

# DEPARTMENT OF ZOOLOGY, TURA GOVERNMENT COLLEGE

## SYLLABUS

### I SEMESTER (Paper 1 A)

**UNIT 1:** Systematics: Definition; Taxonomic hierarchy; Binomial nomenclature; Six-kingdom classification (Bacteria, Protozoa, Fungi, Plantae, Animalia and Chromista); Classification, salient features and examples of Non-chordates (Kingdom Protozoa upto Phyla, other major phyla upto classes). Chordates(upto classes); Introduction to minor phyla.

**UNIT 2:** Protozoa: *Paramecium*-Morphology and reproduction; Lifecycle and pathogenicity of *Entamoeba histolytica* and *Plasmodium vivax*. Porifera: *Sycon*-Skeletal and canal systems. Coelenterata: *Obelia* – Morphology and reproduction. Helminthes: *Ascaris lumbricoides* – Morphology, life cycle and pathogenicity.

**UNIT 3:** Annelida: Leech – Morphology, digestive and urinogenital systems. Arthropoda: Cockroach – Morphology, digestive, respiratory, excretory and reproductive systems. Mollusca: *Pila* – Morphology, digestive, respiratory, excretory and reproductive systems. Echinodermata: *Asterias* – Morphology and water vascular system.

**UNIT 4:** Hemichordata: Salient features of *Balanoglossus*. Protochordata: Salient features of Amphioxus. *Petromyzon*: Morphology, respiratory and reproductive systems. Pisces: *Labeo* – Morphology, digestive and respiratory systems. Rabbit: Type Study – Morphology, digestive, respiratory, Circulatory, urinogenital and nervous systems.

**UNIT 5:** Origin of life; Theories of evolution: Lamarckism, Darwinism and Synthetic theory; Evidences of evolution – anatomical, embryological and paleontological; Geological time scale; Introduction to evolution of man.

### PAPER 1B (PRACTICAL)

#### A. Dissections

1. Nervous system of cockroach
2. Reproductive system of cockroach
3. Digestive system of *Channa/Labeo*/common carp
4. Afferent branchial system of *Channa/Labeo*/common carp
5. Demonstration of dissections of arterial, digestive and urinogenital system of albino mouse/albino rat/chicken

#### B. Mounting

1. General protocol for preparation of microscopic slides: Basic concepts of fixation, staining, dehydration, clearing and mounting
2. Permanent stained preparations of the following:
  - a. *Paramecium*/ *Euglena* (whole mount)
  - b. *Obelia* colony
  - c. Parapodium of *Neries*
  - d. Gemmules of sponge (whole mount)
  - e. Blood film of a vertebrate (single stain)

#### C. Osteology- Mammalia

1. Vertebrae
2. Limb bones and girdles
3. Skull

- D. Study of prepared slides
1. T/S of Earthworm through typhlosolar region
  2. T/S of male and female *Ascaris*
  3. T/S of Amphioxus through branchial region
  4. T/S of stomach, intestine, pancreas, liver, lung, kidney and gonads of a vertebrate
- E. Study of museum specimens
1. Representatives from Non-chordates and Chordates
  2. Study of fossils
  3. Evidences of evolution through charts and models

## II SEMESTER (Paper 2A)

**UNIT 1:** Prokaryotic and eukaryotic cells. Ultrastructure and functions of plasma membrane, mitochondria, endoplasmic reticulum, golgi complex, ribosomes, centrioles and lysosomes. Cytoskeleton: Introduction to microtubules and microfilaments.

**UNIT 2:** Nuclear envelope and nucleolus. Chromatin: Chemical composition and organisation of Euchromatin and heterochromatin; Chromosome: Morphology, primary constriction, secondary constriction, and satellite bodies. Classification on the basis of position of centromere; Polytene and lampbrush chromosomes.

**UNIT 3:** Cell cycle: Phases and regulation; Mitosis, meiosis, synaptonemal complex. Cancer: Characteristics of cancer cells, classification according to tissue types; Common carcinogens. Immunity: innate and acquired; Active and passive immunity; Cells and organs of the immune system.

**UNIT 4:** Mendel's experiments and principles of inheritance; Concept of genotype, phenotype, dominance, recessiveness, co-dominance and incomplete dominance; Back cross and Test cross. Chromosomal theory of inheritance. Multiple alleles (ABO blood groups in man); Gene interactions: Complementary, supplementary, inhibitory and duplicate types; Pleiotropic genes and lethal genes (Tay Sachs disease and sickle cell anemia).

**UNIT 5:** Linkage and crossing over. Sex determination: Chromosomal and genic balance theories, environmental factors. Chromosomal aberrations: Structural (deletion, duplication, inversion and translocation) and numerical (euploidy and aneuploidy)

## PAPER 2B (Practical)

1. Study of cell organelles from slides/models/charts
2. Preparation and study of different stages of mitosis in onion root tip.
3. Preparation (demonstration only) and study of different stages of meiosis from grasshopper testis using permanent slides.
4. Study of chromosome types from slides/photographs.
5. Preparation and study of polytene chromosomes from *Chironomus* larva.
6. Study of phenotypic variations in a natural population (at least 3 characters).
7. Determination and study of multiple alleles (ABO blood groups) and Rh factor.

### **III SEMESTER**

#### **PAPER 3A (THEORY)**

**UNIT 1:** Physiology of digestion and absorption of carbohydrates, proteins and lipids; Vitamins: Types, sources and their significance. Respiration: Breathing and gaseous exchange in vertebrate lung. Composition and functions of blood; Types of heart in vertebrates; Structure of mammalian heart.

**UNIT 2:** Ultrastructure of skeletal muscle; Mechanism of skeletal muscle contraction. Structure of mammalian kidney and nephron; Physiology of urine formation. Ultrastructure of neuron; nerve impulse conduction and synaptic transmission; Reflex action.

**UNIT 3:** Structure and functions of major endocrine glands: Hypothalamus, Pituitary, thyroid, parathyroid, pancreas, adrenals, testis and ovary. Introduction to neuroendocrine system in insects.

**UNIT 4:** Classification and significance of carbohydrates, proteins and lipids. Amino acids: Essential and non essential. Glycolysis and TCA cycle;  $\beta$ -Oxidation of fatty acids

**UNIT 5:** Enzymes: Properties, classification and nomenclature; Active site and mechanism of enzyme action; Factors affecting enzyme activity; Co-factors and co-enzymes. Nucleic acids: Nucleosides, nucleotides and polynucleotides; Double helical structure of DNA and structure of RNA.

#### **PAPER 3B (PRACTICAL)**

1. Preparation of haemin crystals from human blood.
2. Determination of clotting time of human blood.
3. Oxygen consumption in fish with reference to body weight.
4. Study of histology of endocrine glands from permanent slides (pituitary, thyroid, thymus, pancreas, adrenal, testis and ovary).
5. Detection of carbohydrates, lipids and proteins (at least 3 tests each).
6. Estimation of ascorbic acid by titration method.

### **IV SEMESTER**

#### **PAPER 4A (THEORY)**

**UNIT 1:** Gametogenesis: Spermatogenesis and oogenesis; Fertilisation; Parthenogenesis. Types of eggs; Cleavage and Types of cleavage. Process of blastulation, fate map and Gastrulation in frog upto the formation of three germ layers; Metamorphosis in insects and frog.

**UNIT 2:** Ecology: Concepts, subdivisions, scope and importance; Levels of organisation in the biosphere. Structure of ecosystem- Ecological factors (biotic and abiotic); Trophic structure: Food chains, food webs and energy flow; Trophic relationships- ecological pyramids. Productivity.

**UNIT 3:** Ecological niche. Population: Growth and regulation. Concepts of biotic community. Inter and intraspecific interactions. Resources (renewable and non renewable) and their management. Environmental pollution (air, water and soil).

**UNIT 4:** Pisciculture: Culturable fish species of India; Culture and management of fish with reference to composite fish culture; Induced breeding. Sericulture: Different species of silk moth; Life history of *Bombyx mori* and methods of culture; Products of sericulture and its economic importance.

**UNIT 5:** Apiculture: Species of honey bees; Life history and social organisation; Methods of bee keeping, economic importance. Integrated pest management (Physical, chemical, hormonal and biological).

### **PAPER 4B (PRACTICAL)**

1. Study of types of eggs in vertebrates
2. Study of larval forms (crustacean, molluscan and echinoderm) from permanent slides.
3. Study of the stages of development of frog from permanent slides in whole mount/sections (cleavage, blastula and gastrula).
4. Preparation of permanent slides of non chordate larval forms (Mysis, Nauplius, mosquito larva).
5. Study of metamorphosis in Amphibia (using Charts/Models)
6. Estimation of dissolved oxygen in water samples.
7. Estimation of carbon dioxide in water samples.
8. Estimation of total alkalinity in water samples.
9. Qualitative study of plankton from fresh water samples.
10. Study of the life cycle of silk moth.
11. Study of different castes of honey bee.
12. Identification of Indian major carps and common exotic carps.

## **V SEMESTER**

### **PAPER 5A (THEORY)**

**UNIT 1:** Protozoa: Locomotion and nutrition. Porifera : Canal and skeletal systems. Cnidaria: Polymorphism in Siphonophora; Corals and coral reefs. Morphological and physiological adaptations of parasitic helminthes. Annelida: Excretory system.

**UNIT 2:** Onychophora: General organisation and affinities. Arthropoda: Types of mouthparts and feeding in insects; Vision in insects. Mollusca: Torsion and detorsion in Gastropoda. Echinodermata: Comparative study of water vascular system.

**UNIT 3:** Hemichordata: Affinities of *Balanoglossus*. Protochordata: Affinities of *Amphioxus*. Retrogressive metamorphosis in *Ascidia*. Agnatha: Comparative study of *Petromyzon* and *Myxine*. Pisces: Scales and fins in fishes; Accessory respiratory organs; Migration of fishes. Dipnoi: General characters and affinities.

**UNIT 4:** Amphibia: Parental care. Reptilia: Poisonous and non-poisonous snakes, poison apparatus and mechanism of biting. Aves; Flight adaptations and migration in birds. Mammalia: Affinities of monotremata and marsupalia. Dentition in mammals. Comparative anatomy of kidney in vertebrates.

UNIT 5: Zoogeography: Concepts and zoogeographic realms, patterns and regulation of behaviour, genetic and hormonal. Colouration and mimicry. Adaptation in vertebrates: aquatic, desert, arboreal, cursorial and deep sea adaptations.

### **PAPER 5B (PRACTICAL)**

#### A. Dissections:

1. Nervous System in prawn/ earthworm
2. Accessory respiratory organ in teleost fish
3. Digestive system in albino rat/ albino mouse/ chicken
4. Reproductive system in albino rat/ albino mouse/ chicken

#### B. Mounting( permanent):

1. Cyclops
2. Setae of earthworm
3. Spicules of sponge
4. Scales ( cycloid, ctenoid and placoid) of fishes
5. Feathers of birds ( filoplumes, downfeathers, barbs and barbules)

#### C. Study of Permanent Slides and Specimens

1. Histology: T/S of stomach, intestine, liver, kidney, spleens and gonads of fish/aves/mammals
2. Permanent slides of representatives from Protozoa to Echinodermata( sections and whole mounts)
3. Adaptive modification of beak and feet in birds using charts and models

## **V SEMESTER**

### **PAPER 6A (THEORY)**

UNIT I: Genome organization in virus, bacteria and eukaryotes; Central dogma of molecular biology; DNA replication in prokaryotes; Transcription and translation in prokaryotes; Genetic code. Regulation of gene expression in prokaryotes: *lac operon*

UNIT II: Fine structure of gene: Cistron, recon and muton; Split genes and overlapping genes; Transposons. Gene mutations:Types and mutagenic agents; DNA damage and repair. Detection of mutation in *Drosophila* (Muller's CIB method)

UNIT III: Extra nuclear inheritance: Kappa particles in *Paramecium*. Sex-linked inheritance in *Drosophila* (eye colour) and man ( colour blindness); Dosage compensation and Lyon's Hypothesis. Non Disjunction of sex chromosomes in *Drosophila*; Human Karyotype. Sex determination in man; Genetic disorders in man – Down's, Turner's and Klinefelter's Syndrome, Phenylketonuria, Hemophilia

UNIT IV: Humoral and cell mediated immunity; Characteristics of antigens; Antibodies: structure, classes and functions; Antigen-antibody interaction; Major histocompatibility complex; Introduction to cytokines

UNIT V: Principles and applications of biological techniques: Light and electron microscopy; Centrifugation; Chromatography (paper, gel filtration and ion-exchange)

### **PAPER 6B (PRACTICAL)**

1. Separation and identification of amino acids by paper chromatography
2. Demonstration of antigen-antibody interaction in vitro: Single radial immune-diffusion in agarose gel
3. Study of nucleic acids from models/charts.
4. Calorimetric estimation of DNA and RNA
5. Preparation and identification of meiotic stages from grasshopper testis
6. Karyotyping of normal human chromosomes complement from supplied photographic plates
7. Karyotyping of chromosomal complement of Down's/Turner's/Klinefelter's syndrome from supplied photographic plates.
8. Demonstration of electrophoretic separation of DNA/protein

## **VI SEMESTER**

### **PAPER 7A (THEORY)**

UNIT 1: Chemical foundations of physiology: Concept of normal, molar and molal solutions; Acids, bases, pH and buffers; Diffusion and osmotic pressure. Enzyme kinetics: Michaelis-Menten equation and its relation to enzyme activity; Significance of  $K_m$  and  $V_{max}$ ; Enzyme inhibition (reversible and irreversible).

UNIT 2: Carbohydrates: Linear and ring forms of monosaccharides (Pentose and Hexose); Polysaccharides (starch, glycogen and hyaluronic acid); Glycogenesis and glycogenolysis. Electron transport system and oxidative phosphorylation. Amino acids, peptides and proteins: levels of organisation, transamination; deamination and urea cycle.

UNIT 3: Structure and functions of haemoglobin; Blood coagulation: Coagulation factors and mechanism. Cardiac cycle. Blood pressure and its regulation. Mechanism of gaseous exchange through gills and lungs. Osmoregulation in fish.

UNIT 4: Neurosecretory cells; Types of neurohormones; Endocrine and paracrine hormones; Placental hormones; Hormones of gastrointestinal tract; Pheromones. Biosynthesis of thyroid hormones. Mechanism of hormone action: Peptide/protein and steroid hormones.

UNIT 5: Reproductive cycles (estrous and menstrual) in mammals; Hormonal regulation of spermatogenesis and oogenesis in humans; In vitro fertilisation and embryo transfer technology; Pregnancy hormones; Lactation; Contraceptive methods for males and females.

## **PAPER 7B (PRACTICAL)**

1. WBC count in human blood.
2. RBC count in human blood.
3. Estimation of glucose by colorimetric method.
4. Estimation of protein by colorimetric method (Lowry's/Biuret) method
5. Study of human salivary amylase activity in relation to temperature.
6. Estimation of haemoglobin in human blood.
7. Dissection and display of pituitary and gonads in a teleost.
8. Dissection and display of endocrine glands in albino mouse/rat.
9. Microtomy: Preparation of histological slides of vertebrate tissues- liver, kidney, gonads, intestine and adrenal (minimum four slides of different tissues).

## **VI SEMESTER**

### **PAPER 8A (THEORY)**

UNIT 1: Patterns of cleavage; Morphogenetic movements (epiboly, invagination, ingression, involution and delamination); Embryonic induction and concept of Organiser; Gastrulation in chick up to the formation of three germinal layers.

UNIT 2: Foetal membranes and types of placenta in mammals; Organogenesis of the vertebrate eye; Regeneration in invertebrates and vertebrates; Teratogenesis and developmental birth defects. Concepts of Ageing.

UNIT 3: Salient features of aquatic and terrestrial ecosystems. Liebig's law of limiting factors and Shelford's law of tolerance. Biogeochemical cycles: carbon, phosphorous and nitrogen cycles. Ecological succession. Major Biomes.

UNIT 4: Environmental concerns: Radioactive pollution; Biological indicators; Biomagnification; Anthropogenic activity and environment: Ozone depletion; Green house effect and global warming; Acid rains. Wildlife conservation: In situ (sanctuaries, national parks and biosphere reserves) and ex situ (botanical and zoological gardens, Germplasm Bank).

UNIT 5: Introduction to genetic engineering; Restriction enzymes. Cloning vectors: Plasmid, cosmid,  $\lambda$  phage, shuttle vectors; Expression vectors. Introduction to host cells: Transformation, transduction; Particle gun. Southern blotting; PCR; DNA Fingerprinting; Genomic library and cDNA library; Application of recombinant DNA technology. Ethical issues and Biosafety regulations.

## **PAPER 8B (PRACTICAL)**

1. Preparation of whole mount of chick embryo.
2. Study of regeneration in Hydra/Planaria.
3. Study of whole mount/sections of different developmental stages of chick embryo from permanent slides.
4. Community analysis
5. Qualitative analysis of aquatic communities from different water bodies.
6. Estimation of total hardness of water samples.
7. Quantitative estimation of plankton.
8. Analysis of community similarities and species diversity indices.
9. Field trip and submission of Field Report.