

**Department of Biological Sciences, Aliah University, Newtown, Kolkata**  
**Syllabus for the 3 Years B.Sc. Honours Degree in Zoology (Honours)**  
**For 2016-2019 & 2017-2020 Sessions (Ongoing batches)**

**Semester – I (Honours)**

Sl. No	Course Structure	Course Code	Course Title	L-T-P-C	Full Marks	Credit
1.	Zool (Major)	BZ 101	Invertebrates: Classification; Type study, Special features.		50	4
2.	Zool (Major)	BZ 103	Chordates: Classification; Type study, Special features		50	4
3.	Zool (Major)	BZ 191	Practical (Invertebrate)		50	4
4.	Botany	BB 131	Theoretical		50	4
5.	Chemistry	CH 131	Theoretical		50	4
6.	Compulsory	EN 131	Communicative English		50	4
					<b>300</b>	<b>24</b>

**Semester – II (Honours)**

Sl. No	Course Structure	Course Code	Course Title	L-T-P-C	Full Marks	Credit
1.	Zool (Major)	BZ 102	Evolution & Adaptations		30 + 20	4
2.	Zool (Major)	BZ 104	Ethology & Ecology		20 + 30	4
3.	Zool (Major)	BZ 106	Biostatistics & Embryology		20 + 30	4
4.	Botany	BB 132	Theory		50	4
5.	Chemistry	CH 132	Theory		50	4
6.	Compulsory	AI 132	Elementary Arabic & Islamic Studies		50	4
					<b>300</b>	<b>24</b>

**Semester - III (Honours)**

Sl. No	Course Structure	Course Code	Course Title	L-T-P-C	Full Marks	Credit
1.	Zool (Major)	BZ 201	Taxonomy, Histology Zoogeography, Animal Physiology		10 + 15 + 10 + 15	4
2.	Zool (Major)	BZ 291	Practical (Vertebrate)		50	4
3.	Botany	BB 231	Theory		50	4
4.	Botany	BB 261	Practical		50	4
5.	Chemistry	CH 231	Theory		50	4
6.	Chemistry	CH 261	Practical		50	4
					<b>300</b>	<b>24</b>

**Semester - IV (Honours)**

Sl. No	Course Structure	Course Code	Course Title	L-T-P-C	Full Marks	Credit
1.	Zool (Major)	BZ 202	Parasitology & Economic Zoology		50	4
2.	Zool (Major)	BZ 292	Practical		50	4
3.	Botany	BB 232	Theory		50	4
4.	Botany	BB 262	Practical		50	4
5.	Chemistry	CH 232	Theory		50	4
6.	Chemistry	CH 262	Practical		50	4
					<b>300</b>	<b>24</b>

**Semester - V (Honours)**

Sl. No	Course Structure	Course Code	Course Title	L-T-P-C	Full Marks	Credit
1.	Zool (Major)	BZ 301	Immunology		50	4
2.	Zool (Major)	BZ 303	Biotechniques and Bio Instrumentation		25 + 25	4
3.	Zool (Major)	BZ 305	Cell and Molecular Biology		50	4
4.	Zool (Major)	BZ 307	Biochemistry		50	4
5.	Zool (Major)	BZ 391	Practical		50	4
6.	Compulsory	ES 331	ENVS		50	4
					<b>300</b>	<b>24</b>

**Semester - VI (Honours)**

Sl. No	Course Structure	Course Code	Course Title	L-T-P-C	Full Marks	Credit
1.	Zool (Major)	BZ 302	Biotechnology		50	4
2.	Zool (Major)	BZ 304	Human Physiology		50	4
3.	Zool (Major)	BZ 306	Genetics & Microbiology		30 + 20	4
4.	Zool (Major)	BZ 308	Computational Biology		50	
5.	Zool (Major)	BZ 392	Practical		50	4
6.	Zool (Major)	BZ 394	Practical / PROJECT WORK		50	4
					<b>300</b>	<b>24</b>

**Semester I Zoology Subsidiary**

Sl. No	Course Structure	Course Code	Course Title	L-T-P-C	Full Marks	Credit
1.	Zool (sub)	BZ 131	Invertebrates, Vertebrates and Ecology		50	4
			<b>Total</b>		<b>50</b>	<b>4</b>

**Semester II Zoology Subsidiary**

Sl. No	Course Structure	Course Code	Course Title	L-T-P-C	Full Marks	Credit
1.	Zool (sub)	BZ 132	Cytogenetics, Mol Biology, Evolution and Adaptation		50	4
			<b>Total</b>		<b>50</b>	<b>4</b>

**Semester III Zoology Subsidiary**

Sl. No	Course Structure	Course Code	Course Title	L-T-P-C	Full Marks	Credit
1.	Zool (sub)	BZ 231	Biochemistry, Physiology and Immunology		50	4
2.	Zool (sub)	BZ 261	Practical		50	4
			<b>Total</b>		<b>100</b>	<b>8</b>

**Semester IV Zoology Subsidiary**

Sl. No	Course Structure	Course Code	Course Title	L-T-P-C	Full Marks	Credit
1.	Zool (sub)	BZ 232	Developmental Biology and Economic Zoology		50	4
2.	Zool (sub)	BZ 262	Practical		50	4
			<b>Total</b>		<b>100</b>	<b>8</b>
			<b>GRAND TOTAL</b>		<b>300</b>	<b>24</b>

## Semester- I

### **BZ 101: Invertebrate Biology**

Total Marks 50, Credits 4

1. Classification of the major phyla of Invertebrates and Chordates-  
Classificatory schemes of the living world - Six-Kingdom concept.  
Distinguishing characters and classification of Protozoa (up to Phyla) [Levine *et al*, 1980]; Porifera (up to class); Phylum Cnidaria (up to class); Phylum Platyhelminthes (up to class); Phylum Aschelminthes (up to class); Phylum Annelida (up to class); Phylum Arthropoda (up to Class) Phylum Mollusca (up to class); Phylum Echinodermata (up to class).
2. Type study: i). *Paramoecium* (Reproduction). ii). *Sycon* (Cell types, Canal system). iii). *Obelia* - Structure and life history. *Pheretima* (Excretory system, Reproductive System). iv). *Periplaneta* (Digestive, Circulatory, Excretory and Reproductive System). v). *Pila* (Digestive, Respiratory System). vi). *Asterias* (Feeding and Locomotion).
3. Special features of Representative invertebrates: Locomotion and Osmoregulation in Protozoa, Canal system in Porifera, Polymorphism in Cnidaria; Types and Formation of Coral reefs; Types and formation of Coelom, Metamerism in Annelids, Hormones in Insects, Water vascular system in Echinoderms. Anatomical peculiarities and Systematic position of *Peripatus*.

### **BZ 103: Vertebrate Biology**

Total Marks 50, Credits 4

1. Classification of Phylum Chordata (a) Urochordata, Cephalochordata, Chondrichthyes, Osteichthyes, Aves and Mammalia (up to sub class) and Amphibia and Reptilia up to order (*Classification as per J.Z. Young, Life of Vertebrates*).
2. Type study: i) *Branchiostoma* (Feeding, Excretory System). ii) *Labeo* (Circulatory & Respiratory system). iii). *Bufo* (Heart & Brain). iv) *Columba* (Exoskeleton & Respiratory System). v) *Cavia* (Heart, Brain and Cranial nerves).
3. Special features of Representative vertebrates: Swim bladder in Fishes; Accessory respiratory organs in Teleosts, Anatomical peculiarities and systematic positions of Dipnoi. Neoteny / Paedogenesis in Amphibia, Distinguishing features of Non-poisonous and Poisonous snakes; Poison apparatus and biting mechanism in snakes. Aerodynamics of Bird's flight; Glands in mammals; Echolocation in Bats and Cetaceans. Anatomical peculiarities and systematic positions of Monotremata.

### **BZ 191: (Practical) Invertebrate Biology**

Total Marks 50, Credits 4

- Group - A: Dissections: i) Earthworm: Nervous system, Reproductive System,  
ii) Cockroach: Salivary apparatus, Nervous System, Male and Female Reproductive System.
- Group - B: Invertebrate mounting/Staining: Earthworm - Setae; Cockroach - Mouthparts
- Group - C: Invertebrate specimen identification (As per Classification Schemes of the theoretical paper) *Paramoecium* , *Euspongia*, *Scypha* , *Obelia*, *Aurelia* , *Physalia*, *Porpita*, *Adamsia*, *Fasciola*, *Ascaris*, *Chaetopterus*, *Aphrodite*, *Eupagurus*, *Balanus*, *Squilla*, *Oniscus*, *Belostoma*, *Buthus*, *Mantis*, *Chiton*, *Patella*, *Pinctada*, *Mytilus*, *Sepia*, *Loligo*, *Octopus*, *Ophiura*, *Astropecten*, *Balanoglossus*.
- Laboratory Note Book must be prepared on day-to-day basis and should be signed by the concerned teacher.

**Semester - II****BZ 102: Evolution & Adaptations**

Total Marks 50, Credits 4

**Evolution:**

- i) Origin of life (Chemical steps); Synthetic theory of Evolution
- ii) Role of Isolation on speciation. Founder effect and Bottle Neck effect; Modes of speciation - sympatric, allopatric and parapatric processes
- iii) Species Concept (Biological and Evolutionary).
- iv) Hardy-Weinberg equilibrium and factors affecting it; Genetic Drift.

**Adaptations:**

Adaptive features of Aquatic vertebrates (Fish and Whale). Adaptive features of Desert Reptiles and Mammals. Adaptive significance of Coloration and Mimicry.

**BZ 104: Ethology & Ecology**

Total Marks 50, Credits 4

**Ethology:**

Concept of Innate and Learned Behaviour, Fixed Action Pattern.  
 Elements of Sociobiology: Selfishness, Cooperation, Altruism and Kinship.  
 Mating systems and their Significance.

**Ecology:**

Concept of Ecosystems. Energy Flow through trophic levels.  
 Population Dynamics: Natality and Mortality, Growth forms, Regulation of Population density.  
 Community structure: Characteristics, Types, Niche concept. Wet-land ecosystem and its importance.  
 Ecological Succession: Concept of Community change, Theories of Climax, Models of Succession.  
 Biodiversity: Importance and causes of depletion; In-situ and Ex-situ conservation. Hotspots and Megadiversity countries.  
 Pollution: types, sources and effects and control of air, water and noise pollution

**BZ 106: Statistics & Embryology**

Total Marks 50, Credits 4

**Statistics:**

Methods of Sampling. General idea of Probability. Central Tendency, Deviation from Mean,  
 Test of Significance (Student's t-Test). Goodness of fit (Chi-Square Test),

**Developmental Biology:**

Gametogenesis. Biochemical events in Fertilization. Cleavage and role of yolk on cleavage.  
 Concept of Fate Map. Gastrulation in Frog and Chick. Concepts of Organizer, Induction and Competence. Development of Extra embryonic membranes in Chick;  
 Placenta in Mammals. Development of Heart and Brain in Chick

**Semester – III****BZ 201: Taxonomy, Histology, Zoogeography & Animal Physiology**

Total Marks 50, Credits 4

**Taxonomy:**

General idea of Classification, Systematic and Taxonomy; Hierarchy, Common taxonomic types. General idea of Codes of Zoological Nomenclature. Synonym and Homonym. Basic idea of Cytological and Biochemical taxonomy.

**Histology:**

Tissues-Different types and functions, Histological structure of Stomach, Duodenum, Ileum, Jejunum, Colon, Liver, Pancreas, Lung, Kidney, Testis and Ovary.

**Zoogeography:**

Zoogeographical Realms with examples; Impact of Barriers on Animal Distribution.

**Animal Physiology:**

Introduction to fundamental concepts and systems in animal physiology with emphasis on the general vertebrate body plan emphasizing mammalian physiology with comparative discussion with other group of vertebrates.

General structures and physiology of the digestive, circulatory, respiratory, excretory, endocrine, nervous, reproductive, skeletal & muscular system with special emphasis on osmoregulation mechanism.

**BZ 291 Practical (Vertebrate)**

Total Marks 50, Credits 4

Group- A: Demonstrations: Afferent and Efferent branchial system of *Labeo*. Ninth and Tenth cranial nerves of *Labeo*. Fifth and Seventh cranial nerves of *Gallus*.

Group- B: Chordate Preparations/Staining-Mounting: a. Staining-Mounting of Cycloid, Ctenoid and Placoid scales. b. Pecten of fowl.

Group- C: Chordate specimen identification with reasons: (As per classification schemes of theoretical paper) *Ascidia*, *Doliolum*, *Branchiostoma*, *Ammoecoetes larva*, *Torpedo*, *Hippocampus*, *Heteropneustes*, *Exocoetus*, *Syngnathus*, *Ambystoma*, *Rhacophorus*, *Tylotriton*, *Draco*, *Chamaeleo*, *Naja*, *Vipera*, *Psittacula*, *Alcedo*, *Pteropus*, *Funambulus*, *Suncus*.

Group- D: Identification of Bones with reasons i). Skull: *Bufo*, *Calotes*, *Columba*, *Cavia*, ii). Appendicular bones: *Columba*, *Cavia*. iii). Girdle bones: *Columba*, *Cavia*. iv) Vertebrae: *Columba*, *Cavia*.

Laboratory Note Book must be prepared on day-to-day basis and should be signed by the concerned teacher.

**Semester – IV****BZ 202: Parasitology & Economic Zoology**

Total Marks 50, Credits 4

**Parasitology:**

Parasites and Hosts: types and examples; Host-Parasite Interactions: Morphological and Physiological changes. Inter specific interactions: Phoresis, Commensalisms, Parasitism and Mutualism Life-cycle, Pathogenecity and Control of *Giardia intestinalis*, *Leishmania*, *Ascaris lumbricoides* and *Wuchereria bancrofti*. Biology of Vectors and their Control measures: *Anopheles*, *Culex* and *Phlebotomus*

**Economic Zoology:**

- i) Sericulture : Types of silk moths and their host plants. Life history and Life history and rearing of *Bombyx mori*, harvesting and processing of cocoon.
- ii) Aquaculture : Induced breeding and Composite fish culture. Exotic fishes
- iii) Apiculture : Types of Indian Honey bees, Methods of Rearing, Methods of Extraction and preservation of Honey.
- iv) Lac culture : Lac insect and lac host plants, Strains of lac insects, Cultivation of lac insect, Composition of Lac. Processing of lac and uses.
- v) Poultry: Types of fowl breeds, Deep litter system of rearing.
- vi) Bionomics and control of *Scirpophaga incertulas*, *Sitophilus oryzae* and *Bandicoota bengalensis*.
- vii) Integrated Pest Management.
- viii) Artificial Insemination and principles of cattle breeding.

**BZ 292 Practical**

Total Marks 50, Credits 4

Quantitative estimation of Dissolved O<sub>2</sub> and CO<sub>2</sub> (APHA method) of water by titrimetric methods. Determination of soil pH using pH meter.

Whole mount of 24, 36, 48 hrs. and 72 and 96 hrs. chick embryo.

Tissue fixation, Embedding, Microtomy and Staining of histological tissues of white Rat.

Identification of histological tissue sections (Ileum, Liver, Pancreas, Thyroid, Kidney, Adrenal, Testis and Ovary) with characters.

Identification of ectoparasites and pests (up to Order and Generic characters): *Menopon* , *Pediculus*, *Scirpophaga* , *Leptocorisa* , *Nilaparvata* , *Apion*, *Spodoptera*, *Sitophilus*, *Tribolium*.

Identification of fishes: *Labeo bata*, *Channa striatus*, *Mystus vittatus*, *Pampus argenteus*, *Harpodon nehereus*, *Notopterus notopterus*.

Laboratory Note Book must be prepared on day-to-day basis and should be signed by the concerned teacher daily. The Laboratory Note Book must be submitted on the day of examination, Viva voce.

**Semester – V****BZ 301: Immunology**

Total Marks 50, Credits 4

- i) Overview of Immune System- Historical perspective of Immunology, Early theories of Immunology, Cells and organs of the Immune system
- ii) Innate and Adaptive Immunity- Anatomical barriers, Inflammation, Cell and molecules involved in innate immunity, Adaptive immunity (Cell mediated and humoral), Passive: Artificial and natural Immunity, Active: Artificial and natural Immunity, Immune dysfunctions (brief account of autoimmunity with reference to Rheumatoid Arthritis and tolerance, AIDS).
- iii) Antigens- Antigenicity and immunogenicity, Immunogens, Adjuvants and haptens, Factors influencing immunogenicity, B and T-Cell epitopes
- iv) Immunoglobulins- Structure and functions of different classes of immunoglobulins, Antigenantibody interactions, Immunoassays (ELISA and RIA), Polyclonal sera, Hybridoma technology: Monoclonal antibodies in therapeutics and diagnosis
- v) Major Histocompatibility Complex- Structure and functions of MHC molecules. Endogenous and exogenous pathways of antigen processing and presentation
- vi) Cytokines & Complement System- Properties and functions of cytokines, Therapeutics Cytokines; Components and pathways of complement activation.
- vii) Hypersensitivity & Vaccines- Gell and Coombs' classification and brief description of various types of hypersensitivities; Vaccination, various types of vaccines

**BZ 303: Biotechniques and Bio-Instrumentation**

Total Marks 50, Credits 4

Microscopy and Microscopic techniques: Mechanism, application of light, inverted phase contrast, fluorescent microscope, confocal microscope, Micrometry

Spectroscopy: Instrumentation and application of UV - visible spectrophotometer, fluorescence spectroscopy; pH meter and its applications

Cell disruption techniques – Physical and chemical methods, PCR, RT-PCR

Centrifugation – basic principles of sedimentation, types of centrifuges and rotors, ultra centrifugation, differential centrifugation, density gradient,  $r$  and  $g$  calculation.

Chromatography – General principles and definition. Principles of Gel filtration, affinity chromatography, HPLC and ion-exchange chromatography.

Electrophoresis - PAGE, SDS-PAGE, isoelectric focussing, agarose gel electrophoresis, recovery of DNA from agarose gels

**BZ 305: Cell and Molecular Biology**

Total Marks 50, Credits 4

- i) Prokaryotic and Eukaryotic cells, Virus, Viroids, Mycoplasma, Prions
- ii) Various models of plasma membrane structure. Transport across membranes: Active and Passive transport, Facilitated transport. Cell junctions: Tight junctions, Desmosomes, Gap junctions
- iii) General idea of the structure and functions of cellular organelles: Ultra structure and functions of Mitochondria, Golgi apparatus, Ribosome, Lysosome, Endoplasmic reticulum and Nucleus. Ultra structure of chromosome with special emphasis on Nucleosome concept.
- iv) Cell cycle- Mitosis, Meiosis & regulation, Apoptosis.
- v) Salient features of DNA and RNA. Watson and Crick model of DNA
- vi) DNA Replication in prokaryotes and eukaryotes, mechanism of DNA replication, Semi-conservative, bidirectional and semi-discontinuous replication, RNA priming, Replication of circular and linear *ds*-DNA, replication of telomeres



- vii) RNA polymerase and transcription Unit, mechanism of transcription in prokaryotes and eukaryotes, synthesis of rRNA and mRNA, transcription factors
- viii) Genetic code, Degeneracy of the genetic code and Wobble Hypothesis; Process of protein synthesis in prokaryotes, Proteins involved in initiation, elongation and termination of poly peptide chain; Inhibitors of protein synthesis; Difference between prokaryotic and eukaryotic translation
- ix) Transcription regulation in prokaryotes: Principles of transcriptional regulation with examples from *lac* operon and *trp* operon; Transcription regulation in eukaryotes: Activators, repressors, enhancers, silencer elements; Gene silencing, Genetic imprinting
- x) DNA repair- Pyrimidine dimerization and mismatch repair

**BZ 307: Biochemistry**  
Total Marks 50, Credits 4

- i) Covalent and Non-covalent Bonds, H-bonds, Vander Waals Force, structure and properties of water, pH and buffer, Henderson-Hasselbalch Equation.
- ii) Carbohydrate- Definition, properties and classification, Stereoisomerism, Disaccharides and Polysaccharides, Important carbohydrates
- iii) Carbohydrate Metabolism- Sequence of reactions and regulation of glycolysis, Citric acid cycle, Phosphate pentose pathway, Gluconeogenesis, Glycogenolysis and Glycogenesis
- iv) Structure and Significance of lipids: Physiologically important saturated and unsaturated fatty acids, Tri-acylglycerols, Phospholipids, Glycolipids, Steroids
- v) Lipid Metabolism-  $\beta$ -oxidation and omega -oxidation of saturated fatty acids with even and odd number of carbon atoms; Biosynthesis of palmitic acid; Ketogenesis
- vi) Amino acids: Structure, Classification and General properties of  $\alpha$ -amino acids; Physiological importance of essential and non-essential  $\alpha$ -amino acids; Isoelectric point, pK values, peptide bond  
Proteins: Bonds stabilizing protein structure; Levels of organization in proteins; Denaturation; Introduction to simple and conjugate proteins,
- vii) Catabolism of amino acids: Transamination, Deamination, Urea cycle; Fate of C-skeleton of Glucogenic and Ketogenic amino acids
- viii) Enzymes- Nomenclature and classification; Cofactors; Specificity of enzyme action; Isozymes; Mechanism of enzyme action; Enzyme kinetics; Factors affecting rate of enzyme-catalyzed reactions; Derivation of Michaelis-Menten equation, Concept of  $K_m$  and  $V_{max}$ , Enzyme inhibition; Allosteric enzymes and their kinetics
- ix) Oxidative Phosphorylation- Redox systems; Review of mitochondrial respiratory chain, Inhibitors and un-couplers of Electron Transport System

**BZ 391: Practical**  
Total Marks 50, Credits 4

Preparation of mitotic stage from onion root tip; Meiotic stages from grasshopper testis;  
Identification of Carbohydrate, Lipids and Protein. Alkaline phosphatase enzyme assay.  
Estimation of differential count of WBC from man. Determination of blood group in man.  
Demonstration for determination of human blood pressure  
Laboratory Note Book must be prepared on day-to-day basis and should be signed by the concerned teacher. The Laboratory Note Book must be submitted on the day of examination.

**Semester - VI****BZ 302: Biotechnology**

Total Marks 50, Credits 4

- i) Concept and scope of biotechnology
- ii) Molecular Techniques in Gene manipulation- Cloning vectors: Plasmids, Cosmids, Phagemids, Lambda Bacteriophage, M13, BAC, YAC, MAC and Expression vectors
- iii) Restriction enzymes: Nomenclature, detailed study of Type II.
- iv) Transformation techniques: Calcium chloride method and electroporation.
- v) Construction of genomic and cDNA libraries and screening by colony and plaque hybridization. Southern, Northern and Western blotting
- vi) DNA sequencing: Sanger method. Polymerase Chain Reaction, DNA Finger Printing and DNA micro array
- vii) Production of cloned and transgenic animals: Nuclear Transplantation, Retroviral Method, DNA microinjection
- viii) Applications of transgenic animals, Production of transgenic plants: *Agrobacterium* mediated transformation Production of pharmaceuticals, production of donor organs, knock out mice. Application of transgenic animal & plants
- ix) Animal cell culture, Expressing cloned genes in mammalian cells, Molecular diagnosis of genetic diseases (Cystic fibrosis, Sickle cell anemia)
- x) Recombinant DNA in medicines: Recombinant insulin and human growth hormone, Gene therapy

**BZ 304: Human Physiology**

Total Marks 50, Credits 4

- i) Physiology of Digestion- Structural organization and functions of gastrointestinal tract and associated glands; Mechanical and chemical digestion of food; Absorptions of carbohydrates, lipids, proteins, water, minerals and vitamins; Hormonal control of secretion of enzymes in Gastrointestinal tract.
- ii) Physiology of Respiration- Histology of trachea and lung; Mechanism of respiration, Pulmonary ventilation; Respiratory volumes and capacities; Transport of oxygen and carbon dioxide in blood; Respiratory pigments, Dissociation curves and the factors influencing it; Control of respiration
- iii) Renal Physiology- Structure of kidney and its functional unit; Mechanism of urine formation; Regulation of water balance; Regulation of acid-base balance
- iv) Blood- Components of blood and their functions; Structure and functions of haemoglobin Haemostasis: Blood clotting system, Haemopoiesis, Blood groups: Rh factor, ABO and MN
- v) Physiology of Heart- Structure of mammalian heart; Coronary circulation; Structure and working of conducting myocardial fibers. Origin and conduction of cardiac impulses; Cardiac cycle; Cardiac output and its regulation, nervous and chemical regulation of heart rate. Electrocardiogram, Blood pressure and its regulation
- vi) Brief outline of the organization and basic function of the nervous system (central and peripheral)

**BZ 306: Genetics & Microbiology**

Total Marks 50, Credits 4

**Genetics:**

- i) C-value paradox, Physico-chemical properties, structures, Types and functions of DNA and RNA.
- ii) Principles of inheritance, Incomplete dominance and co-dominance, Multiple alleles, Lethal alleles, Epistasis, Pleiotropy, Sex-linked, sexinfluenced and sex-limited characters inheritance.

- iii) Linkage, Crossing over and Recombination (Holliday model)
- iv) Mutation - types with example, Chromosomal aberrations, Transposable elements
- v) Sex determination and Dosage compensation in *Drosophila* and man.

### Microbiology

- i) Concept of microorganisms (prokaryotic microbes and eukaryotic microbes).
- ii) Whittaker's Five Kingdom and Carl Woese three domain concept of living organisms. General features of Eubacteria and Archaeobacteria.
- iii) Classification of bacteria, structure of cell wall
- iv) Theories and principles of Gram staining, acid fast staining, endospore staining, negative staining, capsule staining, flagella staining.
- v) Viruses: Structures and properties of enveloped (Herpes), helical (TMV) and icosahedral (Polyoma) viruses. Classification of viruses on the basis of their nucleic acids.
- vi) Virus related components: Viroids and prion, Bacteriophages – Single stranded and Double stranded RNA and DNA phages. Reproduction of DNA and RNA phages. Lytic and temperate phages. Lysogeny, life cycles of T4 and  $\lambda$  phages.
- vii) Recombination in Bacteria-Transformation, Conjugation and Transduction.
- viii) Microbes in health and disease: Beneficial microbial interactions with humans. Harmful microbial interactions with humans: host-parasite interactions, Virulence factors and toxins.
- ix) Brief overview of antibiotics, antibiotic resistance and their mechanism of action

### BZ 308: Computational Biology

Total Marks 50, Credits 4

- i) Introduction to computational biology signifying its crucial role in developing quantitative models of biological systems at all levels of complexity.
- ii) Sequencing of data, searching and alignment, structural data, genome sequencing, genome analysis, gene and protein expression and biological networks and pathways, protein structure prediction.
- iii) Introduction to computational cell biology that include biological modeling and image analysis and algorithm used in the determination, stimulation, and engineering of molecular structures.
- iv) Introduction to bioinformatics with special emphasis on online computational resources:
- v) Central dogma of molecular biology, central dogma of genomics – the flow of information.
- vi) Data bases [i.e. EMBL, Gen Bank, the DNA database of Japan (DDBJ)] serve as repositories for quadrillions of sequences and its application.
- vii) Access different kinds of molecular data [such as protein, and DNA sequences.
- viii) Tools for data mining and analysis.

### BZ 392: Practical

Total Marks 50, Credits 4

- i) Isolation of DNA and RNA, estimation of DNA and RNA, DNA gel electrophoresis.
- ii) Study of different blotting-Southern, Northern and western
- iii) Pedigree analysis, Gram staining of bacteria, media preparation, plating.

### BZ 394: Practical

Total Marks 50, Credits 4

- i) Paper chromatography
- ii) Mixed and pure bacteria culture (streak dilution method) from water and curd (demonstration), Gram-staining of curd bacteria
- iii) Biological databases, access to DNA, protein sequences, sequence analysis [sequence alignment, BLAST, identification of coding and non-coding sequence analysis], using online tools.



## Zoology General (Subsidiary)

### Semester I

#### **BZ 131: Invertebrates, Vertebrates and Ecology**

Total Marks 50, Credits 4

#### **Group-A Invertebrates:**

Classification: Classification with distinctive features and suitable examples of sub-king dom Protozoa (up to Phylum) (Levine *et al*, 1980) and Phylum Porifera, Cnidaria, Platyhelminthis, Annelida, Arthropoda, Mollusca and Echinodermata (up to Class)

Type Study: i) *Paramoecium* (Osmoregulation, Conjugation). ii) *Sycon* (Cell types, Canal System). iii) *Obelia* (Zooids and Metagenesis). iv) Excretory Organs and mode of Excretion in *Planaria*, and Prawn. v) Respiratory organs and mode of respiration in *Buthus* and *Pila*. vi) Open circulation in *Periplaneta* vii) Earthworm (Excretion, Reproduction). viii) *Periplaneta* (Excretion, Reproduction).

#### **Group – B Vertebrates:**

Classification: Classification with distinctive features and examples of Phylum Chordata. Up to Classes: Lower Chordates; up to Sub-Classes: Chondrichthyes and Osteichthyes; up to living Orders: Amphibia and Reptilia and up to Sub-Classes: Aves and Mammalia.

Type study: *Branchiostoma* (Feeding, Excretion); *Labeo* (Heart, Respiration); *Bufo* (Heart), *Columba* (Feather, Respiration).

Functional anatomy (Chordates): Integument: General Structure and its derivatives in Mammals (Hair and Glands); Accessory Respiratory Organs in Fishes; Bovine Ruminant Stomach.

#### **Group C Ecology:**

i) Definition and Components of Ecosystem, Food chain, Food web, Ecological pyramid. ii) Energy flow through trophic levels. iii) Outline idea of Population ecology and Community Ecology. iv) Air and Water pollutions – causes, effects and control measures. Biodiversity, causes of depletion and control measures. Conservation of Wildlife: Purpose & Methods. Concept of National Park. Sanctuary & Biosphere Reserve.

### Semester – II

#### **BZ 132: Cytogenetics, Mol Biology, Evolution and Adaptation**

Total Marks 50, Credits 4

#### **Group A: Cytogenetics and Molecular Biology:**

i) Ultrastructure and function of plasma membrane, mitochondria, Golgi complex. ii) Structure of Chromosome, Nucleosome concept. iii) Cell cycle. iv) Structure, types and functions of DNA and RNA. v) Modes of inheritance of autosomal and sex linked genes in man (Thalassemia and Colour blindness). vi) Linkage and Recombination, vii) Sex determination in *Drosophila* and man. viii) Down, Turner and Klinefelters syndrome. ix) Oncogene and cancer.

**Group B: Evolution and Adaptation:** i) Chemical basis of Origin of Life. ii) Outline idea about Modern Synthetic Theory. iii) Brief idea about species as a unit of evolution (account of biological and sibling species, Allopatric and Sympatric speciation). iv) Secondary aquatic adaptation (Whale), Volant adaptation in Bird. v) Basic idea about Geological Time Scale.

**Semester – III**  
**BZ 231: Biochemistry, Physiology and Immunology**  
 Total Marks 50, Credits 4

**Group A: Biochemistry:**

i) Classification of carbohydrate, protein and lipid. ii) Concept of Glycolysis, Krebs cycle, Neoglucogenesis. iii) Enzyme- Classification, Characteristics and Mechanism of enzyme action. Effects of pH and temperature on enzymatic action.

**Group B: Physiology:**

i) Composition of vertebrate blood; Blood coagulation; ABO blood group and Rh factor. ii) Physiology of nerve impulse and synaptic transmission. iii) Osmoregulation in fishes.

**Group C: Immunology:**

i) Innate and Acquired immunity. ii) Types and functions of T and B- Lymphocytes. iii) Basic Concept of Antigen and Antibody. iv) Structure of a typical Antibody molecule.

**BZ 261: Practical Paper I**

Total Marks 50, Credits 4

**Dissections:** (Two major dissections – one invertebrate and one vertebrate)

1. i) Cockroach: Nervous and Female reproductive system, ii) Earthworm : Nervous system, ii) *Lata / Labeo* : Afferent, Brain, Cranial nerves (IX th and X th origin and distribution).

2. Mounting and preparation : i) Mouth parts of cockroach, Setae of *Pheretima*, ii) Cycloid, Ctenoid and Placoid scale. iii) Blood film of man iv) Gut contents of cockroach for protozoa (Fixation, staining and identification)

3. Identification with reasons: one from bones, one from histological slides, two from non-chordates and two from chordate specimens; systematic position upto taxon as mentioned in the theory.

Bones: Skull, vertebrae, limb and girdle bones of *Columba* and *Cavia*

Histological slides : Sections of mammalian liver, pancreas, testis, ovary, kidney, thyroid.

**Non-chordate specimens :** *Paramoecium, Scypha, Obelia, Pennatula, Sea-anaemone, Ascaris, Nereis, Hirudinaria, Buthus, Hippa, Balanus, Squilla, Lepisma, Cimex, Pediculus, Chiton, Bombyx mori, Lamellidens, Achatina, Sepia, Loligo, Mytilus, Starfish, Balanoglossus.*

**Chordate specimens :** *Branchiostoma, Petromyzon, Scolidon, Torpedo, Lates, Hippocampus, Heteropneustes, Clarias, Syngnathus, Rhacophorous, Axolotl larva, Tylototriton, Turtle, Draco, Hemidactylus, Naja, Vipera, Psittacula, Passer, Alcedo, Pteropus, Funambulus, Suncus.*

Report on field study tours: Zoological garden and Museum,

Laboratory Note Book & Viva –voce

**Semester – IV****BZ 232: Developmental Biology and Economic Zoology**

Total Marks 50, Credits 4

**Group A: Developmental Biology:**

- i) Spermatogenesis and Oogenesis.
- ii) Outline idea about Fertilization.
- iii) Types of Eggs in Chordates.
- iv) Characters and types of Cleavage; process of cleavage in Frog and chick
- v) Gastrulation in Frog and Chick.
- vi) Extra-embryonic membranes in chick.
- vii) Types and functions of Placenta.
- viii) Organizer concept.

**Group B: Economic Zoology:**

- i) Sericulture : Types of silk moths and their host plants. Life history and Life history and rearing of *Bombyx mori*, harvesting and processing of cocoon.
- ii) Aquaculture : Induced breeding and Composite fish culture. Exotic fishes
- iii) Apiculture : Types of Indian Honey bees, Methods of Rearing, Methods of Extraction and preservation of Honey.
- iv) Lac culture : Lac insect and lac host plants, Strains of lac insects, Cultivation of lac insect, Composition of Lac. Processing of lac and uses.
- v) Poultry: Types of fowl breeds, Deep litter system of rearing.
- vi) Bionomics and control of *Scirpophaga incertulas*, *Sitophilus oryzae* and *Bandicoota bengalensis*.
- vii) Integrated Pest Management.

**BZ 262: Practical Paper II**

Total Marks 50, Credits 4

1. Experimental Works: i) Measurement of pH of water sample by pH-meter ii) Estimation of dissolved O<sub>2</sub> / free CO<sub>2</sub> content of water. iii) Differential count of WBC of man. iv) Preparation of Haemin crystals of Man.
2. Identification: a) Pests: *Scirpophaga*, *Tribolium*, *Sitophilus*, *Lepisma*. b) Fish: *Cirrhinus mrigala*, *Labeo rohita*, *Catla catla*, *Mystus vittatus*, *Hypophthalmichthys molitrix*, *Ctenopharyngodon idella*, *Wallago attu*, *Channa striatus*. c) Insect vectors: *Anopheles*, *Culex*
3. Personal activity (Any One): 1. Study and Submission of Life history stages of *Anopheles* or *Culex* mosquito. 2. Study of Reptilian and Avian Diversity in your Locality.
1. Laboratory Note Book must be prepared on day-to-day basis and should be signed by the concerned teacher after the laboratory work.