Tripura University

(A Central University)

Suryamaninagar

West Tripura, Tripura – 799022

Syllabus for

Four Year Under Graduate Programme

Subject: Zoology

(NEP – 2020)

Year – 2023

DETAILED COURSE CONTENT OF ZOOLOGY (MAJOR)

(SEMESTER – 1ST - SEMESTER – 5TH)

1st Year

Semester-I

Paper 1: NON-CHORDATES

Paper Code: ZL101C

Total Marks: 100 (IA = 40 + ESE = 60) Credit = 04

(Credits – 04)

Unit - I

Contribution of National Scientists in Zoology

Salim Ali, Vishwa Gopal Jhingran, Hiralal Chaudhuri, Gopal Ch Bhattacharya, Ramdeo Mishra, Hargobind Khorana, Lalji Singh, Radha D Kale, M K Chandra Sekheran, C. R. Narayan Rao, M. C. Dash, Valmik Thapar.

Phylum - Protozoa

• General Characteristics and classification of sub-kingdom Protozoa upto Phylum.
•Locomotion in *Amoeba*
• Reproduction in *Paramecium*

Phylum - Parazoa

• General characteristics and classification of Porifera upto classes
• Histology & body wall of *Sycon*
• Canal system of *Sycon*

Unit – II

Phylum - Metazoa

• General characteristics and classification of Cnidaria upto classes
• Trimorphism & metagenesis of *Obelia*

Phylum - Platyhelminthes

•General characteristics and classification upto classes
•Life cycle of *Fasciola hepatica*

Phylum - Nemathelminthes

• General characteristics and classification upto classes
• Life cycle of *Ascaris*

Unit – III

Phylum - Annelida

• General characteristics and classification upto classes
• Digestive & excretory system of Earthworm

Phylum - Arthropoda

• General characteristics and classification upto classes
• Digestive system of *Periplaneta*
• Circulation in *Periplaneta*

Unit – IV

Phylum - Mollusca

• General characteristics and classification upto classes
• Respiratory system in *Pila*
•Nervous system in *Pila*

Phylum - Echinodermata
• General characteristics and classification upto classes
•Water vascular system in *Asterias*
• Basic larval form and evolutionary significance

Phylum - Hemichordata
• General characteristics of Hemichordata

Paper 2A: Economic Zoology
Paper Code: ZL102C
Total Marks: 60 (IA = 24 + ESE = 36) Credit = 02

Unit – I
Vermiculture & Vermicomposting
•. Principle of vermicomposting, different ecological categories of earthworm (Epigeic, Endogeic, Anesic), importance of vermicomposting, vermitechnology & management.

Unit – II
Sericulture
• Principle, different types of silk moth and their host plants, rearing methods, diseases of silk moth. Management with special reference to local varieties

Apiculture
• Principle, different types of honey bees, rearing methods, diseases of honey bees. Management with special reference to local varieties

Unit – III
Fresh water pisciculture
• Polyculture
• Induced breeding technology
• Fish seed transportation, fish diseases,
• Management

Unit - IV
Poultry
• Types of breeds
• Methods of rearing
• Diseases and their management

Dairy Farming
• Basics of Dairy farming and management.

Paper 2B: Practical (I)
Paper Code: ZL102C
Total Marks: 40 (IA = 16 + ESE = 24) Credit = 02

1. Identification with reasons
   Paramoecium, Scypha, Obelia, Physalia, Fasciola, Taenia, Ascaris, Metaphire, Hirudinaria, Periplaneta, Limulus, Mite, Pila, Lamellidens, Octopus, Asterias, Balanoglossus.
2. Dissection and display of digestive, reproductive and nervous systems of *Periplaneta.*
3. Mouth parts of *Periplaneta.*
4. Spot identification and economic importance of—- *Perionyx, Apis* sp, *Bombyx,* and Carps.
5. Identification of diseases with reasons from the photographs provided of the faunal group.
   - silk moth, fish, poultry.

Semester-II

Paper 3: CHORDATES

Paper Code: ZL201C

Total Marks: 100 (IA = 40 + ESE = 60) Credit = 04

Unit – I

Protochordata

- General characteristics of Cephalochordata with special reference to the ciliary mode of feeding in *Branchiostoma/Amphioxus*.
- General characteristics of Urochordata with special reference to retrogressive metamorphosis in *Ascidia*

Unit – II

Cyclostomata

- General characteristics of Cyclostomata
- Differences between *Petromyzon* and *Myxine*

Pisces

- General Characteristics of Chondrichthyes & Osteichthyes
- Accessory respiratory organs in fishes

Unit – III

Amphibia

- General characteristics and classification upto order
- Parental care in Amphibia
- Neoteny & Paedogenesis in Amphibia

Reptilia

- General characteristics and classification upto order
- Heart of Crocodile
- Differences between venomous and non-venomous snakes
- Biting mechanism of snake

Unit – IV

Aves

- General characteristics and classification upto order
- Double mode of respiration

Mammals

- General characteristics and classification upto order
- Comparative account of heart and aortic arch of mammal with those of bird, reptile, amphibian and fish
- Digestive system of ruminant and non-ruminant

Paper 4A: CELL BIOLOGY
Paper Code: ZL202C
Total Marks: 60 (IA = 24 + ESE = 36) Credit = 02

Unit – I
Cell
- The basic concept of Cell (Prokaryotic and Eukaryotic)
- Cell- Cell theory, cell size, the shape of cells, and types of cells
- Structure and function of prokaryotic cell
- Structure and function of eukaryotic cell – special reference to animal and plant cell
- Differences between animal and plant cells

Unit - II
Structure and function of-
- Plasma membrane
- Nucleus
- Mitochondria
- Golgi bodies
- Ribosomes
- Endoplasmic reticulum
- Lysosomes
- Chromosome
- Nucleic acid

Unit – III
- Cell cycle and regulations
- Cell divisions – Mitosis and Meiosis

Unit - IV
Cancer Biology
- Tumor and its type, characteristics of cancer cells,
- Viral and cellular oncogenes, Development of cancer
- Types of cancer, Types of carcinogens,
- Therapeutics of cancer

Paper 4B: Practical (II)
Paper Code: ZL202C
Total Marks: 40 (IA = 16 + ESE = 24) Credit = 02

1. Identification with reasons —*Branchiostoma, Ascidia,Petromyzon, Myxine, Scoliodon, Hippocampus, Channa, Rohu, Dipnoi, Hyla, Calotes, Naja, Columba, Chiroptera, Bandicota/Rattus.*
2. Dissection and display of digestive system, IXth & Xth cranial nerves of *Cirrhinusmrigala/Channa*
3. Study of gill arch, cycloid & ctenoid scales, hyoid & pectin of fowl.
4. Study of Mitotic cell division stages
5. Study of meiotic cell division stages (permanent slide).
6. Study of salivary gland chromosome from larva of *Drosophila*

2nd Year
Semester-III
Paper 5: GENETICS
Paper Code: ZL301
Total Marks: 100 (IA = 40 + ESE = 60) Credit = 04

Unit - I
- Mendelian Inheritance
- Gene interaction with reference to epistasis and non-epistasis (co-dominance and incomplete dominance)
- DNA as a genetic material with experimental evidence

Unit – II
- Concept of alleles, lethal alleles and multiple alleles (ABO Blood grouping)
- Linkage, crossing over and recombination, gene mapping (three-point test cross)
- Sex determination in *Drosophila* (Genic balance theory) and human; Barr body.

Unit - III
- Chromosomal abnormalities and different syndromes in human—: Turner's syndrome, Klinefelter's syndrome, Down syndrome, Cri-du-Chat syndrome
- Autosomal and Sex-linked inheritance: Autosomal- Albinism and Thalasemia.
- Sex linked inheritance—- Colour blindness and Haemophilia

Unit - IV
- Mutation: Types of mutation, mutagens, induction and detection of sex chromosomal lethal mutation by ClB method
- Human genetic disorders: Phenylketonuria and Alkaptonuria (Phenylalanine pathway), Albinism (Tyrosine pathway), Sickle cell anaemia.
- Cytoplasmic inheritance

Paper 6A: DEVELOPMENTAL BIOLOGY
Paper Code: ZL302C
Total Marks: 60 (IA = 24 + ESE = 36) Credit = 02

Unit - I
- Gametogenesis
- Ultrastructure of spermatozoa and ova with special reference to mammal
- Fertilization

Unit - II
- Cleavage, types, cleavage in frog and chick
- Gastrulation in chick embryo
- Fate map

Unit - III
- Extra-embryonic membrane formation and function in chick embryo
- Embryonic induction,
- Organizer concept
- Formation of the eye in chick embryo

Unit - IV
- Placenta: types and function.
- Formation of the placenta in rabbit
- Concept of In-vitro fertilization, stem cells
- Amniocentesis

Paper 6B: PRACTICAL(III)
Paper Code: ZL302C
Total Marks: 40 (IA = 16 + ESE = 24) Credit = 02

- Pedigree analysis in human (charts)
- Karyotyping in human (charts)
- Identification (with reasons) of male and female Drosophila and their mutants (microphotographs)
- Identification of chick embryo with reason (during different incubation period): 16-18 hours, 21- 24 hours, 48hours,72 hours.

2nd Year
Semester-IV
Paper 7: ANIMAL PHYSIOLOGY
Paper Code: ZL401C
Total Marks: 100 (IA = 40 + ESE = 60) Credit = 04

Unit - I

- Extracellular and intracellular digestions
- Transport of oxygen and carbon dioxide in mammals (Bohr effect and Chloride shift)
- Thermoregulation in Ectotherms and Endotherms, role of the hypothalamus in temperature regulation with regard to Endotherms

Unit - II

- Concept of Isotonic, Hypotonic, and Hypertonic solution, Osmoregulation in fresh and marine water fishes
- Mechanism of nitrogen excretion in vertebrates
- Mechanism of urine formation in mammals and counter-current mechanism

Unit - III

- Structure of neurone
- Resting membrane potential, origin of action potential, and propagation through myelinated and non-myelinated nerves
- Types of synapse, synaptic transmission, and neuromuscular junction
- Role of neurotransmitter
- Chemical and molecular muscular contraction

Unit - IV

- Ketogenesis and its regulation, ketone body synthesis and utilization
- Catabolism of amino acids: Transamination and Deamination
- Urea-Ornithine cycle and its significance
- Animal energetics – concept of energy metabolism
- Measurements of metabolic rate – direct and indirect colourimetry
- Concept of RQ and its significance

Paper 8A: ENDOCRINOLOGY AND REPRODUCTIVE BIOLOGY
Paper Code: ZL402C
Total Marks: 60 (IA = 24 + ESE = 36) Credit = 02

Unit - I

- Introduction to the endocrine system and classification of glands
- Hormones and their functions in vertebrates with special reference to protection in fishes, amphibia and birds
- Hormones and their functions in invertebrates with special reference to metamorphosis in insects

Unit – II

Histological structure and functions of-

- Pituitary gland,
- Thyroid gland,
- Pancreas,
- Adrenal gland,
- Testis and ovary

Unit - III

Endocrine disorder in human with special reference to-

- Pituitary
- Thyroid glands
- Adrenal glands

Unit - IV

- Role of hormones in Reproduction
- Spermatogenesis, and oogenesis
- Menstrual cycle
- Oestrus cycle in rat

Paper 8B: PRACTICAL (IV)
Paper Code: ZL402C
Total Marks: 40 (IA = 16 + ESE = 24) Credit = 02

- Study of osmosis (using human blood /RBC).
- Study of Haemin crystal formation from human blood
- Study of salivary amylase activity using starch solution
- Identification of permanent slides with reasons of transverse section of mammalian Thyroid gland, Pancreas, Ovary and Testis.
- Identification of leukocyte and ABO blood grouping

3rd Year

Semester -5

EVOLUTIONARY BIOLOGY AND CHRONOBIOLOGY

Paper Code: ZL 501C
Total Marks: 100 (IA = 40 + ESE = 60) Credit -4

Unit I: Origin of Life, Fossils, and Geological Time

- Origin of Life: Concept of Hot dilute soup, Proteinoid, Microsphere, Coacervate, Protocell; Experimental evidence of abiotic synthesis of biomolecules (Miller & Urey Experiment).
- Geological Time Scale: Basic idea with major examples of fauna; Background extinction and Mass extinction.
- Fossils: Types, methods of fossilization, and age determination (Carbon dating and other techniques).
- Evolution of horse as an example of macroevolution.

(This unit gives the foundation of how life originated and how evolutionary history is traced.)

Unit II: Principles of Evolutionary Biology

- Neo-Darwinism (Synthetic Theory of Evolution).
- Genetic variation: Sources of variation in natural populations (mutation, recombination, migration, etc.).
- Types of Natural Selection: Stabilising, Directional, and Disruptive.
- Hardy-Weinberg Principle: Gene and genotype frequency; conditions and significance.
- Factors influencing Hardy-Weinberg equilibrium (mutation, migration, selection, genetic drift (Bottleneck phenomenon, Founder effect), non-random mating.

(This unit deals with modern evolutionary mechanisms and population genetics.)

Unit III: Speciation and Isolation Mechanisms

- Isolating mechanisms: Types and importance of reproductive isolation.
- Modes of Speciation: Allopatric, Sympatric, and Parapatric.
- Adaptive radiation with reference to placental mammals.
- Brief case studies/examples of speciation with reference to resource partitioning (e.g.– Darwin's finches, cichlid fishes).

(This unit helps to understand how new species arise and maintain distinct identities.)

Unit IV: Chronobiology and Ethology

- Origin and History of Ethology: Contributions of Karl von Frisch, Ivan Pavlov, Konrad Lorenz, Niko Tinbergen.
- Concepts of proximate and ultimate behaviour.
- Basics of Animal Behaviour: Innate vs. Learned behaviour (characteristics, differences, classifications, examples).
- Animal Communication: Role of pheromones in territory marking, courtship, and mating; Concept of Allelochemicals: Allomone, Kairomone, Synomone, Apneumone
- Biological Rhythms: Circadian, Tidal, and Lunar rhythms.
- Concept of Biological clock and its regulation.

(This unit links evolution with behaviour and biological timing.)

3rd Year, Semester - 5

Paper — ZL 502C (Theory)

Adaptation and Zoogeography

Total Marks: 60 (IA = 24 + ESE = 36) Credit = 02

Unit I: Adaptations – General Concepts

- Concept of adaptation in animals: Pre-adaptation, Post-adaptation, Primary adaptation, secondary adaptation, Homology, Analogy.
- Convergent and divergent adaptations (with examples).
- Adaptive radiation in placental mammals with special reference to teeth and limbs.
- Significance of adaptations in evolution and survival.

(This unit introduces to adaptation concepts and evolutionary patterns.)

Unit II: Adaptive Features in Selected Animals

- Adaptive features of Camel (desert adaptation – morphological, anatomical, and physiological).
- Adaptive features of Whale (aquatic adaptation – streamlining, blubber, physiological mechanisms).
- Adaptive features of Pigeon (aerial adaptation – wings, hollow bones, respiratory efficiency).
- Comparative approach: desert, aquatic, and aerial adaptations.
- Adaptive features of Hoolock Gibbon, *Chameleo* (Arboreal adaptation- morphological, anatomical, physiological)

(Knowledge of concrete examples of adaptation in familiar animals)

Unit III: Adaptation in Colouration and Mimicry

- Colouration in animals: Cryptic (camouflage) and Warning (aposematic) colouration.
- Mimicry in animals:
    - Protective mimicry
    - Aggressive mimicry
    - Warning mimicry
    - Batesian and Müllerian mimicry (with examples).
- Ecological and evolutionary significance of colouration and mimicry.

(This unit connects adaptations with ecology and survival strategies.)

Unit IV: Zoogeography

- Zoogeography: Definition and importance with special reference to Continental Drift Theory.
- Discontinuous distribution of animals with examples.
- Wallace's Line and Weber's Line – significance in biogeography.
- Zoogeographical realms of the world:
    - Geographical boundaries
    - Climate characteristics
    - Major faunal composition of each realm (with examples).
- Brief note on the relevance of zoogeography in biodiversity and conservation.

(This unit gives a global picture and knowledge for applied zoology, biodiversity, and ecology.)

5th Sem PRACTICAL -1
Paper Code: ZL502C (Practical)
Total Marks: 40 (IA = 16 + ESE = 24) Credit = 02

• Problems from Hardy-Weinberg equilibrium (gene and Genotype frequency)
• Adaptive features: *Fasciola, Physalia, Hemidactylus*, *Exocoetus*, *Rhacophorus*/ *Hyla, Chameleo, Columba,*
Chiroptera.
• Placement of faunal groups in respective Zoogeographical realms (map pointing)
• Study of Skull and limb bone of Class — Amphibia, Reptiles, Aves and Mammals

3rd Year, Semester-5

Paper - 503C

ECOLOGY

(100 Marks— IA = 40 + ESE = 60) Credit -4

Unit I: Ecological Foundations

- Concepts of Autecology and Synecology with examples
- Ecosystem: Definition, structure, and components.
- Levels of ecological organization, concept of organism, population, community, ecosystem, biome, biosphere
- Laws of limiting factors, Liebig's law of minimum, Shelford's law of tolerance, Ecotype, Ecad, Guilds
- Concepts of habitat and niche including types of niches.

(This unit provides the basic building blocks of ecology.)

Unit II: Ecosystem Structure and Function

- Food chain (Grazing, Detritus) and Food web, Top-down and Bottom-up control
- Ecological pyramids: Numbers, Biomass, Energy
- Energy flow in ecosystems, Lindeman's law, Law of Thermodynamics (First and Second), Ecological efficiencies
- Population Ecology:
    - Density, Natality, Mortality, Age distribution, Dispersion, Dispersal
    - Survivorship curves.
    - Population growth curves (exponential and logistic).
    - r- and k-selection

(This unit explains how energy and populations function within ecosystems.)

Unit III: Community Ecology and Succession

- Community characteristics: species diversity, abundance, dominance, richness, Shannon-Wiener index, Simpson index
- Stratification in communities (forest and lake examples).
- Ecotone and edge effect.
- Ecological succession: types (primary, secondary, autogenic, allogenic) and examples

- Process of succession (Terrestrial, Aquatic) with examples, concept and types of Climax.

(This unit shifts from individual/population level to community-level processes.)

Unit IV: Applied Ecology and Conservation

- Biodiversity: types and levels.
- Biodiversity hotspots, Keystone species, Umbrella species, Flagship species with examples.
- Wildlife conservation strategies: in situ and ex situ.
- Protected areas with special reference to Tripura.
- Red Data Book, Indian Wildlife Protection Act & Schedules.
- Threats and conservation strategies for selected species:
    - Indian Tiger, Phayre's Leaf Monkey, Indian Bison, Green Imperial Pigeon.

(This unit links ecology to real-world conservation)

3rd Year, Semester - 5

Paper - ZL504C (Theory)

PARASITOLOGY & BASIC MICROBIOLOGY

60 Marks - (IA = 24 + ESE = 36) Credit 02

Unit I: Host–Parasite Relationships

- Concepts of parasitism (monogenic, digenic, parasitoidism, super-parasitism, multiple-parasitism, hyper-parasitism) with examples, host–parasite interactions.
- Helminthic parasites:
    - *Taenia* (tapeworm).
    - *Ascaris* (roundworm).
- General impact of parasites on hosts.

(This unit builds the foundation of parasitology.)

Unit II: Protozoan Parasites and Human Diseases

- Life cycle, pathogenicity, and prophylaxis of:
    - *Plasmodium* (Malaria)
    - *Entamoeba* (Amoebiasis)
    - *Giardia* (Giardiasis)
    - *Wuchereria* (Filariasis)
- Importance of prophylactic measures in public health.

  (This unit covers medically important parasites relevant to students' daily life and healthcare.)

Unit III: Basics of Microbiology

- Basics of microbial cell structure (Virus, Bacteria, *Mycoplasma*, Yeast and Mould)
- Classification of microbes based on:
    - Oxygen requirement (aerobes, anaerobes).
    - pH tolerance.
    - Staining properties (Gram-positive, Gram-negative, acid-fast).
- Microbes in animal guts:
    - Collembola.
    - Earthworm.
    - Ruminants.

(This unit explains microbial diversity and ecological roles.)

Unit IV: Applied Microbiology

- Concepts of Prebiotic, Probiotic, and Symbiotic interactions.
- Beneficial roles of microbes in:
    - Human health (gut flora, probiotics).
    - Animal welfare.
    - Agriculture and biotechnology (if desired, can add simple examples like nitrogen fixation, fermentation).

(This unit links microbiology to applied aspects)

3rd Year, Semester - 5

Paper - ZL504C (Practical)

Total Marks: 40 (IA = 16 + ESE = 24) Credit = 02

• Estimation of population density (i) Quadrate method (ii) Capture recapture method
• Identification and ecological role of the following: *Collembola*, Mite, *Daphnia, Cyclops, Cypris*
(Slides)
• Isolation of bacteria by serial dilution method / Gram staining.
• Identification and observation of gut parasite of cockroach / fish/ fowl

Books (5th Semester)

Evolutionary Biology, Chronobiology, Adaptation & Zoogeography

1. Evolution – Douglas J. Futuyma (Sinauer Associates / Oxford University Press)
2. Evolutionary Biology – Scott Freeman & Jon C. Herron (Pearson publishers)
3. Evolution – M.K. Agarwal (S. Chand & Company – Publisher)
4. Zoogeography and Animal Distribution – Darlington P.J. (Foreign, Wiley)

Adaptation & Zoogeography

5. Zoogeography: The Geographical Distribution of Animals – Darlington, P.J. (Wiley Publication)
6. Animal Adaptation and Distribution – Allee, W.C. & Schmidt, K.P. (University of Chicago Press)
7. Ecology and Zoogeography – M.S. Mani (McGraw Hill / Today & Tomorrow's Printers) (Indian; Rastogi Publications).
8. Biogeography: An Ecological and Evolutionary Approach – C. Barry Cox, Peter D. Moore, & Richard J. Ladle. (Wiley-Blackwell publisher)

Ecology

9. Ecology: Concepts and Applications – Manuel C. Molles (McGraw Hill publications)
10. Fundamentals of Ecology – Eugene P. Odum & Gary W. Barrett (Brooks Cole / Cengage)
11. Ecology and Environmental Biology – P.D. Sharma (Rastogi Publications)

Parasitology & Microbiology

12. Parasitology: Protozoan and Helminthic Infections – K.D. Chatterjee (CBS Publishers)
13. Foundations of Parasitology – Gerald D. Schmidt & Larry S. Roberts (McGraw Hill publications)
14. Microbiology – Prescott, Harley & Klein) McGraw Hill publications)

DETAILED COURSE CONTENT OF ZOOLOGY – MINOR

(SEMESTER – 1ST - SEMESTER – 5TH)

1st Year
Semester-I
Paper 1A: NON-CHORDATES AND ECONOMIC ZOOLOGY
Paper Code: ZL101M
Total Marks: 60 (IA = 24 + ESE = 36) Credit - 03

Non-Chordates

Unit - I

Contribution of National Scientists in Zoology—

Salim Ali, Vishwa Gopal Jhingran, Hiralal Chaudhuri, Gopal Ch Bhattacharya, Ramdeo Mishra, Hargobind Khorana, Lalji Singh, Radha D Kale, M K Chandra Sekheran, C. R. Narayan Rao, M. C. Dash, Valmik Thapar.

Phylum – Protozoa

- Classification up to class
- General Characteristics
- Locomotion in *Amoeba*

Phylum – Parazoa

- Classification up to class
- General characteristics
- Canal system of *Sycon*

Phylum – Metazoa

- Classification up to class
- General characteristics
- Trimorphism & metagenesis of *Obelia*

Unit - II

Phylum – Platyhelminthes

- Classification up to class
- General characteristics
- Life cycle of *Fasciola hepatica*

Phylum – Nemathelminthes

- Classification up to class
- General characteristics
- Life cycle of *Ascaris*

Phylum – Annelida

- Classification up to class
- General characteristics
- Digestive system of Earthworm

Unit - III

Phylum – Arthropoda

- Classification up to class
- General characteristics
- Digestive system of *Periplaneta*

Phylum – Mollusca

- Classification up to class
- General characteristics
- Respiratory system in *Pila*

Phylum – Echinodermata
• Classification up to class
• General characteristics
•Water vascular system in *Asterias*

Phylum – Hemichordata
• Classification up to class
• General characteristics of Hemichordata

Unit – IV - ECONOMIC ZOOLOGY

Vermiculture & Vermicomposting
•. Principle of vermicomposting, different ecological categories of earthworm (Epigeic, Endogeic, Anesic), importance of vermicomposting, vermitechnology & management.

Sericulture
• Principle, different types of silk moth and their host plants, rearing methods, diseases of silk moth . Management with special reference to local varieties

Apiculture
• Principle, different types of honey bees, rearing methods, diseases of honey bees. Management with special reference to local varieties

Fresh water pisciculture
• Polyculture
• Induced breeding technology
• Fish seed transportation, fish diseases,
• Management

Poultry
• Types of breeds
• Methods of rearing
• Health, diseases and their management

Basics of Dairy farming and management.

Paper 1B: PRACTICAL - 1
Paper Code: ZL101M
Total Marks: 40 (IA = 16 + ESE = 24) Credit - 01

PRACTICAL – I

1. Identification, Systematic position, and Specimen Characters
   Paramoecium, Scypha, Obelia, Physalia, Taenia, Ascaris, Metaphire, , Hirudinaria, Periplaneta, Pila, Octopus, Asterias,
2. Dissection and display of digestivesystems of *Periplaneta*
3. Mouth parts of *Periplaneta*
4. Spot identification and economic importance of—- *Perionyx, Apis* sp, *Bombyx* and some major Carps (Rohu, Catla, Mrigal).

Semester-II
Paper 2A: CHORDATES AND CELL BIOLOGY
Paper Code: ZL201M
Total Marks: 60 (IA = 24 + ESE = 36) Credit - 03

Chordates

Unit - I

Protochordata
- General characteristics of Cephalochordata with special reference to ciliary mode of feeding in *Branchiostoma/Amphioxus*.
- General characteristics of Urochordata with special reference to retrogressive metamorphosis in *Ascidia*

Cyclostomata
- General characteristics of Cyclostomata
- Differences between *Petromyzon* and *Myxine*

Pisces
- General Characteristics of Chondrichthyes & Osteichthyes
- Accessory respiratory organs in fishes

Unit - II

Amphibia
- General characteristics and classification upto order
- Parental care in Amphibia

Reptilia
- General characteristics and classification upto order
- Differences between venomous and non-venomous snakes

Unit - III

Aves
- General characteristics and classification upto order
- Double mode of respiration

Mammals
- General characteristics and classification upto order
- Digestive system of ruminant and non-ruminant

Unit – IV - CELL BIOLOGY

1. Structure and function of—-
   - Plasma membrane
   - Nucleus
   - Mitochondria
   - Golgi bodies
   - Ribosomes
   - Endoplasmic reticulum
   - Lysosomes
2. Cell cycle and regulations
3. Cell divisions
4. Cancer cell and its characters

Paper 2B: PRACTICAL -II
Paper Code: ZL201M
Total Marks: 40 (IA = 16 + ESE = 24) Credit - 01

PRACTICAL – II

1. Identification, systematic position, and specimen characters —*Branchiostoma, Ascidia, Petromyzon, Scoliodon, Channa, Rohu, Hyla, Naja, Columba, Chiroptera.*
2. Dissection and display of digestive system *Cirrhinus mrigala/Channa sp.*
3. Study of Mitotic cell division stages
5. Study of meiotic cell division stages (permanent slide).

2nd Year
Semester-III
Paper 3A: GENETICS & DEVELOPMENTAL BIOLOGY
Paper Code: ZL301M
Total Marks: 60 (IA = 24 + ESE = 36) Credit - 03

Genetics

Unit - I

- Mendelian Inheritance
- Genetic Interaction
- DNA as a genetic material

Unit - II

- Concept of alleles and multiple alleles (ABO Blood grouping)
- Crossing over and recombination
- Sex determination in *Drosophila* (Genic balance theory) and human; Barr body.

Unit - III

- Chromosomal abnormalities and different syndromes in human - Turner's syndrome, Klinefelter's syndrome, Down syndrome
- Autosomal and Sex-linked inheritance: Autosomal- Albinism and Thalassemia.
- Sex-linked inheritance- Colour blindness and Haemophilia
- Mutation: Types of mutation, mutagens
- Cytoplasmic inheritance

Unit – IV-DEVELOPMENTAL BIOLOGY

- Gametogenesis and ultrastructure of spermatozoa and ova.
- Fertilization
- Cleavage and Gastrulation in chick embryo
- Extra-embryonic membrane formation and function in chick embryo
- Placenta: types and function.

Paper 3B: PRACTICAL - III
Paper Code: ZL201M
Total Marks: 40 (IA = 16 + ESE = 24) Credit - 01

- Karyotyping in human (charts)
- Identification (with reasons) of male and female Drosophila (microphotographs)
- Identification of chick embryo with reason (during different incubation period): 24 hours, 48hours,72 hours.

Semester-IV
Paper 4A: ANIMAL PHYSIOLOGY, ENDOCRINOLOGY, AND REPRODUCTIVE BIOLOGY
Paper Code: ZL401M
Total Marks: 60 (IA = 24 + ESE = 36) Credit - 03

ANIMAL PHYSIOLOGY

Unit – I
- Extracellular and intracellular digestions
- Transport of oxygen and carbon dioxide in mammals (Bohr effect and Chloride shift)
- Concept of Isotonic, Hypotonic and Hypertonic solution, Osmoregulation in fresh and marine water fishes

Unit - II
- Mechanism of nitrogen excretion in vertebrates
- Mechanism of Urine formation in mammals
- Generation of action potential in neurone, Synapse and synaptic transmission

ENDOCRINOLOGY AND REPRODUCTIVE BIOLOGY

Unit - III
- Introduction to Endocrinology and Endocrine glands
- Histological structure and functions of:
    - Pituitary gland,
    - Thyroid gland,
    - Pancreas,
    - Adrenal gland,
    - Testis and ovary

Unit - IV
- Types of hormones and their functions in vertebrates
- Endocrine disorder in human with special reference to Pituitary and Thyroid glands
- Role of hormones in the regulation of —- spermatogenesis, oogenesis
- Oestrus cycle in rat

Paper 4B: PRACTICAL - IV
Paper Code: ZL402M
Total Marks: 40 (IA = 16 + ESE = 24) Credit - 01

Practical – IV

- Study of Haemin crystal formation from human blood
- Study of salivary amylase activity using starch solution
- Identification of permanent slides with reasons of the transverse section of the mammalian Pituitary, Thyroid gland, Adrenal gland, Pancreas, Ovary, and Testis.

3RD Year
Semester - V
Paper 5A: EVOLUTIONARY BIOLOGY, ADAPTATION & ZOOGEOGRAPHY
Paper Code: ZL501M
Total Marks: 60 (IA = 24 + ESE = 36) Credit - 03

Unit I: Origin and Evidence of Evolution

- Origin of Life: Chemical basis, abiotic synthesis of biomolecules (Miller–Urey Experiment).
- Protocells or Coacervates.
- Evolution of horse as an example of macroevolution.

(Foundation unit – introduces how life began and how evolutionary evidence is traced.)

Unit II: Modern Evolutionary Theories

- Neo-Darwinism (Synthetic Theory of Evolution).
- Genetic variation: mutation, recombination, gene flow, genetic drift.
- Types of Natural Selection: Stabilising, Directional, and Disruptive.
- Adaptive radiation in Placental mammals with special reference to limbs.

(Focuses on mechanisms driving evolution at the genetic and population levels.)

Unit III: Speciation and Isolation Mechanisms

- Isolating mechanisms and importance of reproductive isolation.
- Modes of speciation: Sympatric, Allopatric, Parapatric.
- Adaptive radiation with special reference to limbs of placental mammals

(Explains how new species arise and the role of reproductive barriers.)

Unit IV: Adaptation and Zoogeography

- Adaptive features of Camel (desert), Whale (aquatic), and Pigeon (aerial) – morphological, anatomical, physiological.
- Colouration: Cryptic and Warning.
- Mimicry: Protective, Aggressive, and Warning (Batesian & Müllerian).
- Zoogeographical realms of the world – geographical boundaries, climate, and faunal composition.

(Applied part – connects evolution with adaptations, distribution, and survival.)

3rd Year – Semester V

Paper Code: ZL501M (Practical)

Total Marks: 40 (IA = 16 + ESE = 24) Credit - 01

- Adaptive features: *Fasciola, Physalia, Hemidactylus, Exocoetus,* tree frog, *Chameleon, Columba, Chiroptera.*
- Placement of faunal groups in respective Zoogeographical realms (map pointing)
- Study of Skull and limb bone of Class — Amphibia, Reptiles, Aves and Mammals

DETAILED COURSE CONTENT OF ZOOLOGY (INTERDISCIPLINARY)

Interdisciplinary Course
[FUNDAMENTAL ZOOLOGY]

1st Year

Semester – I

Paper – 1 (Theory)

ZL101-ID: Animal Diversity

Marks: 100 (IA = 40 + ESE = 60)

Unit I (Non-chordates)
Protozoa, Porifera, Cnidaria, Helminths

Phylum characters of **Protozoa, Porifera, Cnidaria, Helminths**

- Locomotory organelles in Protozoa
- Canal system in Porifera
- Polymorphism and metagenesis in Obelia
- Adaptive features of *Ascaris* and *Fasciola*

Unit II (Non-chordates)
Annelida, Arthropoda, Mollusca, Echinodermata

Phylum characters of Annelida, Arthropoda, Mollusca, Echinodermata. -Digestive and Circulatory system in Cockroach
- Excretory system in Earthworm
Torsion and Respiratory system in *Pila*

Larva and Water Vascular system in Echinodermata

Unit III (Chordates)
Hemichordates, Cephalochordates, Urochordates
- Basic chordate characters, characters of Hemichordates, Cephalochordates, Urochordates .
- Retrogressive metamorphosis in Ascidia

Unit IV (Chordates - Vertebrates)
Cyclostomes, Pisces, Amphibia, Reptilia, Aves, Mammalia

Class characters of Cyclostomes, Pisces, Amphibia, Reptilia, Aves, Mammalia.
- Differences between Petromyzon and Myxine
- Chondrichthyes and Osteichthyes

Accessory respiratory organs
- Heart of Amphibia and Reptiles
- Poisonous and Non-poisonous snakes
- Exoskeletal structure and Flight adaptation in Aves
- Adaptation in Chiroptera, Camel, and Whale

Books Recommended:

- Invertebrates – L.H. Hyman
- Biology of Animals Vol-I by Ganguly, Sinha & Adhikari, New Central Book Agency, Kolkata
- Modern Text Book of Zoology: Invertebrates by R.L. Kotpal, Rastogi Publications
- Invertebrate Zoology by E.L. Jordan & P.S. Verma, S. Chand & Company Ltd.
- Biology of Animals Vol-II by Ganguly, Sinha & Adhikari, New Central Book Agency, Kolkata
- Modern Text Book of Zoology: Vertebrates by R.L. Kotpal, Rastogi Publications
- Vertebrate Zoology by E.L. Jordan & P.S. Verma, S. Chand & Company Ltd.

Interdisciplinary Course (Fundamental Zoology)

Semester – III

Paper – 2 (Theory)

ZL301-ID: Applied Zoology

Marks: 100 (IA=40 + ESE= 60) Credit 03

Vermiculture & Vermicomposting
Principle of vermicomposting, different ecological categories of earthworm (Epigeic, Endogeic, Anesic), importance of vermicomposting, vermitechnology & management.

Sericulture
Principle, different types of silk moth and their host plants, rearing methods, diseases of silk moth. Management with special reference to local varieties

Apiculture
Principle, different types of honey bees, rearing methods, diseases of honey bees. Management with special reference to local varieties

Fresh water pisciculture
Polyculture
Induced breeding technology
Fish seed transportation, fish diseases,
Management

Poultry
Types of breeds
Methods of rearing
Health, diseases, and their management

Basics of Dairy farming and management

Books Recommended:

- Economic Zoology by Shukla and Upadhyay
- Text Book of Applied Zoology: Vermiculture, Apiculture, Sericulture, Lac Culture. By Jabde, P.V.,
- Applied Zoology by T.K.Banerjee, New Central Book Agency, Kolkata
- A Hand Book of Economic Zoology by J. Ahsan & bS.P.Sinha, S.Chand & Company Ltd.
- Kenchor Jeeban Baichitra O Kencho Prajukti by Priya Sankar Chaudhuri, Gyan Bichitra Prakashani, Agartala.
- Comprehensive Sericulture Vol. II: Silkworm Rearing and Silk Reeling by Ganga, G. Oxford and IBH, New Delhi. (2003)
- Elementary Applied Zoology by Debjyoti Chattopadhyay, Book Syndicate Pvt. Ltd.
- Livestock production management by Shastry and Thomas

Interdisciplinary Course (Fundamental Zoology)

Semester – IV

Paper – 3 (Theory)

ZL401-ID: Genetic Disorders and Pathogenic Diseases

Marks: 100 (IA=40 + ESE= 60) Credit 03

Genetic Disorders

Structure and function of chromosome

ABO Blood groups

Concept on –

Haemophilia, colour-blindness, albinism, thalassemia, sickle cell anaemia, Down's syndrome, Turner's syndrome, Klinefelter's syndrome

Pathogenic Disease

Concept of host and parasite

Life cycle and control measures of –

Plasmodium, Entamoeba, Giardia, Liver fluke, Tape worm, Round worm, and *Ascaris*

Books Recommended:

- Genetics by M. W. Strickberger, Pearson Education India Ltd.
- Principles of Genetics by E. J. Gardner, M. J. Simmons & D.P. Snustad, Wiley Publishers
- Principle of Genetics, B. D. Singh. Kalyani Publications
- Genetics by P. K. Gupta, Rastogi Publications, Meerut
- Genetics by Verma & Agarwal, S. Chand & Company Ltd.
- Parasitology by K.D. Chatterjee,
- Text Book of Medical Parasitology by P. Chakraborty, New Central Book Agency
- Paniker's Text Book of Medical Parasitology by Paniker, C.K.J., Ghosh, S. Jaypee, New Delhi.
- Medical Parasitology by Dey, N.C., Dey, T.K. and Dey Sinha M. New Central Book Agency, Kolkata (2010)