

# DRAFT SYLLABUS UNDER AUTONOMY

## ZOOLOGY

**SEMESTER I**

**COURSE : S.ZOO.1.01**

**ANIMAL SYSTEMATICS AND ECOLOGY**

**[45 lectures]**

### LEARNING OBJECTIVES:

To teach students basic classification of animals (vertebrates and invertebrates), and provide an understanding of how environment affects the distribution of animals.

### UNIT I : INVERTEBRATE CLASSIFICATION

**[15 Lectures]**

#### Levels of organization:

**(3 lectures)**

- Concept of Unicellularity and Multicellularity, Organization of germ layers (Diploblastic and Triploblastic), Organization of tissues (Fate of ectoderm, Mesoderm and Endoderm)
- Division of labour and Colonization
- Development of coelom: Acoelomate, pseudocoelomate, coelomate organization.
- Symmetry (Radial and Bilateral), Segmentation and Cephalization.

#### Salient features, with examples, for Phyla, subphyla and classes.

**(12 lectures)**

- Unicellular organization: Phylum Protozoa
- Multicellular organization: Colonization level – Phylum Porifera
- Multicellular organization: Division of labour – Phylum Coelenterata
- Acoelomate organization: Phylum Platyhelminthes.
- Pseudocoelomate organization: Phylum Nematelminthes.
- Coelomate organization with metameric segmentation: Phylum Annelida
- Coelomate organization with jointed appendages: Phylum Arthropoda.
- Coelomate organization with mantle: Phylum Mollusca
- Coelomate organization with enterocoel: Phylum Echinodermata

### UNIT II : VERTEBRATE CLASSIFICATION

**[15 lectures]**

- **Phylum Hemichordata**
- **Phylum Chordata**

- Subphylum Urochordata
- Subphylum Cephalochordata.
- Subphylum Vertebrata
  - ❖ Superclass: Agnatha
    - Class Cyclostomata
  - ❖ Superclass: Gnathostomata
    - Class Pisces
    - Class Amphibia
    - Class Reptilia
    - Class Aves
    - Class Mammalia

### **UNIT III : ECOLOGY**

**[15 lectures]**

- Concept of Ecosystem
- Concept of energy flow, food chain and food web
- Concept of biogeochemical cycles (Carbon, oxygen, nitrogen, phosphorus and water cycles)
- Human activities affecting biogeochemical cycles
- Ecological niches and adaptation
- Biodiversity Definition of Biodiversity hotspots, benefits of biodiversity, Conservation of biodiversity.
- Human activities affecting biodiversity.

### **C.I.A. : Quiz and Field Report**

## **SEMESTER I**

**COURSE : S.ZOO.1.02**

### **GENETICS AND BIOTECHNOLOGY**

**[45 lectures]**

#### **LEARNING OBJECTIVES:**

1. To provide an understanding of the basic principles and practices in biotechnology and its exploitation in commercial practice.
2. To learn and understand the basic laws of genetics that governs heredity and its applications for humans.

### **UNIT I : BIOTECHNOLOGY - 1**

**[15 lectures]**

- Concept of Biotechnology: Definition and overview.
- Sterilization: Principle of Dry Heat sterilization, Steam sterilization, Disinfection.

- Molecular Separation Techniques: Principle of Chromatography and Electrophoresis
- Food Biotechnology: Preparation of Bread, Beer and Wine.
- Enzyme Biotechnology: Enzymes as meat tenderizer, Bio-detergents and concept of enzyme immobilization
- Transgenic animals e.g. production of Pharmaceuticals ( $\alpha$ -1 anti-trypsin)

## **UNIT II: BIOTECHNOLOGY - 2**

**[15 lectures]**

- Animal cloning e.g. Dolly
- Ex-vivo and In-vivo strategies in Gene therapy.
- Ethical issues related to Gene therapy
- Concept of Bioremediation
- Use of microbes in bioremediation of hydrocarbons (PAHs)

## **UNIT III : MENDELIAN AND HUMAN GENETICS**

**[15 lectures]**

- History of Mendelian genetics
- Concept of gene and allele in genetics.
- Concept of Dominance, Segregation and Independent Assortment
- Mendelian Monohybrid inheritance.
- Exceptions to Monohybrid inheritance: Lethal genes, Co-dominance and Incomplete dominance.
- Mendelian Dihybrid inheritance.
- Variations of Dihybrid inheritance: Recessive Epistasis, Dominant Epistasis, Inhibitory gene interaction.
- Multiple Alleles: Concept with e.g. Human Blood group system.
- Cytoplasmic inheritance: Kappa particles in Paramecium, Shell coiling in Limnea
- Mendelian genetics in humans: Autosomal Dominant inheritance, Autosomal recessive inheritance, X-linked recessive inheritance, X-linked Dominant inheritance.
- Human pedigree analysis based on inheritance patterns.

**C.I.A. : Quiz**

**SYSTEMS BIOLOGY AND ETHOLOGY**

**[45 lectures]**

**LEARNING OBJECTIVES:**

1. To help students appreciate the complexity of systems and differences in the physiology of animals.
2. To help students understand animal interactions and the importance of behavior for survival.

**UNIT I : SYSTEMS BIOLOGY – I**

**[15 lectures]**

**Movement and locomotion:**

**[04 lectures]**

- Amoeboid movement
- Ultrastructure of cilia and ciliary movement
- Ultrastructure of myofibril and sliding filament theory
- Action of muscle (Role of muscle in movement)

**Nutrition:**

**[04 lectures]**

- Animals without alimentary canal e.g. Amoeba
- Animals with incomplete alimentary canal e.g. Hydra
- Animals with complete alimentary canal e.g. Bird

**Brief account of physiology of digestion in vertebrates and symbiotic digestion in Ruminants.**

➤ **Respiration:**

**[04 lectures]**

- Types of respiratory surfaces: Trachea, spiracles, gills, lungs of Frog and Human, Air sacs of birds.
- External respiration and cellular respiration with reference to human.

➤ **Circulation:**

**[03 lectures]**

- Types of circulating fluids: Water, coelomic fluids, lymph and blood.
- Types of circulation: Protoplasmic streaming
- Open and closed circulation, single and double circulation.
- Heart in Daphnia, cockroach and chordates
- Structure of cardiac muscle.

**UNIT II : SYSTEMS BIOLOGY – II**

**[15 lectures]**

➤ **Excretion and Osmoregulation**

**[04 Lectures]**

- Concept of osmoregulation and excretion

- Categorization of animals on the basis of principal nitrogenous excretory products
- Ornithine cycle, formation of urea, deamination and detoxication

➤ **Control and Coordination:** **[04 Lectures]**

- Irritability
- Structure of a neuron: sense organs, human eye and ear
- Conduction of nerve impulse: Resting potential and refractory period
- Synaptic transmission.
- Endocrine regulation: Hormones as chemical messengers, feedback mechanisms.

➤ **Reproduction:** **[03 Lectures]**

- Gametogenesis, structures of egg and sperm of mammal
- Fertilization and Invitro fertilization
- Oviparity, viviparity and ovoviviparity

**UNIT III : ETHOLOGY** **[15 lectures]**

➤ **Development of behaviour and animal learning:**

- Ontogeny of behaviour
- Environmental influence on behaviour
- Sensitive periods during development
- Classical conditioning, extinction and habituation
- Instrumental learning and use of reinforcers
- Concept of Animal interactions: Symbiosis, Mutualism, Commensalism, Parasitism, Predation and Antibiosis
- Cognitive aspects of learning:
- Nature of cognitive process
- Insight learning

**C.I.A. : Quiz**

**SEMESTER II**

**COURSE : S.ZOO.2.02**

**EVOLUTION AND BIOCHEMISTRY**

**[45 lectures]**

**Learning Objectives:**

1. To help students gain a holistic understanding of the various theories on the origin of life.
2. To understand the structure and functioning of basic biomolecules.

## UNIT I : MOLECULAR BASIS OF LIFE - I

[15 lectures]

- **Biological Micro and macromolecules – Monomeric constituents, polymers and significance Of carbon.**
  - **Proteins:**
    - Amino acids: Types based on carboxylic, amino and aromatic groups
    - Peptide bond
    - Structure of proteins: Primary, secondary, tertiary and quaternary structure
    - Biological role of proteins.
  - **Carbohydrates:**
    - Nomenclature, isomerism and classification
    - Glycosidic bond
    - Types of carbohydrates: Monosaccharides – Glucose, fructose, galactose  
Disaccharides – maltose, sucrose, lactose  
Polysaccharides – Starch, glycogen, cellulose, chitin and heparin
  - **Biological role of Carbohydrates**

## UNIT II : MOLECULAR BASIS OF LIFE - II

[15 lectures]

- **Lipids:**
  - Fatty acids: Structure, types and properties
  - Mono, di and triglycerides
  - Phospholipids, sphingolipids
  - Sterols and waxes
  - Biological role of lipids
- **Nucleic acids:**
  - Chemical structure of nitrogenous bases, pentoses
  - Nucleosides and nucleotides
  - Polynucleotide: 3' → 5' phosphodiester linkage.
  - Types of RNA: mRNA, tRNA and rRNA
  - Cloverleaf model of tRNA
- **Differences between DNA and RNA**

## UNIT III : EVOLUTION

[15 lectures]

- Theories of Evolution:
  - Prebiotic evolution
  - Panspermia
  - Biotic evolution

- Concept of Microevolution and Co-evolution
- Concept of Variation in population
- Speciation mechanisms: Allopatric and Sympatric speciation
- Isolating mechanisms in nature: Spatial, Ethological, reproductive
- Genetic drift

## C.I.A. : Quiz

## PRACTICALS

### SEMESTER I

### COURSE : S.ZOO.1.PR

#### PRACTICAL 1.

1. Levels of organization in the animal kingdom
  - A] Symmetry:
    - i) Asymmetric organization: Amoeba
    - ii) Radial symmetry: Sea anemone
    - iii) Bilateral symmetry: Planaria
  - B] Acoelomate: T.S. of Liverfluke
  - C] Pseudocoelomate: T.S. of Ascaris
  - D] Coelomate: T.S. of Earthworm
  - E] Segmentation:
    - i) Pseudosegmentation: Tapeworm
    - ii) Metamerism: Earthworm
  - F] Cephalization:
    - i) Cockroach – Head
    - ii) Cephalothorax - Prawn
  
2. Animal Diversity
 

Protozoa:	Amoeba, Euglena
Porifera:	Leucosolenia, bath sponge
Coelenterata:	Hydra, Obelia colony, Aurelia any one coral
Platyhelminthes:	Planaria, Liver fluke, Tapeworm
Nemathelminthes:	Ascaris (male and female)
Annelida:	Earthworm and Leech
Arthropoda:	Crab, lobster, Lepisma, beetle, dragonfly, butterfly, spider, centipede, millipede
Mollusca:	Chiton, Dentalium, Pila, bivalve, Sepia, Nautilus
Echinodermata:	Starfish, brittle star, sea urchin, sea cucumber, feather star
Hemichordata:	Balanoglossus
Urochordata:	Herdmania
Cephalochordata:	Amphioxus
Cyclostomata:	Petromyzon/Myxine
Pisces:	Chondrichthyes – Shark, sting ray Osteichthyes – Sciaena, flying fish
Amphibia:	Frog, toad, Caecilian, salamander
Reptilia:	Chameleon, Calotes/Gecko, turtle, tortoise, snake, crocodile

Aves: Kite, duck  
Mammalia: Hedgehog, bat

3. Study of Paramoecium culture to observe live Paramoecium
4. Study of nutritional apparatus: Amoeba, L.S. of Hydra, Planaria, digestive system of cockroach and earthworm (both for demonstration only), wheel organ of Amphioxus, scroll valve of Shark, digestive system of Pigeon, ruminant stomach.
5. Detection of activity of digestive enzymes (invertase, amylase, protease, lipase) from the gut of cockroach

## **PRACTICAL 2.**

1. Handling of common laboratory equipment: Autoclave, Centrifuge, Homogenizer, electrophoresis apparatus. Study of Microscope: Use, care and function of its components.
2. To demonstrate fermentation of grape juice/sugarcane juice or any fruit juice – (detection of alcohol generated during fermentation by benzoic acid)
3. Effect of papain (raw papaya extract ) as a meat tenderizer
4. Identification through photographs: Methodology for transgenesis
  - i) Microinjection into egg
  - ii) Transgenesis of embryonic stem cell
  - iii) Methodology for gene therapy for SCID or any human disease
5. Human pedigree analysis: Dominant, recessive and X-linked characters.
6. Demonstration of agarose gel electrophoresis for the separation of egg white proteins.
7. Study of bacteria by Gram staining method
8. To evaluate the quality of milk by methylene blue reduction method.

## **SEMESTER II**

## **COURSE : S.ZOO.2.PR**

### **PRACTICAL 1.**

1. Study of effect of pH on amylase activity
2. Mounting of trachea and spiracles from cockroach, study of gills of fish, lung of frog and mammal.
3. Study of heart of cockroach, determining the rate of heart beat in Daphnia, Study of whole mounts and L.S. of following hearts: Fish (2-chambered), Frog (3-chambered), Mammal (4-chambered).
4. Study of permanent slides of blood smear of Frog and Mammal
5. Mounting of nephridium of earthworm, observation of sagittal section of mammalian kidney, permanent slide of T.S. of mammalian kidney, Bowman's capsule.
6. Urine analysis for detection of normal and abnormal constituents.
7. Detection of Ammonia in the water excreted by fish.
8. Detection of uric acid from the excreta of bird.

9. Study of mammalian brain, Observation of T.S. of mammalian spinal cord.
10. Observation of permanent slides of: Sponge gemmule, Hydra budding, mammalian sperm, T.S. mammalian testis, T.S. mammalian ovary showing Graffian follicle, observation of hen's egg with developing embryo at any stage of development.
11. Study of animal interactions:
  - a. Commensalism – Hermit crab and Sea anemone, Echinus and shark
  - b. Parasitism – Ectoparasite: head louse and bed bug  
Endoparasitism: *Trichinella spiralis*
  - c. Predation – Praying mantis, spider
12. Determination of Population density by sub-sampling method.
13. Mimicry: Leaf insect, stick insect, stick worm (caterpillar), Kallima butterfly, Monarch butterfly and common tiger butterfly (Danais)

## **PRACTICAL 2.**

1. Paper chromatography for separation of amino acids.
2. Thin layer chromatography of lipids and adsorption chromatography using chalk to separate pigments.
3. Qualitative tests for proteins, lipids and carbohydrates
4. Extraction and qualitative detection of nucleic acids: DNA (SDS-NaCl extraction), RNA (Phenol extraction)
5. Preparation of beads of calcium alginate for immobilization of enzyme amylase or yeast cells
6. Assay of immobilized invertase from immobilized yeast cells by DNSA method.
7. Study of evidence of evolution:
  - A] Analogy – i) Leg of grasshopper and leg of mammal  
ii) Wing of insect, wing of bird, wing of bat
  - B] Homology – i) Fore limb of an amphibian and a reptilian  
ii) Wing of bird and bat
  - C] Study of fossils: Tribolite and Ammonite
  - D] Study of living fossils: Limulus and Lingula

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