helix-coil transition, parallel and anti-parallel  $\beta$ -pleated sheets, Ramachandran plot and its significance

Lipids: Simple and complex lipids, Glycerophospholipids, Sphingolipids, Gangliosides, Eicosanoids and prostaglandins

Cholesterol: Structure and biosynthesis.

Nucleic acids and Nucleotides: Biosynthesis of purines and pyrimidines, de novo and Salvage pathway, various confirmations of nucleotides.

#### **UNIT-5**

Bioinformatics and Molecular Biology Techniques:

Introduction and scope of Bioinformatics, Data bases Nucleic acid sequences Genomes, Protein sequence and structures.

Access to molecular biology data bases Entrez Sequence retrieval system (SRS) Protein identification resource (PIR).

Sequence alignments and phylogenetic trees Southern and northern blotting, Western blotting, ELISA, PCR, FACS. In situ hybridization, FISH, RISH, Immunostaining, Microarray, FACS,

DNA protein Interaction methods, EMSA, South Western, Protein-protein interaction methods, Pull down assay, Far western Blot, FRET-FREM,



| BRANCH           | Subject       | Subject Code |
|------------------|---------------|--------------|
| M.Sc. (Zoology ) | Practical – I | MSZ2-523     |

## List of Practicals

### UNIT-1

#### Measures of Central Tendency

Collection of biological data (field/lab data).

Calculation of mean, median, mode

Application-based problem solving.

Measures of Variation

Application of ANOVA (One-way) using example datasets.

Test of Significance

Performing Z-test, F-test, T-test using biological data.

Graphical Representation

Construction and analysis of-Line diagram, Bar graph, Histogram, Pie chart

-Pictogram, Cartogram, Frequency polygon

Distribution and Correlation

Calculation and plotting of correlation (Pearson/Spearman) using sample data

Tabulation and Chi-square

Designing of statistical tables (primary and secondary).

Chi-square test for goodness of fit and association.

### UNIT-2

#### Basic & Habitat Ecology

Field study on niche characteristics of selected species.

Comparative study of grassland vs. forest ecosystem composition.

Mapping and identification of habitat zones (with reference to NE India)



### Wetland Ecology

Field visit to a local wetland.

Assessment of wetland flora/fauna.

Study of ecological roles in nutrient cycling, wildlife habitat.

### Forest Ecology

Identification of tree species, phenology study.

Observation of canopy cover, forest stratification, seed dormancy.

field survey on forest fragmentation and its impact on species diversity

### **UNIT-3**

Construction of ethograms for selected species (in lab or field)

Observation and recording of foraging or social behaviour

Design of behavioural experiments (e.g., maze learning, choice tests)

Data analysis using descriptive statistics and behaviour software (e.g., BORIS)



| BRANCH           | Subject        | Subject Code |
|------------------|----------------|--------------|
| M.Sc. (Zoology ) | Practical – II | MSZ2-524     |

## List of Practical

### UNIT-1

1. DNA Isolation from Plant or Animal Tissue.
2. Agarose Gel Electrophoresis for DNA Fragment Separatio
3. Protein Estimation using Bradford or Lowry Method
4. Spectrophotometric Analysis of Nucleic Acids or Proteins.
5. pH Measurement and BufferPreparation
6. Microscopy Cell Staining and Observation (e.g., onion cells, cheek cells)
7. Centrifugation-Separation of Cellular Components
8. SDS-PAGE for ProteinAnalysis.
9. Chromatography Techniques: Paper, Thin, Column, or Ion Exchange

### UNIT-2

1. Determination of Absorption Spectrum of Biomolecules
2. Viscosity Measurement of Biological Fluids
3. Beer-Lambert Law Verification using UV-Vis Spectrophotometer
4. Thermal Denaturation of DNA (Melting Curve Analysis)
5. Enzyme Kinetics: Michaelis-Menten Curve and Km Determination.

### UNIT-3

1. Retrieval of DNA/Protein Sequences from NCBI/UniProt
2. BLAST Analysis for Gene/Protein Identification
3. Gene Structure Analysis using Ensembl Genome Browser
4. Protein Structure Visualization using PyMOL or UCSF Chimera
5. Phylogenetic Tree Construction using MEGA Software
6. Motif and Domain Analysis using InterProScan.
7. 3D Protein Structure Retrieval and Analysis from PDB