

**SYLLABUS FOR B.Sc. ZOOLOGY**  
**NETAJI SUBHAS UNIVERSITY, JAMSHEDPUR**

*(2021-2024)*



**DEPARTMENT OF ZOOLOGY**  
**NETAJI SUBHAS UNIVERSITY, JAMSHEDPUR**

## Semester –I

COURSE	Code Of Papers	Name of Papers	Internal marks	External marks	Practical marks	Total Marks
Core Course	C-1	Systematic & Diversity of Non chordate	20	50	30	100
	C-2	Biochemistry	20	50	30	100
	P-1	Practical based in C-1 & c-2				
AECC Ability Enhancement Compulsory Course	AECC-1	Communicative English /MIL	20	30	--	50
Generic Elective	GE-1	Chemistry/ /Botany	20	50	30	100
		Practical-GE				
						350

## Semester –II

COURSE	Code Of Papers	Name of Papers	Internal marks	External marks	Practical marks	Total Marks
Core Course	C-3	Diversity of chordates	20	50	30	100
	C-4	Molecular Biology	20	50	30	100
	P-2	Practical based on C-3 & C-4				
AECC Ability Enhancement Compulsory Course	AECC-2	Environmental Science	20	30	---	50
Generic Elective	GE-2	Chemistry/ /Botany	20	50	30	100
		Practical-GE				
						350

## Semester –III

COURSE	Code Of Papers	Name of Papers	Internal marks	External marks	Practical marks	Total Marks
Core Course	C-5	Endocrinology	20	50	30	100
	C-6	Immunology	20	50	30	100
	C-7	Ecology	20	50	30	100
	P-3	Practical based on C-5,C-6& C-7				
Skill Enhancement Course	SEC-1	IT Skill	15	25	10	50
Generic Elective	GE-3	Chemistry/ /Botany	20	50	30	100
		Practical-GE				
						450

## Semester –IV

COURSE	Code Of Papers	Name of Papers	Internal marks	External marks	Practical marks	Total Marks
Core Course	C-8	Genetics	20	50	30	100
	C-9	Evolution	20	50	30	100
	C-10	Cell biology	20	50	30	100
	P-4	Practical based on C-8,C-9& C-10				
Skill Enhancement Course	SEC-2	IT Skill	15	35		50
Generic Elective	GE-4	Chemistry/ /Botany	20	50	30	100
		Practical-GE				
						450

## Semester –V

COURSE	Code Of Papers	Name of Papers	Internal marks	External marks	Practical marks	Total Marks
Core Course	C-11	Animal physiology: life sustaining systems	20	50	30	100
	C-12	Biotechnology	20	50	30	100
	P-5	Practical based on C-11& C-712				
Discipline specific Elective	DSE-1	Economic Zoology	20	50	30	100
	DSE-2	Project work	-----			100
	P-6	Practical on DSE-1				30
						400

## Semester –VI

COURSE	Code Of Papers	Name of Papers	Internal marks	External marks	Practical marks	Total Marks
Core Course	C-13	Developmental biology	20	50	30	100
	C-14	Biostatistics	20	50	30	100
	P-7	Practical based on C-11 & C-12				
Discipline specific Elective	DSE-3	Wild Life conservation & Management	20	50	30	100
	DSE-4	Project work	-----			100
	P-8	Practical on DSE-3				30
						400

# **B.Sc. (Honours) Zoology**

## **Semester I**

### **Core Course –(C-1): Systematic & Diversity of Non chordate**

#### **UNIT-I:**

- 1.1 Elementary Knowledge of Zoological nomenclature and international code.
- 1.2 Classification of lower invertebrates. (Protozoa, Porifera, Coelenterates)
- 1.3 Classification of higher invertebrates (Annelida, Arthropoda, Mollusca, Echinodermata)

#### **UNIT-II:**

- 2.1 Protozoa — Type study of Plasmodium.
- 2.2 Protozoa and Diseases.
- 2.2 Porifera— Type study of Sycon
- 2.4. Corals and Coral Reef formation

#### **UNIT-III:**

- 3.1 Helminthes: Type study of Fasciola hepatica
- 3.2 Platyhelminths and diseases
- 3.3 Nematodes and diseases
- 3.4 Annelida — Type study of earthworm, metamerism

#### **Unit IV:**

- 4.1 Arthropoda— Type study of Prawn
- 4.2 Type study of Periplaneta
- 4.3 Insect and vectors of human diseases.
- 4.4 Mollusca— Type study of Pila

#### **UNIT-V**

- 5.1 Echinodermata— External Features and water vascular system of Starfish
- 5.2 Larval forms of Echinoderms
- 5.3 Hemichordata : Type study of *Balanoglossus*
- 5.4 Affinities of *Balanoglossus*.

#### **References:**

1. Parker, T.J. & Haswell, W.A. A Text –book of zoology, volume 1, McMillan co.
2. Brooks, W.K. Handbook of invertebrate zoology .Kessinger Publishers.

# **B.Sc. (Honours) Zoology**

## **Semester-I**

### **Core Course (C-2): Biochemistry**

#### **Unit I**

- 1.1 Carbohydrates: Classification of carbohydrates
- 1.2 Monosaccharide's: Structure, types and properties of monosaccharide's
- 1.3 Oligosaccharides: Structure, types and properties of oligosaccharides.
- 1.4 Polysaccharides: Structure, types and properties of Polysaccharides.

#### **Unit II:**

- 2.1 Amino acids and its types on the basis of solubility
- 2.2 Essential and Non essential amino acids Amino acids and formation of peptide bonds.
- 2.3 Proteins and their classification
- 2.4 Functions of amino acids.

#### **Unit III:**

- 3.1 Lipids and its structure
- 3.2 Lipids: Classification
- 3.3 Saturated and unsaturated fatty acids
- 3.4 Functions of lipids

#### **Unit IV:**

- 4.1 Enzyme: Chemical nature and properties.
- 4.2 Factors affecting enzyme activity
- 4.3 Enzyme inhibition: Reversible and Irreversible
- 4.4 Mechanism of Enzyme action: Lock and Key model and Induced fit theory

#### **Unit V:**

- 5.1 Vitamins: Classification of vitamins
- 5.2 Fat soluble vitamins and their functions
- 5.3 Water soluble vitamins and their functions
- 5.4 Diseases associated with the deficiency of vitamins

#### **References:**

1. Murray, R.K., Granner, D.K., Mayer, P.A. & Rodwell, V.W. Harper's Biochemistry. McGraw- Hill Publ
2. Lehninger, A.L., Nelson, D.L. & Cox, M.M. Principles of Biochemistry. CBSD Publishers & Distributors, Delhi.

## **Practical (P-1)**

1. Collection of specimens, recording of : locality, co-ordinates, altitude, river basin, lake ,mountain range etc.,
2. Method of collection, name, description and characters of particular organisms.
3. Fixation and preservation techniques-wet, dry, slide preparation
4. Description of a species.
5. Specimens: Sycon, spongilla, physalia, porita, FaviaTubipora, Madrepora, Aurelia seaanemoneAlcyonium, TaeniaHetroneis, Aphrodite, chaetopterusabella Leech, Bonellia spider limulusmillipede centipede crab, peripatusscopion, Termite, Daphnia Cyclops Balanuschiton,Dentallium pearl Oyester, Limax, Nautilus, Octopus sepia LoligosolenAplysia starfish Antedon,Holothuria sea urchin, Brittle star.
6. Quantification of Carbohydrates
7. Quantification of Lipids
8. Quantification of Proteins
9. Separation of amino acid using Paper chromatography
10. Separation of amino acid using Thin Layer chromatography

# **B.Sc. (Honours.) Zoology**

## **Semester-II**

### **Core Course (C-3 ):Diversity of chordates**

#### **UNIT-I:**

- 1.1 General account & affinities of Hemichordata
- 1.2 General account & affinities of Urochordates
- 1.3 General account & affinities of Cephalochordates,
- 1.4 Affinities of Prototheria&Metatheria

#### **UNIT-II**

- 2.1 General characters and classification of Cyclostomes
- 2.2 General characters and classification of Fishes
- 2.3 General characters and classification of Amphibians
- 2.4 General characters and classification of Reptiles

#### **UNIT III:**

- 3.1 Parental Care of Amphibia.
- 3.1 Flight adaption in Birds
- 3.2 Migration in Birds
- 3.3 Origin and evolution of Amphibia

#### **UNIT- IV**

- 3.1 Retrogressive metamorphosis in Urochordates
- 3.2 Comparative account of Petromyzon and Myxine
- 3.3 Accessory Respiratory organ in fishes
- 3.4 Pedogenesis and neoteny with special reference to Axolotl larvae

#### **UNIT-V:**

- 4.1 Poisonous & Non-poisonous India,Biting& feeding mechanism of Snakes
- 4.2 Parental care in Fishes
- 4.3 Comparative anatomy of Integument : Reptiles, Birds, Mammals
- 4.4 Comparative anatomy of heart, kidney in vertebrates

#### **References:**

1. Sedgewicke, A. A student textbook of Zoology. Central Book Depot, Allahabad
2. Kent Jr. G.e. 1969. Comparative Anatomy of the vertebrates. The C.Y. Mosby Corn. Toppan, Japan.



# **B.Sc. (Honours.) Zoology**

## **Semester-II**

### **Core Course (C-4): Molecular Biology**

#### **Unit I**

- 1.1 Nucleic acid: Sugars and bases.
- 1.2 Watson Crick model of DNA
- 1.3 Difference between A, B and Z type of DNA.
- 1.4 Denaturation of DNA strands

#### **Unit II:**

- 2.1 Ribonucleic acid: Sugars and bases.
- 2.2 Structures of RNA
- 2.3 Different types of RNA
- 2.4 RNA as catalyst: Ribozyme

#### **Unit III:**

- 3.1 Double helical structure of DNA
- 3.2 Eukaryotic DNA packaging
- 3.3 Establishment of DNA as genetic material
- 3.4 Different types of enzymes involved in DNA replication

#### **Unit IV:**

- 4.1 Replication in prokaryotes
- 4.2 Transcription in prokaryotes
- 4.3 Genetic code: Wobble hypothesis
- 4.4 Translation in Prokaryotes

#### **Unit V:**

- 5.1 Concepts of Operon (Positive and Negative, Inducible and Repressible)
- 5.2 Lac Operon and its mechanism
- 5.3 Trp Operon and its regulation

#### **References:**

1. De Robertis- Cell and Molecular Biology
2. Alberts et al.: Molecular Biology of the cell. Garland Publ., New York.

## **Practical (P-2)**

1. Study of specimens : Amphioxus, Balanoglossus, Ascidian, Petromyzon, Myxine, Electric ray, Sea horse, Saw fish, Sucker fish, Hammer headed shark, Salamander, Hyla, Hemidactylus, Mabuaia, Varanus, Turtle, Tortoise, Chameleon, Draco, Cobra, Viper, sea-snake, Krait, Parrot, Cuckoo, Kite, Myna, Flying fox, Duck-billed Platypus, Echidna.
2. Study of bones: 1. Toad or Frog - skull, lower jaw, pectoral & pelvic girdles, vertebrae 2. Calotes - skull, lower jaw, pectoral & pelvic girdles, atlas and axis. 3. Pigeon - lower jaw, cervical vertebrae, rib, pectoral and pelvic girdles and pygostyle. Rabbit - skull, lower jaw, pectoral and pelvic girdles.
3. Identification of DNA using UV-Visible Spectroscopy
4. Identification of RNA using UV-Visible Spectroscopy
5. Identification of Protein using UV-Visible Spectroscopy
6. Quantification of DNA using DPA methods
7. Quantification of RNA using Orcinol methods

# **B.Sc. (Honours.) Zoology**

## **Semester-III**

### **Core Course (C-5 ): Endocrinology**

#### **Unit I:**

- 1.1 Endocrine glands: Definition of endocrine, Paracrine and Autocrine system.
- 1.2 Neurosecretory cells
- 1.3 Significance of endocrine and neuro - endocrine system.
- 1.4 Classification of hormone

#### **Unit II:**

- 2.1 Structure of Hypothalamus
- 2.2 Structure of pituitary gland
- 2.3 Hormones of pituitary glands and their functions
- 2.4 Disorders of pituitary gland hormones

#### **Unit III**

- 3.1 Structure of Thyroid Gland – Biosynthesis of Thyroid Hormones
- 3.2 Biological functions of Thyroxin
- 3.3 Regulation of Thyroid Secretion
- 3.4 Thyroid Dysfunction-parathyroid Glands

#### **Unit IV:**

- 4.1 Biological Action of parathyroid Hormones – parathyroid Dysfunction.
- 4.2 Structural features – Hormones of Adrenal Cortex
- 4.3 Biological Action of Adrenaline and Noradrenaline – Emergency Hormones.
- 4.4 Islets of Langerhans: Insulin and their functions

#### **Unit V:**

- 5.1 Male Reproductive system – Hormonal control of Testes
- 5.2 Chemistry of Testosterone – Functions of Testosterone
- 5.3 Female Reproductive system-Role of Hormones in Female Sexual cycle
- 5.4 Placental Hormones – parturition-Lactation.

#### **References:**

1. Rastogi, S.C. Essentials of Animal Physiology. Wiley Eastern Ltd
2. Guyton, A.C. & Hall, J.E. Textbook of Medical Physiology. 9th Edn., Elsevier, a division of Reed Elsevier India Pvt., Ltd.

# **B.Sc. (Honours.) Zoology**

## **Semester-III**

### **Core Course (C-6):Immunology**

#### **Unit I:**

- 1.1 Immunity: Introduction
- 1.2 Cells of immune system
- 1.3 Cells and organs of Immune system (Primary and Secondary Lymphoid organs)
- 1.4 Haematopoeisis.

#### **Unit II:**

- 2.1 Types of Immunity – Innate and acquired.
- 2.2 Basic properties of antigens
- 2.3 B and T cell epitopes, haptens, and adjuvants.
- 2.4 Structure, function and types of an antibody.

#### **Unit III:**

- 3.1 Monoclonal antibodies and their production
- 3.2 Antigen-antibody interactions as tools for research and diagnosis.
- 3.3 T-Cell and B-Cell activation.
- 3.4 Humoral and Cell mediated immunity.

#### **Unit IV:**

- 4.1 Structure and functions of major histocompatibility complex.
- 4.2 Basic properties and functions of Cytokines
- 4.3 Elementary idea of Complement system
- 4.4 Interferon: Definition and uses

#### **Unit V:**

- 5.1 Basic idea of Hypersensitivity
- 5.2 Concept of Autoimmunity
- 5.3 Immunodeficiency: AIIDS
- 5.4 Introduction to Vaccines and types of Vaccines.

#### **References:**

1. Kindt, T. J., Goldsby, R. A., Osborne, B. A., Kuby, J. (2006). VI Edition. Immunology. W.H. Freeman and Company.
2. Delves, P. J., Martin, S. J., Burton, D. R., Roitt, I.M. (2006). XI Edition. Roitt's Essential Immunology, Blackwell Publishing.

# **B.Sc. (Honours) Zoology**

## **Semester-III**

### **Core Course (C-7):Principle of Ecology**

#### **Unit I:**

- 1.1 Basic concepts of Ecology: Definition, significance, Concepts of habitat and ecological niche.
- 1.2 Factors affecting Environment: Abiotic factors (light-intensity, quality and duration), temperature, humidity, topography; edaphic factors; biotic factors.
- 1.3 Population Growth Kinetics: Growth models
- 1.4 Population Interactions: Neutralism, Mutualism, Commensalism, Competition, Amensalism, Predation, Parasitism.

#### **Unit II:**

- 2.1 Ecosystem: Types structure and function
- 2.2 Factors affecting ecosystem: Biotic and Abiotic factors
- 2.3 Energy flow in Ecosystem
- 2.4 Ecological Pyramids: Pyramid of number, Pyramid of Biomass and Pyramid of energy

#### **Unit III:**

- 3.1 Fresh water habitat
- 3.2 Marine habitat
- 3.3 Terrestrial habitat
- 3.4 Biodiversity: Natural resources and their conservation with special reference to forests

#### **Unit iv:**

- 4.1 Air pollution and its control.
- 4.2 Water pollution and its control
- 4.3 Domestic and industrial sewage treatment plants, BOD and COD of water
- 4.4 Green house effect and global warming, Ozone depletion, Causes of deforestation and reforestation

#### **Unit V:**

- 5.1 Wild life conservation and Wild life protection act
- 5.2 Endangered species of India
- 5.3 National parks and Sanctuaries of India
- 5.4 Urbanization and effect of human population on environment.

#### **References:**

1. Elements of Ecology – T. H. Smith and R. L. Smith
2. Ecology: Principles and Applications – J. L. Chapman & M. J. Reiss(Cambridge Univ. Pr.)

### **Practical (P-3)**

1. Determination of Blood group and Rh factor of Blood.
2. Separation of Plasma from RBC
3. Effects of isotonic, hypotonic and hypertonic solutions on erythrocytes
4. Counting of RBC using Haemocytometer
5. Counting of WBC using Haemocytometer
6. Estimation of haemoglobin percentage of a blood sample
7. Coagulation of blood timing
8. Recording of frog's heart beat
9. Antigen –Antibody interaction (ELISA methods)
10. Demonstration of immunoelectrophoresis
11. Study of ecosystem of a pond.
12. Identification of biotic and abiotic components affecting the pond ecosystem
13. Estimation of turbidity, temperature and pH of pond water.
14. Estimation of air pollution on local flora and fauna of heavily populated area.

# **B.Sc. (Honours.) Zoology**

## **Semester-IV**

### **Core Course (C-8): Genetics**

#### **Unit I :**

- 1.1 Elements of heredity & variation
- 1.2 Mendel's laws of inheritance, Monohybrid and dihybrid cross, their significance and current status
- 1.3 Gene interaction: Incomplete dominance and codominance, Multiple alleles, Lethal alleles, Epistasis, Pleiotropy
- 1.4 Pedigree analysis

#### **Unit II :**

- 2.1 Environmental effects on phenotypic expression of the organisms
- 2.2 Multiple Alleles: Coat Colour in mice, ABO Blood group in man, Rh factor
- 2.3 Linkage and crossing over: Cytological basis of crossing over, Molecular mechanism of crossing over
- 2.4 Recombination: Types and significance

#### **Unit III:**

- 3.1 Chromosomal Mutations: Deletion, Duplication, Inversion, Translocation, Aneuploidy and Polyploidy
- 3.2 Gene mutations: Induced versus Spontaneous mutations
- 3.3 Molecular basis of Mutations
- 3.4 Mutagens and its types

#### **Unit IV:**

- 4.1 Chromosome theory in sex determination.
- 4.2 Genic balance theory of sex determination, X/A ratio in Drosophila
- 4.3 Chromosomal mechanisms of sex determination in mammals, Grasshoppers, birds and Man
- 4.4 Variation in chromosomal number; haploidy, diploidy, polyploidy, aneuploidy.

#### **Unit V**

- 5.1 Genetic disorder in Human beings (Down's, Turner's, Klinefelter's)
- 5.2 Transposons in bacteria
- 5.3 Ac-Ds elements in maize and P elements in Drosophila
- 5.4 Transposons in humans

#### **References:**

1. Principles of Genetics – R. H. Tamarin (McGraw Hill)
2. Genetics – M. W. Strickberger (Macmillan)

# **B.Sc. (Honours.) Zoology**

## **Semester-IV**

### **Core Course (C-9):Evolution**

#### **Unit I:**

- 1.1 Origin of Life: Introduction
- 1.2 Theories of origin of life
- 1.3 Biological evolution
- 1.4 Experimental proof of biological evolution

#### **Unit II:**

- 2.1 Theories of Evolution: Lamarckism
- 2.2 Objections of Lamarckism's theory and Neo-Lamarckism
- 2.3 Theories of Evolution: Darwinism
- 2.4 Objections of Darwinian Theory

#### **Unit III:**

- 3.1 Natural selection: Stabilizing selection, Directional selection
- 3.2 Mutation theory: Hugo De Vries theory
- 3.3 Biological species concept (Advantages and Limitations)
- 3.4 Modes of speciation (Allopatric, Sympatric)

#### **Unit IV:**

- 4.1 Gene flow/Gene Migration, Gene pool: Effect on population
- 4.2 Extinction: Mass extinction (Causes, Names of five major extinctions species)
- 4.3 Role of extinction in evolution
- 4.4 Hardy Weinberg Law

#### **Unit V:**

- 5.1 Significance of Hardy Weinberg Law in evolution
- 5.2 Definition and scope: Founder effect, Genetic drift
- 5.3 Evidences of evolution: Divergent and Convergent evolution
- 5.4 Origin and Evolution of man

#### **References:**

1. Introduction to Evolution – P. A. Moody (Kalyani Pub.)
2. Life: Origin, Evolution and Adaptation – S. Chattopadhyay (Books & Allied Pub.)



# **B.Sc. (Honours) Zoology**

## **Semester-IV**

### **Core Course(C-10): Cell Biology**

#### **UNIT-I :**

- 1.1 History of cell biology, Different types of cells
- 1.2 Introduction to cell theory
- 1.3 Prokaryotic cells (Bacteria, Viruses, Viroids, Mycoplasma, Prions)
- 1.4 Eukaryotic cells, Difference between Prokaryotic and Eukaryotic cell

#### **UNIT-II :**

- 2.1 Structure and function of plasma membrane
- 2.2 Structure and function of Golgi body, ER, Lysosomes.
- 2.3 Structure and function of mitochondria, Ribosome, Centriole.
- 2.4 Structure and function of Nucleus and Nucleolus.

#### **UNIT-III :**

- 3.1 Structure and functions of typical chromosomes
- 3.2 Basic concept of Chromatin and Heterochromatin
- 3.3 Structure and functions of Lamp brush and polytene Chromosome
- 3.4 Satellite DNA and its significance.

#### **UNIT-IV :**

- 4.1 Basic feature of Cell cycle
- 4.2 Cell cycle and its control
- 4.3 Mitosis and its significance
- 4.4 Meiosis and its significance.

#### **UNIT-V :**

- 5.1 Introduction to Apoptosis
- 5.2 Introduction to Necrosis
- 5.3 Difference between Apoptosis and Necrosis with example
- 5.4 Elementary idea of cancer

#### **References:**

1. Cell Biology – G. M. Cooper (Sinauer)
2. The World of Cell – W. M. Becker, L. J. Kleinsmith, J. Hardin

## **Practical (P-4)**

1. Study of mimicry in insects and animals: stick insect, leaf insect, moth, cicada, sea horse, flat fish, remora, flying lizard, bat etc.
2. Study of different types of nests of animals.
3. Study of parental care
4. Study of migrating bird
5. Study of new variety of organisms in your locality
6. Comparative study between Convergent and Divergent evolution
7. Study of sex linked disorders in mammals
8. Demonstration of sex chromatin (Barr body)
9. Study of life cycle of fruit fly
10. Temporary preparation of the salivary gland chromosomes of *Drosophila*
11. Study of slides of Bacterial cell
12. Study of slides of unicellular cell- Amoeba, Paramecium
13. Study of various stages of cell division through permanent slides Mitosis and Meiosis
14. Preparation of Mitotic Slides from onion root tips.
15. Study of Blood cells through slides preparations
16. Study of barr body through slide preparation from hair follicle/ cheek cells of female.

# **B.Sc. (Honours.) Zoology**

## **Semester-V**

### **Core Course (C-11 ): Animal physiology: life sustaining systems**

#### **Unit I:**

- 1.1 Components of blood and their functions
- 1.2 Structure and functions of hemoglobin
- 1.3 Haemostasis: Blood clotting system
- 1.4 Blood groups: Rh factor, ABO

#### **Unit II:**

- 2.1 Structural organization and functions of gastrointestinal tract and associated glands
- 2.2 Mechanical and chemical digestion of food; Absorptions of carbohydrates and lipids.
- 2.3 Digestion and absorption of proteins, water, minerals and vitamins.
- 2.4 Hormonal control of secretion of enzymes in gastrointestinal tract.

#### **Unit III:**

- 3.1 Histology of trachea and lung; Mechanism of respiration, pulmonary ventilation; Respiratory volumes and capacities.
- 3.2 Transport of oxygen and carbon dioxide in blood;
- 3.3 Carbon monoxide poisoning; respiratory pigments, dissociation curves and the factors influencing it.
- 3.4 Control of respiration

#### **Unit IV:**

- 4.1 Structure of kidney and its functional unit
- 4.2 Mechanism of urine formation
- 4.3 Regulation of water balance
- 4.4 Regulation of acid-base balance

#### **Unit V:**

- 5.1 Structure of mammalian heart; Coronary circulation; Structure and working of conducting myocardial fibers.
- 5.2 Cardiac cycle; Cardiac output and its regulation
- 5.3 Electrocardiogram
- 5.4 Blood pressure and its regulation

#### **References:**

1. Comparative Animal Physiology – C. L. Prosser and F. A. Brown (Saunders)
2. General and Comparative Physiology – W. S. Hoar (PHI)

# **B.Sc. (Honours.) Zoology**

## **Semester-V**

### **Core Course (C-12 ):Biotechnology**

#### **Unit I:**

- 1.1 Introduction to Genetic engineering
- 1.2 History of Genetic engineering
- 1.3 Scope of Genetic engineering
- 1.4 Importance of Genetic Engineering in modern era of Biotechnology

#### **Unit II:**

- 2.1 Methods used in Genetic Engineering
- 2.2 Tools Used in Genetic engineering
- 2.3 Different enzymes used in Genetic engineering
- 2.4 Gel Electrophoresis methods used in Genetic Engineering

#### **Unit III:**

- 3.1 DNA isolation from bacteria
- 3.2 Plasmid isolation from bacteria
- 3.3 Vectors: Plasmids, Cosmids, Phagemids: Application as a vectorAs a vector
- 3.4 *E. coli*: A good host

#### **Unit IV:**

- 4.1 Techniques employed to insert the gene of interest into the host,
- 4.2 Agrobacterium mediated Gene Transfer in Plants
- 4.3 Identification and Selection of rDNA.
- 4.4 Construction of cDNA.

#### **Unit V:**

- 5.1 PCR: Introduction and application in Biotechnology
- 5.2 PCR: Types
- 5.3 Expression of cloned genes in host and purification of expressed proteins from host (Insulin).
- 5.4 Genetically modified organisms (Dolly).

#### **References:**

1. Genetic Engineering – P. S. Verma& V. K. Agarwal (S. Chand)
2. Introduction to Biotechnology- W. J. Thieman and M.A. Palladino (Pearson)

## **Practical (P-5)**

1. Extraction of DNA from bacteria
2. Extraction of DNA from plants
3. Extraction of plasmid DNA from bacteria
4. Separation of DNA using Gel- Electrophoresis
5. Extraction of proteins from legumes
6. Protein separation using SDS-PAGE
7. Determination of blood pressure using sphygmomanometer
8. Determination of blood group.

# **B.Sc. (Honours.) Zoology**

## **Semester-V**

### **Discipline Specific Effective (DSE-1): Economic Zoology**

#### **Unit I:**

- 1.1 Classification and Biology of Honey Bees
- 1.2 Social Organization of Bee Colony
- 1.3 Selection of Bee Species for Apiculture
- 1.4 Methods of Extraction of Honey (Indigenous and Modern)

#### **Unit II:**

- 2.1 Exotic and Endemic species of Aquarium Fishes
- 2.2 Common characters and sexual dimorphism of Fresh water and Marine Aquarium fishes such as Guppy, Molly, Sword tail, Gold fish, Angel fish, Blue morph, Anemone fish and Butterfly fish
- 2.3 Use of live fish feed organisms. Preparation and composition of formulated fish feeds, Aquarium fish as larval predator
- 2.4 General Aquarium maintenance - budget for setting up an Aquarium Fish Farm as a Cottage Industry

#### **Unit III:**

- 3.1 Types of silkworms, Distribution and Races
- 3.2 Exotic and indigenous races
- 3.3 Mulberry and non-mulberry Sericulture
- 3.4 Life cycle of Bombyx mori

#### **Unit IV:**

- 4.1 Selection of mulberry variety and establishment of mulberry garden Pests of silkworm
- 4.2 Rearing house and rearing appliances used in silk worm
- 4.3. Disinfectants: Formalin, bleaching powder, RKO
- 4.4 Silkworm rearing technology: Early age and Late age rearing

#### **Unit V:**

- 5.1 Pests of silkworm
- 5.2 Diseases: Protozoan, viral, fungal and bacterial
- 5.3. Control and prevention of pests and diseases
- 5.4 Prospectus of Sericulture in India

#### **References:**

1. B.Vasantharaj David and T. Kumaraswami 1982. Elements of Economic Entomology, Popular book depot, Chennai.
2. Nayar, K.K., Ananthkrishnan, T.N. and B.V. David, V 1992. General and Applied Entomology Tata McGraw, New Delhi

**Practical:**

1. Identification and comment on the economic importance of the following: *Millepora sp.*, *Pinctada sp.*, *Schistocerca sp.*, *Penaeus sp.*, *Pheretima sp.*, *Sepia sp.*, *Schizothorax sp.*, *Paa sp.*, *Ithaginis cruentus* and *Bos grunniens*.
2. Field trip to study Apiculture/ Sericulture/ Pisciculture/Crop fields of Cardamom/ Rice/Maize.

# **B.Sc. (Honours.) Zoology**

## **Semester-VI**

### **Core Course (C-13): Developmental Biology**

#### **Unit I:**

- 1.1 Basics of embryology: Historical review and types of embryology
- 1.2 General idea of asexual and sexual reproduction.
- 1.3 An introduction to animal development in sexually reproducing animals (Reproductive system).
- 1.4 Neuroendocrine regulation of reproductive organs: estrous and menstrual cycles.

#### **Unit II:**

- 2.1 Gametogenesis: spermatogenesis and oogenesis
- 2.2 Ultra structure of sperm and Ovum
- 2.3 Eggs: Structures and Types
- 2.4 Fertilization: In-vitro fertilization. and parthenogenesis

#### **Unit III:**

- 3.1 Fertilization in mammals
- 3.2 Fertilization in Chick
- 3.3 Fertilization in Sea urchin
- 3.4 Polyspermy

#### **Unit IV:**

- 4.1 Types and pattern of cleavage
- 4.2 Cleavage pattern in animals: Blastulation and Gastrulation, development of three germinal layers in animals
- 4.3 Metamorphosis: Tadpole larvae
- 4.4 Regeneration

#### **Unit V:**

- 5.1 Fate of Germ Layers;
- 5.2 Vitellogenesis
- 5.3 Extra embryonic membrane in chick
- 5.4 Placenta: Structure, type and function

#### **References:**

1. Developmental Biology – S. Gilbert (Sinauer)
2. Developmental Biology – R. M. Twyman



# **B.Sc. (Honours.) Zoology**

## **Semester-VI**

### **Core Course (C-14): Biostatistics**

#### **Unit I:**

- 1.1 Biostatistics - Definition and Scope
- 1.2 Collection, Classification and Tabulation of data
- 1.3 Presentation of Data: Diagrams and graphs; bar, pie Histogram, line graph.
- 1.4 Frequency curves - Ogives.

#### **Unit II:**

- 2.1 Calculation of Mean
- 2.2 Calculation of Mode
- 2.3 Calculation of Median
- 2.4 Calculation of Range

#### **Unit III:**

- 3.1 Standard deviation
- 3.2 Calculation of Variance
- 3.3 Standard error and its calculation
- 3.4 Test of Significance: Basic concept, Levels of significance, test of significance,

#### **Unit IV:**

- 4.1 Correlation: Definition, Types of correlation
- 4.2 Regression: Definition, Types of correlation
- 4.3 Correlation and Regression analysis
- 4.4 Karl Pearson's coefficient of correlation

#### **Unit V:**

- 5.1 Types of hypothesis- Null hypothesis and Alternate hypothesis.
- 5.2 Probability: Definition and scope
- 5.3 Probability theorem
- 5.4 Chi square test

#### **References:**

1. Statistics – N. G. Das (Central)
2. Basic Statistics – A. M. Goon, M. K. Gupta & B. Dasgupta (World Pr.)

# **B.Sc. (Honours.) Zoology**

## **Semester-VI**

### **Discipline Specific Effective (DSE-3): Wild Life Conservation and Management**

#### **Unit I:**

- 1.1 Values of wild life - positive and negative
- 1.2 Importance of conservation of Wild life
- 1.3 Study of causes of depletion of Wild life.
- 1.4 World conservation strategies

#### **Unit II:**

- 2.1 Habitat analysis: Topography, Geology, Soil and water
- 2.2 Biological Parameters: food, cover, forage, browses and covers estimation
- 2.3 Advancing the successional process
- 2.4 Standard evaluation procedures: remote sensing and GIS.

#### **Unit III:**

- 3.1 Preservation of general genetic diversity
- 3.2 Restoration of degraded habitats
- 3.3 Estimation of carrying capacity; Ecotourism / wild life tourism in forests
- 3.4 Wildlife conservation in India: (In-situ conservation and ex-situ conservation)

#### **Unit IV:**

- 4.1 Management planning of wild life in protected areas
- 4.2 Care of injured and diseased animal
- 4.3 Important features of protected areas in India
- 4.4 Protected areas National parks & sanctuaries

#### **Unit V:**

- 5.1 Population estimation: Natality, Birth rate, Mortality, fertility schedules and sex ratio
- 5.2 National Organizations involved in wild life conservation
- 5.3 Tiger reserves in India
- 5.4 Management and challenges in Tiger reserve.

#### **Reference Books:**

1. Bookhout, T.A. (1996). Research and Management Techniques for Wildlife and Habitats, 5 th edition. The Wildlife Society, Allen Press.
2. Sutherland, W.J. (2000). The Conservation Handbook: Research, Management and Policy. Blackwell Sciences

## **Practical (P-6)**

1. Identification of mammalian fauna/ avian fauna of any protected area
2. Demonstration of basic equipment needed in wildlife studies use, care and maintenance (Compass, Binoculars, Spotting scope, Range Finders, Global Positioning System, Various types of Cameras and lenses)
3. Familiarization and study of animal evidences in the field; Identification of animals through pug marks, hoof marks, scats, pellet groups, nest, antlers, etc.
4. Demonstration of different field techniques for fauna
5. Trail / transect monitoring for abundance and diversity estimation of mammals and bird (direct and indirect evidences)

# GENERIC ELECTIVE COURSES (GE 1)

## ANIMAL CELL BIOTECHNOLOGY

**UNIT 1:** Introduction: Concept and Scope of Biotechnology

**Unit II:** Techniques in Gene manipulation: Outline process of genetic engineering and recombinant DNA technology, Isolation of genes, Concept of restriction and modification: Restriction endonucleases, DNA modifying enzymes.

**Unit III:** Transformation techniques: microbial, plants and animals: Cloning in mammalian cells, Integration of DNA into mammalian genome- Electroporation and Calcium Phosphate Precipitation method.

**UNIT IV:** Basic techniques in animal cell culture and organ culture, Primary Culture and Cell lines, Culture media- Natural and Synthetic, Stem cells, Cryopreservation of cultures. Agarose and Polyacrylamide Gel Electrophoresis, Southern, Northern and Western blotting, DNA sequencing: Sanger method, Polymerase chain reaction, DNA Fingerprinting.

**Unit V:** Bio safety: Physical and Biological containment.

### References:

1. B.D. Singh: Biotechnology, Kalyani publishers, 1998 (Reprint 2001).
2. T.A. Brown: Gene cloning and DNA analysis: An Introduction, Blackwell Science (2001).

### Practical

1. Packing and sterilization of glass and plastic wares for cell culture.
2. Preparation of culture media.
3. Preparation of genomic DNA from *E. coli*.
4. Plasmid DNA isolation (pUC 18/19) and DNA quantitation using agarose gel electrophoresis (by using lambda DNA as standard).
5. Restriction digestion of lambda ( $\lambda$ ) DNA using EcoR1 and Hind III.

## GENERIC ELECTIVE COURSES (GE 2)

### ANIMAL DIVERSITY

**Unit I:** Protista: General characters of Protozoa; Life cycle of Plasmodium

**Unit II:** Porifera: General characters and canal system in Porifera

**Unit III:** Aceolomates: General characters of Helminthes; Life cycle of *Taenia solium*.

**Unit IV:** Pseudocoelomates: General characters of Nemethehelminthes; Parasitic adaptations

**Unit V:** Arthropoda: General characters. Social life in insects.

#### **References:**

1. Barnes, R.D. (1992). Invertebrate Zoology. Saunders College Pub. USA
2. Campbell & Reece (2005). Biology, Pearson Education, (Singapore) Pvt. Ltd.

#### **Practical:**

1. Study of following specimens: Non Chordates: Euglena, Noctiluca, Paramecium, Sycon, , Physalia, Tubipora, Metridium, Taenia, Ascaris, Nereis, Aphrodite, Leech, Peripatus, Limulus, , Hermitcrab, Daphnia, Millipede, Centipede, Beetle, Chiton, Dentalium, Octopus, Asterias, and Antedon. Chordates: Balanoglossus, Amphioxus, Petromyzon, Pristis, Hippocampus, Labeo, Ichthyophis/Uraeotyphlus, Salamander, Rhacophorus Draco, Uromastix, Naja, Viper, model of Archaeopteryx, any three common birds-(Crow, duck, Owl), Squirrel and Bat.
2. Study of following Permanent Slides: Cross section of Sycon, Sea anemone and Ascaris (male and female). T. S. of Earthworm passing through pharynx, gizzard, and typhlosolar intestine. Bipinnaria and Pluteus larva.

## **GENERIC ELECTIVE COURSES (GE 3)**

### **AQUATIC BIOLOGY**

**Unit I:** Brief introduction of the aquatic biomes: Freshwater ecosystem (lakes, wetlands, streams and rivers), estuaries, intertidal zones, oceanic pelagic zone, marine benthic zone and coral reefs.

**Unit II:** Lakes: Origin and classification, Lake as an Ecosystem, Lake morphometry, Physico-chemical Characteristics: Light, Temperature, Thermal stratification, Dissolved Solids, Carbonate, Bicarbonates, Phosphates and Nitrates, Turbidity; dissolved gases (Oxygen, Carbon dioxide). Nutrient Cycles in Lakes- Nitrogen, Sulphur and Phosphorous.

**Unit III:** Salinity and density of Sea water, Continental shelf, Adaptations of deep sea organisms, Coral reefs, Sea weeds.

**Unit IV:** Causes of pollution: Agricultural, Industrial, Sewage, Thermal and Oil spills, Eutrophication, Management and conservation (legislations), Sewage treatment Water quality assessment- BOD and COD.

**Unit V:** Different stages of stream development, Physico-chemical environment, Adaptation of hill-stream fishes.

#### **References:**

1. Trivedi and Goyal : Chemical and biological methods for water pollution studies
2. Goldman : Limnology, 2nd Edition

#### **Practical:**

1. Identify the important macrophytes, phytoplanktons and zooplanktons present in a lake ecosystem.
2. Determine the amount of Turbidity/transparency, Dissolved Oxygen, and Free Carbon dioxide, Alkalinity (carbonates & bicarbonates) in water collected from a nearby lake / water body.
3. A Project Report on a visit to a Sewage treatment plant/Marine bioreserve/Fisheries Institutes.

## **GENERIC ELECTIVE COURSES (GE 4)**

### **ENVIRONMENT AND PUBLIC HEALTH**

**Unit I:** Sources of Environmental hazards, hazard identification and accounting, fate of toxic and persistent substances in the environment, dose Response Evaluation, exposure Assessment.

**Unit II:** Greenhouse gases and global warming, Acid rain, Ozone layer destruction, Effect of climate change on public health.

**Unit III:** Air, water, noise pollution sources and effects, Pollution control.

**Unit IV:** Sources of waste, types and characteristics, Sewage disposal and its management, Solid waste disposal, Biomedical waste handling and disposal, Nuclear waste handling and disposal, Waste from thermal power plants, Case histories on Bhopal gas tragedy.

**Unit V:** Causes, symptoms and control of tuberculosis, Asthma, Cholera, Minamata disease, typhoid.

#### **References:**

1. Cutter, S.L., Environmental Risk and Hazards, Prentice-Hall of India Pvt. Ltd., New Delhi, 1999.
2. Kasperson, J.X. and Kasperson, R.E. and Kasperson,R.E., Global Environmental Risks, V.N.University Press, New York, 2003.

#### **Practical:**

3. To determine pH, turbidity, fluoride and Cl, in soil and water samples from different locations.

# Ability Enhancement Compulsory Course

## (AECC – Environment Studies)

### Unit 1 : Ecosystems

What is an ecosystem? Structure and function of ecosystem; Energy flow in an ecosystem: food chains, food webs and ecological succession.

### Unit 2: Natural Resources : Renewable and Non-renewable Resources

- Deforestation: Causes and impacts due to mining, dam building on environment.
- Water : Use and over-exploitation of surface and ground water, floods, drought.
- Energy resources: Renewable and nonrenewable energy sources.

### Unit 3 : Biodiversity and Conservation

- Levels of biological diversity : genetic, species and ecosystem diversity; Biogeographic zones of India; biodiversity hot spots
- Threats to biodiversity, Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.
- Ecosystem and biodiversity services: Ecological, economic, social, ethical, aesthetic and Informational value.

### Unit 4: Environmental Pollution

- Environmental pollution : types, causes, effects and controls; Air, water, soil and noise pollution
- Nuclear hazards and human health risks
- Solid waste management : Control measures of urban and industrial waste.

### Unit 5 : Environmental Policies & Practices

- Global warming, ozone layer depletion, acid rain and impacts on human communities and agriculture
- Environment Laws: Environment Protection Act; Air (Prevention & Control of Pollution) Act; Water (Prevention and control of Pollution) Act; Wildlife Protection Act; Forest Conservation Act. International agreements: Montreal and Kyoto protocols and Convention on Biological Diversity (CBD).

### Suggested Readings:

1. Carson, R. 2002. *Silent Spring*. Houghton Mifflin Harcourt.
2. Gadgil, M., & Guha, R. 1993. *This Fissured Land: An Ecological History of India*. Univ. of California Press.
3. Gleeson, B. and Low, N. (eds.) 1999. *Global Ethics and Environment*, London, Routledge.