SYLLABUS & PROGRAMME STRUCTURE OF FOUR YEARS UNDERGRADUATE PROGRAMME

ZOOLOGY

(Major)

(Under National Education Policy – 2020)

(Effective from the Academic Session 2023-2024)

MAHARAJA BIR BIKRAM UNIVERSITY
AGARTALA, TRIPURA: 799004

Course Structure of Zoology
(UG Programme) As per NEP-2020

ZOOLOGY MAJOR

Year	Semester	Paper Code	Paper No.	Credits	Marks	Paper Name
1st Year	I	ZL101C	Paper 1 Theory	4	100 IA=40 + ESE= 60	Non-Chordates
		ZL102C	Paper 2A Theory	2	50 IA=20 + ESE=30	Economic Zoology
			Paper 2B Practical	2	50 IA=20 + ESE=30	Based on Theory Paper 1 & 2A
	II	ZL103C	Paper 3 Theory	4	100 IA=40 + ESE= 60	Chordates
		ZL104C	Paper 4A Theory	2	50 IA=20 + ESE=30	Cell Biology
			Paper 4B Practical	2	50 IA=20 + ESE=30	Based on Theory Paper 3 & 4A
2nd Year	III	ZL201C	Paper 5 Theory	4	100 IA=40 + ESE= 60	Genetics
		ZL202C	Paper 6A Theory	2	50 IA=20 + ESE=30	Developmental Biology
			Paper 6B Practical	2	50 IA=20 + ESE=30	Based on Theory Paper 5 & 6A
	IV	ZL203C	Paper 7 Theory	4	100 IA=40 + ESE= 60	Animal Physiology
		ZL204C	Paper 8A Theory	2	50 IA=20 + ESE=30	Endocrinology and Reproductive Biology
			Paper 8B Practical	2	50 IA=20 + ESE=30	Based on Theory Paper 7 & 8A
3rd Year	V	ZL301C	Paper 9 Theory	4	100 IA=40 + ESE= 60	Evolutionary Biology and Chronobiology
		ZL302C	Paper 10A Theory	2	50 IA=20 + ESE=30	Adaptation and Zoogeography

			Paper 10B Practical	2	50 IA=20 + ESE=30	Based on Theory Paper 9 & 10A
		ZL303C	Paper 11 Theory	4	100 IA=40 + ESE= 60	Ecology
		ZL304C	Paper 12A Theory	2	50 IA=20 + ESE=30	Parasitology and Basic Microbiology
			Paper 12B Practical	2	50 IA=20 + ESE=30	Based on Theory Paper 11 & 12A
	VI	ZL305C	Paper 13 Theory	4	100 IA=40 + ESE= 60	Basics of Systematic and Biostatistics
		ZL306C	Paper 14A Theory	2	50 IA=20 + ESE=30	Biochemistry
			Paper 14B Practical	2	50 IA=20 + ESE=30	Based on Theory Paper 13 & 14A
		ZL307C	Paper 15 Theory	4	100 IA=40 + ESE= 60	Molecular Biology
		ZL308C	Paper 16A Theory	2	50 IA=20 + ESE=30	Applied Entomology and Pest Management
			Paper 16B Practical	2	50 IA=20 + ESE=30	Based on Theory Paper 15 & 16A
4th Year	VII	ZL401C	Paper 17 Theory	4	100 IA=40 + ESE= 60	Tools and Methods in Biology
		ZL402C	Paper 18A Theory	2	50 IA=20 + ESE=30	Biophysics
			Paper 18B Practical	2	50 IA=20 + ESE=30	Based on Theory Paper 17 & 18A
		ZL403C	Paper 19 Theory	4	100 IA=40 + ESE= 60	Computational Biology and Biotechnology
		ZL404C	Paper 20A Theory	2	50 IA=20 + ESE=30	Aquaculture
			Paper 20B Practical	2	50 IA=20 + ESE=30	Based on Theory Paper 19 & 20A
	VIII	ZL405C	Paper 21 Theory	4	100 IA=40 + ESE= 60	Microbiology and Immunology
		ZL406C	Paper 22A Theory	2	50 IA=20 + ESE=30	Medical Zoology

			Paper 22B Practical	2	50 IA=20 + ESE=30	Based on Theory Paper 21 & 22A
		ZL407C	Paper 23 Theory	4	100 IA=40 + ESE= 60	Global Environmental Issues and Biodiversity and Conservation
		ZL408C	Paper 24A Theory	2	50 IA=20 + ESE=30	Research Methodology and Animal Ethics and Intellectual property right (IPR)
			Paper 24B Practical	2	50 IA=20 + ESE=30	Based on Theory Paper 23 & 24A

DETAILED COURSE CONTENT OF ZOOLOGY (MAJOR)

1st Year

Semester-I

Paper 1: NON-CHORDATES

Paper Code: ZL101C

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

(Credits – 04) 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.

NON-CHORDATES

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

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

(iii) Metazoa
• General characteristics and classification of Cnidaria upto classes
• Trimorphism& metagenesis of *Obelia*

(iv) Platyhelminthes
•General characteristics and classification upto classes
•Life cycle of *Fasciola hepatica*

(v) Nemathelminthes
• General characteristics and classification upto classes
• Life cycle of *Ascaris*

(vi) Annelida
• General characteristics and classification upto classes
• Digestive & excretory system of Earthworm

(vii) Arthropoda
• General characteristics and classification upto classes
• Digestive system of *Periplaneta*
• Circulation in *Periplaneta*

(viii) Mollusca
• General characteristics and classification upto classes
• Respiratory system in *Pila*
•Nervous system in *Pila*

(ix) Echinodermata
• General characteristics and classification upto classes
•Water vascular system in *Asterias*
• Basic larval form and evolutionary significance

(x) Hemichordata
• General characteristics of Hemichordata

Paper 2A: Economic Zoology
Paper Code: ZL102C
Total Marks: 50(IA = 20 + ESE = 30) Credit = 02

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

(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

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

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

(v) Poultry
• Types of breeds
• Methods of rearing
• Diseases and their management

(vi) Basics of Dairy farming and management.

Paper 2B: Practical(I)
Paper Code: ZL102C
Total Marks: 50(IA = 20 + ESE = 30) 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: ZL103C
Total Marks: 100(IA = 40 + ESE = 60) Credit = 04

(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*

(ii)Cyclostomata
- General characteristics of Cyclostomata
- Differences between *Petromyzon* and *Myxine*

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

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

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

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

(vii) 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: ZL104C
Total Marks: 50(IA = 20 + ESE = 30) Credit = 02

1. Basic concept of Prokaryotic and Eukaryotic cells
2. Structure and function of-
   - Plasma membrane
   - Nucleus
   - Mitochondria
   - Golgi bodies
   - Ribosomes
   - Endoplasmic reticulum
   - Lysosomes
   - Chromosome
   - Nucleic acid

3. Cell cycle and regulations
4. Cell divisions – Mitosis and Meiosis
5. Cancer biology — Characteristics of cancer cells, development of cancer, types of cancer, types of carcinogens.

Paper 4B: Practical (II)
Paper Code: ZL104C
Total Marks: 50(IA = 20 + ESE = 30) 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: ZL201

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

- DNA as a genetic material
- Concept of alleles and multiple alleles (ABO Blood grouping)
- Crossing over and recombination, gene mapping (three-point test cross)
- Gene interaction
- Sex determination in *Drosophila* (Geneic balance theory) and human; Barr body.
- 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
- 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: ZL202C

Total Marks: 50(IA = 20 + ESE = 30) Credit = 02

• Gametogenesis and ultrastructure of spermatozoa and ova
• Cleavage, Blastulation, and Gastrulation in chick embryo, fate map
• Extra-embryonic membrane formation and function in chick embryo
• Embryonic induction, Organizer concept and Formation of eye in chick embryo
• Placenta: types and function.
• Formation of the placenta in rabbit

Paper 6B: PRACTICAL(III)

Paper Code: ZL202C

Total Marks: 50(IA = 20 + ESE = 30) 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 embryowith reason (during different incubation period): 16-18 hours, 21- 24 hours, 48hours,72 hours.

2nd Year

Semester-IV

Paper 7: ANIMAL PHYSIOLOGY

Paper Code: ZL203C

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

- Extracellular and intracellular digestions
- Transport of oxygen and carbon dioxide in mammals (Bohr effect and Chloride shift)
- Thermoregulation in Ectotherms and Endotherms, role of hypothalamus in temperature regulation with regard to Endotherms
- 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
- Generation of action potential in neurone, Synapse and synaptic transmission
- Ketogenesis and its regulation
- Catabolism of amino acids: Transamination and Deamination
- Urea-Ornithine cycle and its significance

Paper 8A: ENDOCRINOLOGY AND REPRODUCTIVEBIOLOGY

Paper Code: ZL204C

Total Marks: 50(IA = 20 + ESE = 30) Credit = 02

- Histological structure and functions of: Pituitary gland, Thyroid gland, Pancreas, Adrenal gland, Testis and ovary
- Types of hormones and their functions in vertebrates and invertebrates (in insects)
- Endocrine disorder in human with special reference to Pituitary and Thyroid glands
- Role of hormones in regulation of —- spermatogenesis, oogenesis and menstrual cycle
- Oestrus cycle in rat

Paper 8B: PRACTICAL (IV)

Paper Code: ZL204C

Total Marks: 50(IA = 20 + ESE = 30) 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

3rdYear

Semester-V

Paper 9: EVOLUTIONARY BIOLOGY ANDCHRONOBIOLOGY

Paper Code: ZL301C

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

- Origin of Life (Chemical basis): Experimental evidence in favour of abiotic synthesis of basic biomolecules (Miller & Urey Experiment), Protocell or Coacervates.
- Basic idea of Geological Time Scale with major examples of Fauna,
- Fossil— types and age determination by Carbon dating,
- Evolution of horse,
- Neo-Darwinism (Synthetic Theory), Genetic variation and sources of variation in natural populations
- Types of natural Selection: Stabilising, Directional and Disruptive
- Hardy Weinberg Principle and Factors influencing the changes in the gene frequency and genotype frequency
- Isolating mechanisms and importance of Reproductive Isolation
- Mode of Speciation: Sympatric, Allopatric and Parapatric
- Origin and History of Ethology: Brief profile of Karl Von Frisch, Ivan Pavlov, Konrad Lorenz, Niko Tinbergen.
- Proximate and ultimate behavior
- Basics of animal behaviours — Innate and Learning behavior, (Characteristics, differences, classifications and examples)
- Communication in animals with reference to pheromones and its role in territory marking, courtship and mating behavior
- Circadian rhythm, Tidal rhythm, Lunar rhythm, Biological clock

Paper 10A: Adaptation and Zoogeography

Paper Code: ZL302C

Total Marks: 50(IA = 20 + ESE = 30) Credit = 02

- Convergent and divergent adaptation and adaptive radiation in Placental mammals with reference to teeth and limbs
- Adaptive features of Camel, Whale and Pigeon (Morphological, anatomical and Physiological)
- Colouration: Cryptic and Warning
- Mimicry: Protective, Aggressive and Warning (Batesian and Mullerian)
- Discontinuous distribution of Animals, Wallace line, Weber's line.
- Zoogeographical realms of the world— Geographical boundary, Climate and Faunal composition

Paper 10B: PRACTICAL (V)

Paper Code: ZL302C

Total Marks: 50(IA = 20 + ESE = 30) Credit = 02

- Problems from Hardy-Weinberg equilibrium (gene and Genotype frequency)
- 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.

Paper 11: ECOLOGY
Paper Code: ZL-303C
Total Marks: 100(IA = 40 + ESE = 60) Credit = 04

- Autecology and synecology, Levels of organization, Laws of limiting factors.
- Ecosystem: Definition, food chain, food web, ecological pyramids, energy flow in ecosystems
- Basic concepts of habitat, niche, and types of niches
- Population ecology— Natality, Mortality, Survivorship curves, Population growth curves, r and K strategies.
- Community Ecology — species diversity, abundance, dominance, richness, stratification (Forest/ lake), Ecotone and edge effect; Ecological succession types and example.
- Applied ecology: Types & level of biodiversity, Definition with example of ——: Biodiversity Hot spots, Keystone species, Wildlife Conservation (in situ and ex situ conservation), concept of protected areas with special reference to Tripura,
- Red data book, Indian wild life act & Schedule.
- Common threats and conservation strategies for Indian Tiger, Phayre's leaf monkey, Indian Bison, Green Imperial Pigeon.

Paper 12A: PARASITOLOGY AND BASIC MICROBIOLOGY
Paper Code: ZL-304C
Total Marks: 50(IA = 20 + ESE = 30) Credit = 02

- Host Parasite interactions with reference to helminthic parasites (*Taenia, Ascaris)*
- Lifecycle, Pathogenicity and Prophylaxis of- *Plasmodium, Entamoeba, Giardia.*
- Classification of microbes with reference to the requirement of oxygen, pH and staining.
- Microbes in animal gut of Collembola, Earthworm,Ruminantsand their biological significance,
- Concept of Prebiotic, Probiotic and Symbiotic.
- Microbes in human and animal welfare.

Paper 12B: PRACTICAL (VI)
Paper Code: ZL304C
Total Marks: 50(IA = 20 + ESE = 30) 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 and Gram staining.
- Identification and observation of gut parasite of cockroach / fish/ fowl.

3rd Year

Semester - VI

Paper 13: BASICS OF SYSTEMATICS ANDBIOSTATISTICS

Paper Code: ZL305C

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

- Preliminary knowledge of Systematics and Taxonomy: definition, Classification, Phenon, Taxon, Category, Sibling species, polytypic species, cline, super species, sub species, Binomial and Trinomial nomenclature.
- ICZN: rules of zoological nomenclature, Principle of priority; Synonymy and Homonymy
- Concept of classification – three kingdom concept of Carl Woese, 1977 and five kingdom concept of Whittaker, 1969
- Species Concept: Typological, Nominalistic, Biological and Evolutionary
- Population and sampling: Method of collection of data, Frequency distribution and graphical presentation of data.
- Data tabulation and classification:(i) Bar diagram (ii) histogram (iii) Frequency Polygon (iv) Line Graph (v) Pie Chart
- Measures of central Tendency: Mean, median, mode and related numerical
- Measures of dispersion :— (i) Range (ii) quartile deviation(iii) Mean Deviation(iv) Standard deviation (v) Coefficient of Variation
- Probability and distribution: —- Elementary concepts of probability: addition and multiplication law and related numerical.
- Concept of sampling distribution and Standard error, Chi-square (both Mendelian & Non-Mendelian tests),
- t-test (Definition, Properties and numerical)

Paper 14A: BIOCHEMISTRY

Paper Code: ZL-306C

Total Marks: 50(IA = 20 + ESE = 30) Credit = 02

- Concept of pH, buffers and their biological applications
- Biomolecules: Carbohydrates, proteins, lipids and nucleic acids
- Enzymes: General properties, Coenzymes, isoenzymes, ribozymes.
- Mechanisms of enzyme action(Lock and Key and induced feet Theory),
- Enzyme kinetics—- relationship between Km and Vmax
- Factors effecting rate of enzyme catalysed reaction.
- Allosteric enzymes and feedback inhibition
- Glycolysis, Krebs cycle and ETC (including ATP generation)
- Glycogenesis
- Gluconeogenesis
- Citric acid cycle
- Pentose Phosphate Pathway
- β – Oxidation of saturated fatty acids

Paper 14B: PRACTICAL (VII)

Paper Code: ZL306C

Total Marks: 50(IA = 20 + ESE = 30) Credit = 02

- Problems on chi-square and t-test
- Graphical representation of data on Bar diagram, Histogram and Pie chart
- Qualitative identification of Carbohydrate (mono, di and polysaccharides), protein and lipid
- Quantitative estimation of glucose (titrimetric)
- Preparation of buffers and Estimation of pH (pH meter) of biological samples
- Effects of temperature and pH on salivary amylase activity.

Paper 15: MOLECULAR BIOLOGY
Paper Code: ZL307C
Total Marks: 100(IA = 40 + ESE = 60) Credit = 04

- Replication, Transcription and translation in prokaryotes
- Concept of Cistron, Recon and Muton.
- Gene regulation of prokaryotes (Lac and tryptophan operon)
- Recombinant DNA technology(RDT)
- Basic principles: (i)identification of desired DNA (ii) Restriction endonuclease (iii) Cloning vectors (iv)Host cell and transformation (v) Construction of chimeric DNA (vi) mRNA to cDNA Clones with desired DNA
- Genetic basis of Cancer- Definition of Proto-oncogene and viral oncogenes. Transformation of Proto oncogene to oncogene.
- Functional importance of P53 tumour suppressor gene.
- Potential benefits and hazards of RDT

Paper 16A: APPLIED ENTOMOLOGY AND PESTMANAGEMENT
Paper Code: ZL308C
Total Marks: 50(IA = 20 + ESE = 30) Credit = 02

- Insect morphology and anatomy with special reference to mouth parts, digestive and respiratory system.
- Salient features of insect Orders- Lepidoptera, Diptera, Hymenoptera, Coleoptera and Hemiptera.
- Nature of damage, biology and control of *Scirpophagaincertulus* (Paddy pest), *Heliothisarmigera*(Sugarcane pest), *Callosobruchus*sp (Pulses pest), *Aulacophora* sp. (Pumpkin pest), *Leucinodesarbonalis*(Brinjal pest), *Sternochetusmangiferae* (Mango store weevil).
- Nature of damage, biology and control of store grain pests- *Sitophilus*sp, *Tribolium*sp, *Rhyzopertha*sp and *Trogodermagranarium*
- Pollinators- Definition, insect pollinating agents and their mode of pollination, importance of pollinators.
- Lac Culture: Systematic position, Life Cycle, Economic importance, pest and enemies of lac insects and their control.
- Definition of pest, Types of pests
- Methods of pest control- Chemical control, Biological Control and Integrated Pest Management (IPM)
- Studies of different types of insecticides with references to mode of action and examples of the following- Organophosphates, Carbamates and herbal pesticides
- Contact & systemic pesticides: application and their hazards

Paper 16B: PRACTICAL (VIII)
Paper Code: ZL308C
Total Marks: 50(IA = 20 + ESE = 30) Credit = 02

- Identification and economic importance of - *Scirpophagaincertulus* (Paddy pest), *Sitophilus*sp, *Tribolium*sp, *Callosobruchus*sp (Pulses pest), Prawns, *Rotifer, Cyclops,Daphnia*(Specimens/Slides/Microphotographs)
- Submission of insect pests (at least five number) with their Scientific name, Order, Place of collection, name of host plant, date of collection
- Isolation and quantification of genomic DNA/ Blue and white colony selection method (photographs)
- Identification of cancer cell.

4th Year

Semester - VII

Paper 17: TOOLS AND METHODS IN BIOLOGY

Paper Code: ZL401C

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

- Microscopy: Basics of Bright field, Dark field, Phase Contrast, Fluorescence microscopy, Transmission and Scanning Electron microscopy
- Centrifugation: Principle, types and uses
- Spectrophotometry: Principle, types and uses
- Principle of pH meter
- Chromatography: Principle, types- Paper Chromatography, Gel filtration, Ion exchange and Affinity chromatography and their uses
- Electrophoresis: Principle, Agarose and polyacrylamide gel electrophoresis
- Principle of X ray diffraction and its uses in biology
- Microtechniques:
  a) Principle of Microtomy
  b) Fixatives, types and principle of fixation
  c) Principle of Dehydration and procedure
  d) Embedding of tissue- procedure
  e) Block making-procedure
  f) Stains, different types principle of staining
  g) Method of double staining

Paper 18A: BIOPHYSICS

Paper Code: ZL402C

Total Marks: 50(IA = 20 + ESE = 30) Credit = 02

- Concept of Free energy, Enthalpy and Entropy.
- Laws of Thermodynamics and its significance in biology
- Colloids and crystalloids- Properties and their biological importance
- Membrane Biophysics- biophysical nature of cell membrane, ion channels, active and passive transports.
- Proton motive force and transport of ATP
- Couplers and un couplers of ATP synthesis

Paper 18B: PRACTICAL (IX)

Paper Code: ZL402C

Total Marks: 50(IA = 20 + ESE = 30) Credit = 02

- Double staining and identification of histological slides- Mammalian Liver, Testis, Kidney
- Paper chromatography (from leaf extract / amino acid)
- Analysis of genome DNA of various animals (cattle, fish) using BLAST
- Studies of simple and compound microscope
- Studies of stereomicroscope
- Studies of microtome

Paper 19: COMPUTATIONAL BIOLOGY AND BIOTECHNOLOGY
Paper Code: ZL403C
Total Marks: 100(IA = 40 + ESE = 60) Credit = 04

- Computational Biology: Definition, application in the field of Genomics, proteomics, bio modelling/ bimolecular designing and evolutionary biology.
- Data base management & Bioinformatics: Use of software, packages and tools: Basic features and management systems of following databases: Nucleic acid sequences databases, Genome databases, Protein sequence, structures and interacting proteins databases, Biodiversity and ecosystem-based databases.
- Introduction to data retrieval systems: Search engines, sequence retrieval system (SRS) and protein identification resource (PIR). Introduction to molecular sequence analysis software packages and tools: Prediction of motifs, folds and domains, Sequence alignments (BLAST and Clustal W) and phylogenetic trees, NCBI.
- Biotechnology: Concept and scopes
- Cloning of- Vectors, Phasmids, Cosmids, Lambda phage, BAC, YAC
- Restriction enzymes: Nomenclature and functions
- Construction of Genomic and C-DNA Library
- Southern, Northern and Western blotting techniques- Principles, technique and importance
- DNA Sequencing (Sanger Method)
- PCR and DNA Fingerprinting – Principle, technique and importance
- Production of cloned and Transgenic animals
- Use of Recombinant DNA Technology in medicine- Insulin and Growth Hormone production

Paper 20A: AQUACULTURE
Paper Code: ZL404C
Total Marks: 50(IA = 20 + ESE = 30) Credit = 02

- Aquaculture: Principles and Practices
- Kinds of aquatic ecosystem- wetland, pond, lake, river.
- Types of aquaculture: Carp culture, Air breeding fish culture, Prawn culture, Pearl oyster culture
- Selection of species for aquaculture
- Captive breeding technology,
- Supplementary diets and its composition
- Water quality monitoring in captive breeding farm etc.

Paper 20B: PRACTICAL (X)
Paper Code: ZL404C
Total Marks: 50(IA = 20 + ESE = 30) Credit = 02

- Analysis of genome DNA of various animals (cattle, fish) using BLAST
- Identification and causes of various inborn errors of metabolism (PKU, G6PD deficiency etc) using CLUSTALW and allied tools.
- Estimation of dissolved oxygen from water by Winkler's Method
- Estimation of CO2 of pond water ecosystem
- Identification of indigenous minor and major carps with reasons
- Identification of exotic carps with reasons

4th Year

Semester - VIII

Paper 21: MICROBIOLOGY AND IMMUNOLOGY

Paper Code: ZL405C

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

- Brief history of microbiology- germ theory of disease,Antoine van Leeuwenhoek, Louis Pasteur, Robert Koch, Alexander Fleming, Anandamohan Chakraborty (Superbug)
- Nutrition and Bacterial growth: Autotroph and Heterotrophs, Microbial growth (Requirement of pH, Oxygen and Temperature) Growth curve and different phases.
- Cultivation of Microorganisms: Serial dilution method, Forms of Media, pour plate, streak plate and spread plate technique
- Sterilisation—: Physical, Chemical methods (With special reference to Hot air oven, Autoclave, Laminar flow etc. Organic Chemicals and Phenols etc.)
- Role of Microbes In human and animal health: Bacterial (Shegellosis and salmonellosis) rickettsial (Spotted & Typhus fever), viral diseases (SARS), Fungal Disease: Ringworm Infection and Candidoisis (With reference to causative agents in human beings and prophylaxis), role of normal microbial flora of human body, antibiotics, concepts of Vaccine and antisera.
- Introduction to Immunology
- Cells and organs of immune system
- Cell mediated and humoral immunity
- Antigenicity and immunogenicity
- Immunogens, Adjuvants and Haptens
- Factors influencing immunogenicity
- B and T Cell epitopes
- Immunoglobulins: Structure and functions of different classes of immunoglobulins
- Antigen –Antibody interactions
- Immunoassays, Monoclonal antibodies, Hybridoma
- Structure and functions of MHC molecules
- Complement pathways and its activation, types of Hypersensitivities
- Vaccination: Types of vaccines, Recombinant Vaccines and DNA Vaccines

Paper 22A: MEDICAL ZOOLOGY

Paper Code: ZL406C

Total Marks: 50(IA = 20 + ESE = 30) Credit = 02

- Systematic position, Geographical distribution, Life cycle, Mode of Transmission, Pathogenicity, Clinical features and Treatment of-
  A. Protozoa: *Plasmodium vivax, Plasmodium falciparum, Entamoeba histolytica, Leishmania donovani*.
  B. Cestoda: *Taenia solium*and *Echinococcus granulosus.*
  C. C.Nematoda: *Wuchereriabancrofti* and *Ancylostomaduodenalies*

• Arthropods of Medico-veterinary importance: General features, Life cycle, Damage and Control measures of-

a) Mosquitoes: *Anopheles* sp., *Culex* sp. and *Aedes* sp., Tsetse flies.
b) House fly (*Musca domestica).*
c) Lice (*Pediculus* sp.)
d) Bedbug (*Cimex* sp.).
e) Fleas (*Xenopsylla* sp.).
f) Mites: *Sarcoptes*sp.(Itch mite) and *Eutrombicula* sp.(Chiggers).
g) Ticks: *Dermacentor*sp.(Hard tick)
h) *Argas* sp. (Soft tick).

Paper 22B: PRACTICAL (XI)
Paper Code: ZL406C
Total Marks: 50(IA = 20 + ESE = 30) Credit = 02

- Calculation of CFU (Colony Forming Unit) using plate count method
- Direct, indirect Sandwich ELISA through photographs- identification, Principle, Comment
- Identification of medically important fauna (Permanent slides/ Photographs) and comments: *Leishmania, Giardia*, Signet ring of *Plasmodium vivax, Schistoma, Wuchereriabancrofti, Anopheles*, *Culex, Ades, Musca, Cimex, Pediculus, Xenopsylla (*ratflea*) Sarcoptessarcoptes (*Itch mite)
- Gram's Staining of Bacteria
- Biochemical tests for Identification of bacteria

Paper 23: GLOBAL ENVIRONMENTAL ISSUES AND BIODIVERSITY AND CONSERVATION
Paper Code: ZL407C
Total Marks: 100(IA = 40 + ESE = 60) Credit = 04

- Environmental pollution of: Air, Water, Sound (Sources, Kind and effect)
- Acid rain: Its causes and effects on human and ecosystem
- Ozone depletion: Importance of Ozone layer, cause of depletion, Ozone depleting substances (ODS), effects of Ozone depletion, mitigation measures and international protocols
- Global Warming: Green house effect, potential Green house gases causing global warming, impact of global warming on agriculture, economy and human diseases
- Climate change: Earth's Climate through ages, Trends of Climate change, Environmental policy and International agreements- Montreal Protocol 1987, Kyoto Protocol 1997, Convention of climate change
- Biodiversity patterns: Spatial patterns- Latitudinal and elevational trends in biodiversity
- Biodiversity estimation: Qualitative and quantitative methods- scoring, habitat assessment, richness density, abundance, diversity. Community diversity estimation- alpha, beta and gamma diversity, molecular techniques- RAPD, RFLP
- Importance of biodiversity
- Threats to Biodiversity: Natural and anthropogenic disturbances, habitat loss, hunting, deforestation, hydropower development, over exploitation, man wildlife conflict
- Biodiversity in India: different Hot spots, National Biodiversity Action Plan
- Conservation of biodiversity: In-situ conservation (Biosphere Reserves, National Parks, Wildlife Sancturies), Ex-situ Conservation (Zoological gardens, gene banks, seedling banks, DNA banks), IUCN Red list categorization, Red Data book, ecological restoration, afforestation, Joint Forest Management

Paper 24A: RESEARCH METHODOLOGY AND ANIMAL ETHICS AND IPR
Paper Code: ZL408C
Total Marks: 50(IA = 20 + ESE = 30) Credit = 02

- Basic concepts of research: Definition and types of research, Research methods vs methodology, Literature review and its consolidation, Library, Field and Laboratory research
- Data collection and documentation: maintaining a laboratory record, tabulation and generation of graphs
- Overview of biological problems: history, Key biology research Model organisms in biology-Genetics, Physiology, Biochemistry, Molecular biology
- The art of scientific writing and presentation: numbers, units, abbreviations and nomenclature used in scientific writing. Writing References, Scientific writing and ethics, Introduction to copy right-plagiarism.

- Respect to animals' dignity

•The principle of proportionality: responsibility for considering and balancing suffering and benefit
•Responsibility for:

a) considering reducing the number of animals (Reduce)
b) minimising the risk of suffering and improving animal welfare (Refine)
c) openness and sharing of data and material
d) maintaining biological diversity and requirement of due care

•Basic knowledge about the four types of intellectual property right (IPR)—

a) Trademarks
b) Copyrights
c) Patents
d) Trade Secrets

Paper 24B: PRACTICAL (XII)
Paper Code: ZL408C
Total Marks: 50(IA = 20 + ESE = 30) Credit = 02

- Comment on the IUCN status of the fauna (Photographs)
- Identification of common GI tags essential for IPR
- Field visit to zoological garden
- Field visit to wildlife sanctuary
- Review of literature on any suitable topic and its presentation

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SYLLABUS & PROGRAMME STRUCTURE OF FOUR YEARS UNDERGRADUATE PROGRAMME

ZOOLOGY

(Minor)

(Under National Education Policy – 2020)

(Effective from the Academic Session 2023-2024)

MAHARAJA BIR BIKRAM UNIVERSITY
AGARTALA, TRIPURA: 799004

Course Structure of Zoology
(UG Programme) As per NEP-2020

ZOOLOGY MINOR

Year	Semester	Paper Code	Paper No.	Credit	Marks	Paper Name
1st Year	I	ZL101C	Paper -1A Theory	3	75 IA=30 + ESE= 45	Non-Chordates and Economic Zoology
			Paper -1B Practical	1	25 IA=10 + ESE=15	Based on Theory Paper -1A
	II	ZL102C	Paper -2A Theory	3	75 IA=30 + ESE= 45	Chordates and Cell Biology
			Paper -2B Practical	1	25 IA=10 + ESE=15	Based on Theory Paper 2A
2nd Year	III	ZL201	Paper -3A Theory	3	75 IA=30 + ESE= 45	Genetics and Developmental Biology
			Paper -3B Practical	1	25 IA=10 + ESE=15	Based on Theory Paper -3A
	IV	ZL202	Paper -4A Theory	3	75 IA=30 + ESE= 45	Animal Physiology, Endocrinology and Reproductive Biology
			Paper -4B Practical	1	25 IA=10 + ESE=15	Based on Theory Paper 4A
3rd Year	V	ZL301C	Paper -5A Theory	3	75 IA=30 + ESE= 45	Evolutionary Biology, Adaptation and Zoogeography
			Paper -5B Practical	1	25 IA=10 + ESE=15	Based on Theory Paper -5A

	VI	ZL302C	Paper -6A Theory	3	75 IA=30 + ESE= 45	Ecology, Parasitology, Microbiology and Basics of Systematics
			Paper -6B Practical	1	25 IA=10 + ESE=15	Based on Theory Paper 6A
4th Year	VII	ZL401C	Paper -7A Theory	3	75 IA=30 + ESE= 45	Applied Entomology and Aquaculture
			Paper -7B Practical	1	25 IA=10 + ESE=15	Based on Theory Paper -7A
	VIII	ZL402C	Paper -8A Theory	3	75 IA=30 + ESE= 45	Biochemistry, Molecular Biology and Immunology
			Paper -8B Practical	1	25 IA=10 + ESE=15	Based on Theory Paper 8A

1st Year
Semester-I
Paper 1A: NON-CHORDATES AND ECONOMIC ZOOLOGY
Paper Code: ZL101C
Total Marks: 75 (IA = 30 + ESE = 45) Credit - 03

** 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.

NON-CHORDATES - I

(i) Protozoa
• General Characteristics
•Locomotion in *Amoeba*

(ii) Parazoa
• General characteristics
• Canal system of *Sycon*

(iii) Metazoa
• General characteristics
• Trimorphism & metagenesis of *Obelia*

(iv) Platyhelminthes
•General characteristics
•Life cycle of *Fasciola hepatica*

(v) Nemathelminthes
• General characteristics
• Life cycle of *Ascaris*

NON-CHORDATES- II

(i) Annelida
• General characteristics
• Digestive system of Earthworm

(ii) Arthropoda
• General characteristics
• Digestive system of *Periplaneta*

(iii) Mollusca
• General characteristics
• Respiratory system in *Pila*

(iv) Echinodermata
• General characteristics
•Water vascular system in *Asterias*

(v) Hemichordata
• General characteristics of Hemichordata

ECONOMIC ZOOLOGY

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

(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

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

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

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

(vi) Basics of Dairy farming and management.

Paper 1B: PRACTICAL - 1
Paper Code: ZL101C
Total Marks: 25 (IA = 10 + ESE = 15) 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: ZL102C
Total Marks: 75 (IA = 30 + ESE = 45) Credit - 03

CHORDATA - I

(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*

(ii)Cyclostomata
- General characteristics of Cyclostomata
- Differences between *Petromyzon* and *Myxine*

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

CHORDATA - II

(i) Amphibia
- General characteristics and classification upto order
- Parental care in Amphibia

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

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

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

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: ZL102C
Total Marks: 25 (IA = 10 + ESE = 15) 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: ZL201C
Total Marks: 75 (IA = 30 + ESE = 45) Credit - 03

GENETICS - I

- DNA as a genetic material
- Concept of alleles and multiple alleles (ABO Blood grouping)
- Crossing over and recombination
- Sex determination in *Drosophila* (Geneic balance theory) and human; Barr body.
- Chromosomal abnormalities and different syndromes in human—-: Turner's syndrome, Klinefelter's syndrome, Down syndrome

GENETICS - II

- Autosomal and Sex-linked inheritance: Autosomal- Albinism and Thalasemia.
- Sex linked inheritance—- Colour blindness and Haemophilia
- Mutation: Types of mutation, mutagens
- Cytoplasmic inheritance

DEVELOPMENTAL BIOLOGY:

• Gametogenesis and ultrastructure of spermatozoa
• Cleavage, Blastulation, and Gastrulation during the formation of chick embryo
• Extra-embryonic membrane formation and function in chick embryo
• Placenta: types and function.

Paper 3B: PRACTICAL - III
Paper Code: ZL201C
Total Marks: 25 (IA = 10 + ESE = 15) Credit - 01

Practical – III

- 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: ZL202C
Total Marks: 75 (IA = 30 + ESE = 45) Credit - 03

ANIMAL PHYSIOLOGY - 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

ANIMAL PHYSIOLOGY - 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

- Histological structure and functions of: Pituitary gland, Thyroid gland, Pancreas, Adrenal gland, Testis and ovary
- Types of hormones and their functions in vertebrates
- Endocrine disorder in human with special reference to Pituitary and Thyroid glands
- Role of hormones in regulation of —- spermatogenesis, oogenesis
- Oestrus cycle in rat

Paper 4B: PRACTICAL - IV
Paper Code: ZL202C
Total Marks: 25 (IA = 10 + ESE = 15) 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: ZL301C
Total Marks: 75 (IA = 30 + ESE = 45) Credit - 03

Evolutionary Biology-I

- Origin of Life (Chemical basis): Experimental evidence in favour of abiotic synthesis of basic biomolecules (Miller & Urey Experiment), Protocell or Coacervates.
- Evolution of horse,
- Neo-Darwinism (Synthetic Theory), Genetic variation and sources of variation in natural populations

Evolutionary Biology-II

- Types of natural Selection: Stabilising, Directional and Disruptive
- Isolating mechanisms and importance of Reproductive Isolation
- Mode of Speciation: Sympatric, Allopatric and Parapatric

Adaptation and Zoogeography

- Adaptive features of Camel, Whale and Pigeon (Morphological, anatomical and Physiological)
- Colouration: Cryptic and Warning
- Mimicry: Protective, Aggressive and Warning (Batesian and Mullerian)
- Zoogeographical realms of the world— Geographical boundary, Climate and Faunal composition

Paper 5B: PRACTICAL - V
Paper Code: ZL301C
Total Marks: 25 (IA = 10 + ESE = 15) Credit - 01

Practical – V

- 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.

Semester-VI
Paper 6A: ECOLOGY, PARASITOLOGY, MICROBIOLOGY AND BASICS OF SYSTEMATICS
Paper Code: ZL302C
Total Marks: 75 (IA = 30 + ESE = 45) Credit - 03

Ecology

- Ecosystem: Definition, food chain, food web, ecological pyramids, energy flow in ecosystems
- Population ecology— Natality, Mortality, Survivorship curves, Population growth curves, r and K strategies.
- Applied ecology: Types & level of biodiversity, Definition with the example of --: Biodiversity Hot spots, Keystone species, Wildlife Conservation (in situ and ex-situ conservation), the concept of protected areas with special reference to Tripura,
- Red data book, Indian wildlife act & Schedule.
- Common threats and conservation strategies for Indian Tiger, Phayre's leaf monkey, Indian Bison, and Green Imperial Pigeon.

Parasitology and Basic Microbiology

- Host Parasite interactions with reference to helminthic parasites (*Taenia, Ascaris)*
- Lifecycle, Pathogenicity and Prophylaxis of - *Plasmodium*, *Entamoeba, Giardia.*
- Microbes in animal gut of Cockroach, Earthworm, Ruminants and their biological significance,
- Concept of Prebiotic, Probiotic, and Symbiotic.
- Microbes in human and animal welfare.

Basics of Systematics

- Knowledge of Systematics and Taxonomy: definition, Classification, Phenon, Taxon, Category, Binomial and Trinomial nomenclature.
- ICZN: rules of zoological nomenclature, Principle of priority; Synonymy and Homonymy
- Concept of classification –five kingdom concept of Whittaker, 1969, Linnean Hierarchy
- Species Concept: Biological and Evolutionary

Paper 6B: PRACTICAL - VI
Paper Code: ZL302C
Total Marks: 25 (IA = 10 + ESE = 15) Credit - 01

Practical – VI

- Estimation of population density (i) Quadrate method
- Identification and ecological importance of the following: *Collembola*, Mite, *Daphnia*, *Cyclops*, *Cypris* (Slides)
- Study of gut parasites of cockroach/fish/ fowl
- Identification of parasitic features – Slides of Plasmodium, Entamoeba and Giardia.
- Visit to an Ecological park/Wildlife Sanctuary.

4th Year
Semester-VII
Paper 7A: Applied Entomology and Aquaculture
Paper Code: ZL401C
Total Marks: 75 (IA = 30 + ESE = 45) Credit - 03

Applied Entomology -I

- Insect morphology and anatomy with special reference to mouth parts, digestive and respiratory system of Butterfly, Housefly and Honeybee.
- Nature of damage, biology and control of *Scirpophagaincertulus* (Paddy pest), *Heliothis armigera* (Sugarcane pest), *Leucinodes arbonalis* (Brinjal pest), *Sternochetusmangiferae* (Mango store weevil).

Applied Entomology -II

- Nature of damage, biology and control of store grain pests- *Sitophilus* sp, *Tribolium* sp, *Rhyzopertha* sp and *Trogodermagranarium*
- Pollinators- Definition, insect pollinating agents and their mode of pollination, importance of pollinators.
- Lac Culture: Systematic position, Life Cycle, Economic importance, pest and enemies of lac insects and their control.

Aquaculture

- Aquaculture: Principles and Practices
- Types of aquaculture: Carp culture, Prawn culture
- Selection of species for aquaculture
- Captive breeding technology,
- Supplementary diets and its composition
- Water quality monitoring in captive breeding farm etc.

Paper 7B: PRACTICAL - VII
Paper Code: ZL401C
Total Marks: 25 (IA = 10 + ESE = 15) Credit - 01

Practical – VII

- Identification and economic importance of - *Scirpophagaincertulus* (Paddy pest), *Sitophilus* sp, *Tribolium* sp, Prawns, *Rotifer, Cyclops,Daphnia* (Specimens/Slides/Microphotographs)
- Estimation of dissolved oxygen from water by Winkler's Method
- Analysis of pH of pond water
- Submission of insect pests (at least five numbers) with their Scientific name, Order, Place of collection, name of the host plant, date of collection

Semester-VIII
Paper 8A: Biochemistry, Molecular Biology and Immunology
Paper Code: ZL402C
Total Marks: 75 (IA = 30 + ESE = 45) Credit - 03

Biochemistry

- Concept of pH, buffers and their biological applications
- Biomolecules: Carbohydrates, proteins, lipids and nucleic acids
- Enzymes: General properties, Coenzymes, isoenzymes, ribozymes.
- Glycolysis, Krebs cycle and ETC (including ATP generation)

Molecular Biology

- Replication, Transcription and translation in prokaryotes
- Concept of Cistron , Recon and Muton.
- Gene regulation of prokaryotes (Lac operon)
- Genetic basis of Cancer- Definition of Proto-oncogene and viral oncogenes. Transformation of Proto oncogene to oncogene.
- Potential benefits and hazards of RDT

Immunology

- Introduction to Immunology
- Cells and organs of immune system
- Cell mediated and humoral immunity
- Antigenicity and immunogenicity
- Immunogens, Adjuvants and Haptens
- Factors influencing immunogenicity
- B and T Cell epitopes
- Immunoglobulins: Structure and functions of different classes of immunoglobulins
- Antigen –Antibody interactions

Paper 8B: PRACTICAL - VIII
Paper Code: ZL402C
Total Marks: 25 (IA = 10 + ESE = 15) Credit - 01

Practical – VIII

- Qualitative identification of Carbohydrates (mono, di and polysaccharides), protein and lipid
- Quantitative estimation of glucose (titrimetric)
- Identification of leukocytes
- ABO Blood grouping

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SYLLABUS FOR UNDERGRADUATE PROGRAMME

ZOOLOGY

(INTERDISCIPLINARY COURSE)

Under National Education Policy – 2020

(Effective from the Academic Session 2023-2024)

MAHARAJA BIR BIKRAM UNIVERSITY
AGARTALA, TRIPURA: 799004

Course Structure of Zoology
(UG Programme) As per NEP-2020

FUNDAMENTAL ZOOLOGY

(INTERDISCIPLINARY COURSE)

Year	Semester	Paper Code	Paper No.	Credits	Marks	Paper Name
1st Year	I	ZL001C	Paper 1 Theory	3	100 IA = 40 + ESE = 60	Animal Diversity
2nd Year	III	ZL002C	Paper 2 Theory	3	100 IA = 40 + ESE = 60	Economic Zoology
	IV	ZL003C	Paper 3 Theory	3	100 IA = 40 + ESE = 60	Genetic Disorders and Pathogenic Diseases

DETAILED COURSE CONTENT OF

Interdisciplinary Course

FUNDAMENTAL ZOOLOGY

1st year
Semester – I
Paper - 1 (Theory)
ZL001: Animal Diversity
Marks: 100 (IA=40 + ESE= 60) Credit 03

Non-chordates

Classification (up to class)

Important features of the phylum with examples

Protozoa, Rotifera, Bryozoa, Porifera, Cnidaria, Helminths, Annelida, Arthropoda, Mollusca, and Echinodermata

Chordates

Classification (up to class)

Important features with examples

Hemichordates, Cephalochordates, Urochordates, and Vertebrates – Cyclostomes, Pisces, Amphibia, Reptilia, Aves, and Mammalia

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)

ZL002: 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)

ZL003: 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)