

**Syllabus of Zoology**  
**(B.Sc. I, II, & III year)**

Following Major title of papers of B.Sc. I, II, and III are finalized with their contents:

Theory Paper's duration is of Three hours and duration of practicals is Four hours

<b>B.Sc. I</b>		
<b>Papers</b>	<b>Title of paper</b>	<b>Max. Marks</b>
Paper I	Lower Non Chordata ( <i>Protozoa- Helminths</i> )	50
Paper II	Higher Non Chordata ( <i>Annelida- Echinodermata</i> )	50
Paper III	Cell Biology and Genetics	50
Practical	Practical Syllabus based on theory papers	50

<b>B.Sc. II</b>		
<b>Papers</b>	<b>Title of paper</b>	<b>Max. Marks</b>
Paper I	Chordata	50
Paper II	Animal distribution, Evolution and Developmental Biology	50
Paper III	Physiology and Biochemistry	50
Practical	Practical Syllabus based on theory papers	50

<b>B.Sc. III</b>		
<b>Papers</b>	<b>Title of paper</b>	<b>Max. Marks</b>
Paper I	Applied and Economic Zoology	50
Paper II	Biotechnology, Immunology, Biological Tools & Techniques and Biostatistics	50

Paper III	Ecology, Microbiology, Animal Behavior, Pollution and Toxicology	50
Practical	Practical Syllabus based on theory papers	50

**Zoology**  
**B.Sc. Part I, II & III**

**There will be three written papers and one practical examination.**

**Question No. 1 in each class will be compulsory & comprehensive based on units I to IV and of short Answer type. This will carry 40% of total marks (i.e. 20 marks in I & II year and III year). There will be two questions from each unit carrying 60% of the marks, of which one question from each unit has to be attempted.**

**B.Sc. Part I (THEORY) Zoology**

**Paper I- Lower Non Chordata (Protozoa to Helminths)**

The habits, morphology, physiology, reproduction, development (in outline) and classification of the following groups of animals including a detailed study of the types given in each:

	<b>Unit-I</b>
Protozoa	- <i>Euglena</i> , <i>Monocystis</i> and <i>Paramecium</i> .
	<b>Unit-II</b>
Porifera	- <i>Sycon</i>
	<b>Unit-III</b>
Coelenterata	- <i>Obelia</i> and <i>Aurelia</i>
Ctenophora	- Salient features
	<b>Unit-IV</b>
Platyhelminthes	- <i>Fasciola</i> (liver fluke) and <i>Taenia</i> (tape worm)
Nematehelminthes	- <i>Ancylostoma</i> (hook worm)

**Paper II- Higher Non Chordata (Annelida to Echinodermata)**

The habits, morphology, physiology, reproduction, development (in outline) and classification of the following groups of animals including a detailed study of the types given in each:

	<b>Unit-I</b>
Annelida	- <i>Nereis</i>
	<b>Unit-II</b>
Arthropoda	- <i>Palaemon</i> (prawn)
	<b>Unit-III</b>
Mollusca	- <i>Pila</i> (apple-snail)
	<b>Unit-IV</b>

Echinodermata -*Pentaceros* (excluding development)

## Paper III- CellBiology & Genetics

### Unit-I

**Cell Biology I:** Structure and function of cell, Ultra structure of Plasma membrane

### Unit-II

**Cell Biology II:** Structure and function of cell organelles with special emphasis on mitochondria, golgi bodies, nucleus, ribosome and endoplasmic reticulum.

### Unit-III

**Genetics-I:** Structure of Chromosomes, Watson & Crick Model of DNA, Differences between DNA & RNA, Cell Division: Mitosis and Meiosis. Mendel's principles of heredity on chromosomal basis, Monohybrid cross, test cross, dihybrid cross, back cross incomplete dominance, Multiple Alleles, Blood group inheritance. Linkage and crossing over, interaction of genes. The role of DNA in heredity.

### Unit-IV

**Genetics II:** Sex determination, sex differentiation, prenatal detection of genetic diseases (amniocentesis), Sex-linked characters, Genetic diseases and abnormalities, chromosomal aberrations, Eugenics.

## SUGGESTED READINGS

1. **L.H. Hyman** '*The Invertebrates*' Vol I, II and V. – M.C. Graw Hill Company Ltd.
2. **Kotpal, R.L.** 1988 - 1992 Protozoa, Porifera, Coelenterata, Helminthes, Arthropoda, Mollusca, Echinodermata. Rastogi Publications, Meerut.
3. **E.L. Jordan and P.S. Verma** '*Invertebrate Zoology*' S. Chand and Company.
4. **R.D. Barnes** '*Invertebrate Zoology*' by: W.B. Saunders CO., 1986.
5. **Barrington. E.J.W.**, '*Invertebrate structure and Function*' by ELBS.
6. **P.S. Dhami and J.K. Dhami.** Invertebrate Zoology. S. Chand and Co. New Delhi.
7. **Parker, T.J. and Haswell** '*A text book of Zoology*' by, W.A., Mac Millan Co. London.
8. **Barnes, R.D. (1982).** '*Invertebrate Zoology, V Edition*'
9. **Lodish, Berk, Zipursky, Matsudaria, Baltimore, Darnell** '*Molecular Cell Biology*' W.H. Free man and company New York.
10. **Gardner, E.J., Simmons, M.J., Snustad, D.P. (2008).** '*Principles of Genetics.* VIII Edition. Wiley India.

11. **Snustad, D.P., Simmons, M.J. (2009).** *Principles of Genetics*. V Edition. John Wiley and Sons Inc.

**B.Sc. Part I  
ZOOLOGY PRACTICAL SYLLABUS**

**PROTOZOA**

(a) **Amoeba** : Examination of culture. Prepared Slide of Amoeba proteus and A. verrucosa.

(b) **Euglena** : Culture examination for Euglena. Prepared slides.

(c) **Monocystis** : Examination of contents of seminal vesicles of Pheretima or Eutyphoeus for different life- history stages and permanent preparation. Prepared slides.

(d) **Plasmodium** : Preparation of blood film (Leishmen's stain). Prepared slides showing the parasites.

(e) **Paramecium**

Culture examination.

(f) Demonstration of ciliary movements in Paramecium. Addition to mucilage to restrain active

movement. Treatment with Methyl green for staining. Feeding experiment with Congo Red

and Yeast. Trichocysts (discharged), Prepared slides for structure, binary division and conjugation.

(g) Examination of pond water for different kinds of protozoa with special reference to Arcella and Vorticella.

(h) Study of prepared slides :

**Polystomella, Gregarina, Trypanosoma and Noctiluca.**

(i) Examination of rectal protozoans Opalina, Balantidium and Nyctotherus.

**PORIFERA**

(a) **Sycon**

General characters

Spicules glycerine preparation or permanent mount.

Prepared slides of transverse and longitudinal sections

(b) Gemmule of Spongilla permanent preparation.

(c) Different kinds of sponge spicules and sponging fibres of Euspongia-prepared slides.

(d) Euplectella (Venus's flower-basket) Spongilla (fresh-water sponge), Euspongia (bath sponge).

## COELENTERATA

### (a) Hydra

Live specimens.

Prepared slides of entire specimens.

Longitudinal and transverse sections-prepared slides.

### (b) Obelia

Clolony-prepared slide.

Medusa-prepared slide.

### (c) Aurelia

General morphology.

Tentaculocyst-prepared slide.

Prepared slides and models of life-history stages.

(d) **Physalia** (Portguese man of war), **Corallium** (red coral),

**Fungia** (Mushroom coral), **Madrepora** (staghorn coral),

**Pennatula** (sea pen), **Sagartia** of **Metridium** (sea anemone)

## PLATHYHELMINTHES :

### (a) Fasciola

Specimens in situ and prepared slides. Transverse sections and prepared slides. Larval forms prepared slides.

(b) **Taenia** : Prepared slides of scolex, mature and gravid proglottids and transverse section

of mature proglottid.

(c) **Planaria**, **Polystomum**, **Paramphistomum**, **Schistosma**, **Echinococcus** and **Dipylidium**

**Cysticercus** (Bladder worm) and **Cysticercoid**.

(d) Examination of type worms of pigeon or fowl in situ

(e) Permanent preparation of mature and gravid proglottids of **Cotugnia** and **Raellietina** . :

## NEMATHELMINTHES

### (a) Ascaris

External characters. Dissected specimens of male or female. Prepared slides of Transverse

sections of male and female.

(b) **Ascaris lumbricoides** (from man) specimens **Enterobius vermicularis** (from man). **Ancylostoma duodenale** (from man) prepared slides.

## ANNELIDA

### (a) Nereis

External characters. Dissected specimens. Parapodium permanent preparation. Transverse

sections-prepared slides.

**(b) Pheretima**

External characters. Dissection. Glycerine preparations of setae in situ and brain. Permanent preparations of ovary and septal nephridia. Prepared slides of transverse section through various regions.

**(c) Heteronereis, Arenicola, Aphrodite, Eutypoeus, Dero, Branchellion, Haemadipsa, Bonellia (female).**

## **ARTHROPODA**

**(a) Palaemon** External characters; Examination of appendages. Dissections. Glycerin or preparation stained preparation of hastate plate and statocysts.

**(b) Periplaneta**

External characters. Differences between male and female. Dissections. Circulation of blood in the wing of cockroach. Glycerin or preparation stained preparation of mouth appendages, salivary glands, trachea, Malpighian tubules, ovaries and testes.

**(c) Anopheles and Cules**

Glycerin or preparation stained preparation of mouth parts of male and female. Wings prepared slides. Life history-prepared slides. Difference between Anopheles and Culex

**(d) Musca**

External characters. Glycerin or preparation stained preparation of proboscis

**(e) Daphnia, Cyclops, Balanus, Eupagurus (hermit crab) Scylla (crab), Sacculina (on crab).**

Larval forms Nauplius, Zoea, Lepisma (Silver fish), Schistocerca (locust), Odontotermes

(white ant), Cimex (bed bug), Pediculus (louse), Papilio (butterfly), Bombyx (Silk moth), Apis (honey- bee), Polistes (wasp), Camponotus (Black ant), Xenopsylla (rat flea), or Ctenocephalus (dog flea), Thyroglyphus (millipede), Scolopendra (centipede). Lycosa (wolf-spider), Lxodes (tick), Limulus (King crab).

## **MOLLUSCA**

**(a) Lamellidens**

External characters, Dissection of gill lamella and its permanent preparation. Transverse section through middle region of body and Glochidium (larva) - prepared slides.

**(b) Pila**

External characters. Dissection of nervous system. Permanent preparations of gill ctenidium and osphradium.



(c) Chiton, Teredo, Turbinellai (Shankh), Laevicaulis (slug), Doris, Aplysia, Dentalium  
Nautilus, Sepia and Margaritifera (Pearl Oyster).

## **ECHINODERMATA**

### **(a) Pentaceros:**

External characters Dissected specimens. Pedicellaria and Transverse section of arm-prepared slide.

**(b) Echinus** (Sea urchin), Ophiothrix (brittle star), Holothuria (sea cucumber) and Antedon (feather star).

## **CYTOLOGY**

- (a) Cell-Structure – Prepared slides
- (b) Cell Division – Prepared slides
- (c) Preparation of giant chromosomes
- (d) Preparation of onion root tip for the stages of mitosis

### **Suggested manuals:**

1. Practical Zoology- Invertebrates S.S. Lal
2. Practical Zoology - Invertebrates P.S. Verma
3. Practical Zoology - Invertebrates K.P. Kurl

## **B.Sc. Part II (THEORY) Zoology**

There will be three written papers and one practical examination. The following courses are prescribed.

### **Paper I: Chordata**

#### **Unit- I**

**Hemichordata**: Classification and detailed study (habit, morphology, anatomy, physiology and development) of *Balanoglossus*

**Cephalochordata**: Classification and detailed study (habit, morphology, anatomy and physiology) of *Branchiostoma (Amphioxus)*.

#### **Unit -II**

**Urochordata**: Classification and detailed study (habit, morphology, anatomy, physiology and post embryonic development) of *Herdmania*

#### **Unit-III**

Classification of different classes of vertebrates (**Pisces, Amphibia, Reptilia,**) up to order with characters and examples. Poisonous and non poisonous snakes and biting mechanism. Neoteny

#### **Unit-IV**

Classification of different classes of vertebrates (**Aves and Mammalian**) up to order with characters and examples. Dentition in mammals.

### **Paper II: Animal distribution, Evolution and Developmental Biology**

#### **Unit-I**

**Animal distribution**: Geological and geographical distribution with their characteristic fauna; fossils.

#### **Unit-II**

**Origin of Life**, concept of species (classical & modern concept)

**Evolution**: Evidences (including physiological and serological); Theories of evolution (including Neo-Lamarckism, Darwin-Wallace theory of natural selection, Neo-Darwinism, Modern synthetic theory). Evolution of Man. Mutation

### **Unit-III**

**Developmental Biology I:** Aims and scope of Developmental Biology. Gametogenesis, Fertilization, Egg: structure and types. Types & patterns of cleavage

### **Unit-IV**

**Developmental Biology II:** Process of Blastulation & Gastrulation. Fate Map. Development of Chick up to formation of Primitive streak and mammal (*in out line*)  
Extra embryonic membranes of chick.  
Placentation and types of Placenta.

### **Paper III: Physiology and Biochemistry**

General physiology (in outline) with special reference to mammals

#### **Unit-I**

Physiology of digestion, respiration, and blood and circulation

#### **Unit-II**

Physiology of excretion and osmoregulation, neural transmission, muscles

#### **Unit-III**

Physiology of endocrine system, thermoregulation

#### **Unit-IV**

General chemistry and classification of carbohydrates, lipids and proteins;  
Enzymes

### **SUGGESTED READINGS**

- 1. E.L.Jordan and P.S. Verma** ‘*Chordate Zoology*’ -. S. Chand Publications.
- 2. Mohan P.Arora.** ‘*Chordata – I*, Himalaya Publishing House Pvt.Ltd.
- 3. Marshal, Parker and Haswell** ‘*Text book of Vertebrates*’. ELBS and McMillan, England.
- 4. Alfred Sherwood Romer.** Thomas S. Pearson ‘*The Vertebrate Body*, Sixth edition, CBS college Publishing, Saunders College Publishing
- 5. J.W. Young,** *The Life of Vertebrates*, 3rd ed, Oxford University press.
- 6. Harvey Pough F, Christine M. Janis, B. Heiser,** *Vertebrate Life*, Pearson, 6th ed, Pearson Education Inc.2002.
- 7. Veer Bala Rastogi,** “Ecology and Animal Distribution”

8. **Barton, N. H., Briggs, D. E. G., Eisen, J. A., Goldstein, D. B. and Patel, N. H. (2007).** *Evolution*. Cold Spring, Harbour Laboratory Press.
9. **Hall, B. K. and Hallgrimsson, B. (2008).** *Evolution*. IV Edition. Jones and Bartlett Publishers
10. **Campbell, N. A. and Reece J. B. (2011).** *Biology*. IX Edition, Pearson, Benjamin, Cummings.
11. **Douglas, J. Futuyma (1997).** *Evolutionary Biology*. Sinauer Associates.
12. **Minkoff, E. (1983).** *Evolutionary Biology*. Addison-Wesley
13. **Tortora, G.J. and Derrickson, B.H. (2009).** *Principles of Anatomy and Physiology*, XII Edition, John Wiley & Sons, Inc.
14. **Guyton, A.C. and Hall, J.E. (2011).** *Textbook of Medical Physiology*, XII Edition, Harcourt Asia Pvt. Ltd/ W.B. Saunders Company
15. **Berg, J. M., Tymoczko, J. L. and Stryer, L. (2006).** *Biochemistry*. VI Edition. W.H Freeman and Co.
16. **Nelson, D. L., Cox, M. M. and Lehninger, A.L. (2009).** *Principles of Biochemistry*. IV Edition. W.H. Freeman and Co

## B.Sc. Part II

### ZOOLOGY PRACTICAL SYLLABUS

#### **Urochordata**

##### **(a) Herdmania**

- (i) External characters
- (ii) Dissection
- (iii) (a) Permanent preparation of branchial wall  
(b) Section of test and glycerine preparation of spicules.  
Glycerine and permanent preparation on neural gland complex ( neural gland, nerve ganglion and dorsal tubercle).
- (iv) Larva and metamorphosis- prepared slides.

- (b)(i) Thaliacea : *Pyrosoma, Doliolum*
- (ii) Larvacea : *Oikopleura* .

#### **Cephalochordata**

##### **Branchistoma ( *Amphioxus* )**

- (i) General features
- (ii) (a) Permanent preparation of the pharyngeal wall  
(b) Oral hood and velum- prepared slides  
(c) Transverse section through the body – prepared slides.  
(d) Models illustrating development

#### **Cyclostomata**

***Petromyzon*** ( Lamprey ) - External characters

#### **Chondrichthyes**

##### **(a) Fish**

- (i) External characters
  - (ii) Exo-skeleton Glycerine and permanent preparation of placoid scales
  - (iii) Myotomes
  - (iv) Endoskeleton
- (1) Axial skeleton
    - (a) skull
    - (b) Visceral Skeleton
    - (c) Vertebral column
  - (2) Appendicular skeleton
    - (a) Pectoral girdle and fins

- (b) Pelvic girdle, fins and claspers
- (c) Median fins
- (v) Dissection
- (a) Digestive system  
Examination of the folds of stomach and “ scroll valve”
- (b) Vascular system
- (c) Heart, ventral aorta, dorsal aorta, arterial arches ( afferent and efferent )
- ( c ) Gills
- (d) Urinogenital system
- (e) Nervous system : Cranial nerves
- (f) Internal ear
- (g) Eye muscles
- (h) Permanent preparation of ampullae of Lorenzini
- (i) Section through various regions of the body of adult and embryo
- (j) Embryo with yolk-sac placenta

(b)*Pristis* ( Saw fish ), *Astrape* ( Indian electric ray ) *Chimaera* ( rabbit fish ) Slide showing development of placoid scales.

### **Osteichthyles**

- (a)*Labeo rohita* ( rohu )- General morphology and dissected specimen.
- (b)*Acipenser* (sturgeon ), *Lepidosteus* ( gar-pike ), *Hippocampus* ( sea hourse) *Antennarius* ( Indian angler ), *Anguilla* (eel), *Pleuronectes* ( sole ), *Exocoetus* ( flying fish ), *Clarius* ( cat fish ), *Anabas* ( climbing perch ) and *Neoceratodus* ( lungfish ).
- (c) Different kinds of scales- prepared slides

### **Amphibia**

- (a)*Rana tigrina* ( The Indian bull-frog ) Development of frog from modles
- (b)Urodela :  
*Necturus*, *Ambystoma* and Axolotal larva
- (c)Anura :  
*Bufo*, *Rhacophorus* (tree frog), *Alytes* (midwife toad).
- (d)Gymnophiona : *Ichthyopnis*

### **Reptilia**

- (a)*Varanus*
  - (i) External characters
  - (ii) Skeleton
- (1)**Axial Skeleton**
  - (a) Skull

(b) Vertebral column (c) Ribs and sternum

**(2) Appendicular Skeleton**

- (a) Pectoral girdle and fore-limb.
- (b) Pelvic girdle and hind-limb.

**(b) Lacertilla**

*Varanus* ( Indian monitor ), *Holoderma* ( poisonous lizard ) *Hemidactylus* ( wall lizard ), *Chamaeleon* ( garden lizard ) *Draco* ( flying lizard ).

**(c) Ophidia**

Difference between poisonous and non-poisonous snakes, *Naja* ( cobra ), *Vipera* ( viper ), *Typhlops* ( burrowing snake ) and *Python*. Biting mechanism of a poisonous snake ( model ).

**(d) Chelonia** : Derman armature

**(e) Crocodilia** : Difference between Alligator, Crocodile and Gavialis.

**(f)** Extinct reptiles, Models ( five )

***Dimetrodon, Diplodocus, Pteranodon, Tyrannosaurus and Ichthyosaurus***

**Aves**

**(A) *Columba livia intermedia* (pigeon)**

- (i) External Characters. Structure of Feather. Varieties of feathers. Developments of feather-prepared slide.
- (ii) Skeleton of fowl Axial skeleton:
  - (a) Skull
  - (b) Vertebral column
  - (c) Ribs and sternum

**(2) Appendicular skeleton.**

- (a) Pectoral girdle and fore-limb
- (b) Pelvic girdle and hind-limb.

**(B) (i) Archaeornithes-Archaeopteryx (cast)**

**(ii) Neornithes:**

(a) Palaeognathae: ***Struthio*** (ostrich);

(b) Neognathae: ***Gallus*** (fowl), ***Anser*** duck, ***Corvus*** (crow) ,

***Psittacula***

(parrot) and ***Pavo*** (peacock).

Perching mechanism: Model

Skulls and Beaks of Birds.

Feet of birds: Models

(C) Embryonic membranes-whole mount of 72 hour's chick embryo

### **Mammalia**

- (A)(i) Prototheria: *Ornithorhynchus* (Platypus)  
(ii) Metatheria : *Macropus* (Kangaroo).  
(iii) Eutheria :  
(a) Edentata: *Dasypus* (Armadillo)  
(b) Pholidota: *Manis* (Scaly ant-eater).  
(c) Cetacea: *Platanista* (Ganges dolphin).  
(d) Perissodactyla: *Equus caballus* (horse), *Equus vulgaris* (ass), *Equus zebra* (zebra), *Rhinoceros unicornis* (rhinoceros).  
(e) Artictyla: *Camelus dromedaries* (A rabian camel), *Giraffa camelopardalis* (giraffe) Box (ox), *Ovis* (sheep), *Capra* (goat), *Cervus* (deer), *Sus* (dog).  
(f) Proboscidea: *Elephas indicus* (elephant).  
(g) Carnivora: *Felis domesticus* (Cat), *Panthera leo* (lion), *Acinonyx tigris* (Cheetah), *Canis familiari* (dog), *Ursus* (bear) *Hyaena* (hyanea), *Phoca* (seal)  
(h) Rodentia: *Mus* (domestic rat), *Hystrix* (Porcupine)  
(i) Lagomorpha: *Lepus* and *Oryctolagus* (hare and rabbit)  
(j) Insectivora: *Erinaceus* (hedge-hog), *Crocidura* (chhachhundar)  
(k) Chiroptera: *Pteropus* (Flying-fox).  
(l) Primates: *Macaca* (rhesus monkey), *Hylobates* (gibbon), *Simia* (Orang-utan), *Anthropo pithecus* (chimpanzee), *Gorilla*, *Homo sapiens*

### Histology

- (i) Tissues: Preparation of the following  
(a) Epithelia:  
(i) Squamous (ii) Ciliated and (iii) Stratified  
(b) Muscular:  
(i) Striped muscles (ii) Unstriped muscles.  
(c) Connective  
(i) Areolar tissue (ii) Tendon the leg muscles of frog (tease and examine in glycerine)  
(ii) Adipose tissue from insect and frog (iv) cartilage (free hand sections of frogs  
hyoid and suprascapula, train with haematoxyline and (v) Bone (Decalcified).  
(d) Blood; Preparation of Vertebrate blood film, stain with Leishmann's stain.  
(e) Nervous: Neurons  
(f) Histology of various organs-prepared slides.



## **Physiology**

- (i) Experiments to be performed by candidates: Test for amylase. Osmolarity of blood, Hemin crystals and test for sugar and acetone in urine Determination of haemoglobin % in blood sample (s).
- (ii) Detection of amino acids in blood of an animal by paper chromatography.

General :

Candidates will be required, to show knowledge of the method of microscopic techniques and to examine, describe or dissect the types prescribed. Candidates will also be required to submit their notebooks containing a complete record of laboratory work initiated and dated by the teacher for the determination of result of examination.

## **Suggested manuals**

1. **S.S.Lal**, Practical Zoology – Vertebrata
2. **P.S.Verma**, A manual of Practical Zoology – Chordata
3. **Freeman & Bracegirdle**, An atlas of embryology

## **B. Sc. Part III (THEORY) Zoology**

**There will be three written papers and one practical examination. The following courses are prescribed.**

### **PAPER-I Applied and Economic Zoology**

#### **Unit-I**

##### **Parasitology:**

(a) Structure, life cycle, pathogenicity, including diseases, causes, symptoms and control of the following parasites of domestic animals and humans: *Trypanosoma*, *Giardia* and *Wuchereria*,

#### **Unit-II**

**Vectors and pests:** Life cycle and their control of following pests:  
Gundhi bug, Sugarcane leafhopper, Rodents.  
Termites and Mosquitoes and their control

#### **Unit-III**

**Animal breeding and culture:** Aquaculture, Pisciculture, Poultry, Sericulture, Apiculture, Lac-culture.

#### **Unit-IV**

**Wild Life of India:** Endangered species. Important sanctuaries; national parks of India; Different projects launched for the preservation of animal species; *in-situ* and *ex-situ* conservation of wild life.

### **PAPER-II Biotechnology, Immunology, Biological Tools and Techniques and Biostatistics**

#### **Unit-I**

**Biotechnology:** Genetic Engineering (concept and recombinant DNA technology) and its application in agriculture & medical areas and energy production. Biotechnology of food-processing, pharmaceuticals (e.g. use of microbes in insulin production) and fermentation.

## **Unit-II**

**Immunology**. Concepts of immunity, types of immunity, Antigen and Antibodies, vaccines of different diseases and immunological reactions.

## **Unit-III**

**Biological Tools and Techniques**: Principles and uses of instruments: pH Meter, Calorimeter, Microtome, Spectrophotometer & Centrifuge. Microscopy (light, transmission and scanning electron microscopy) Chromatography and Electrophoresis.

## **Unit-IV**

**Biostatistics**: Sampling, Measures of central tendency (mean, median and Mode) and dispersion (variance, standard deviation and standard error); Correlation and Regression

## **PAPER-III Ecology, Microbiology Animal Behavior and Pollution and Toxicology.**

### **Unit- I**

**Ecology**: Ecosystem: Concept, components, fundamental operations, energy flow, food-chain, foodwebs and trophic levels, ecological niche, abiotic and biotic factors. Population: Characteristics and regulation. Ecological succession. Adaptation: Aquatic, terrestrial, aerial and arboreal.

### **Unit-II**

**Microbiology**: Morphology, physiology and infection (outline) of bacteria and viruses. Bacterial and viral diseases.

### **Unit-III**

**Animal Behavior**: Introduction to Ethology, Patterns of behavior (taxes, reflexes, instinct and motivation); biorhythms; learning and memory, Migration of fishes & birds.

#### **Unit-IV**

**Pollution and Toxicology**: Concept, sources, types (air, water, soil, noise & radiation), and control of environmental pollution. Exposure of toxicants (routes of exposure, and duration and frequency of exposure); dose -response relationship categories of toxic effects.

#### **Suggested Readings**

1. **M.P.Arora**, ‘*Ecology*’ Himalaya Publishing company.
2. **P.D.Sharma**, *Environmental Biology*’.
3. **P.R.Trivedi and Gurdeep Raj**. ‘*Environmental Ecology*’
4. **Buddhadev Sarma and Tej Kumar**, *Indian Wildlife Threats and Preservation*
5. **Chapman J.L. and Reiss M.J**, *Ecology Principles and Applications*, Second Ed., Cambridge University Press, London.
6. **Benny Joseph**, *Environmental Studies*, TATA McGraw Hill Com., New Delhi.
7. **Eugene P. Odum**, *Fundamentals of Ecology* Third Ed., NataraJ Publishers, Dehradun.
8. **P.K. Gupta**, “Text Book of Ecology and Environment”
9. **Bhatnagar and Bansal**, “Ecology and Wildlife biology
10. **Reena Mathur**, “Animal Behaviour”
11. **Aloccock**, “Animal Behaviour- an Evolutionary Approach
12. **Kindt, T. J., Goldsby, R.A., Osborne, B. A. and Kuby, J (2006)**. Immunology, VI Edition. W.H. Freeman and Company.
13. **David, M., Jonathan, B., David, R. B. and Ivan R. (2006)**. Immunology, VII Edition, Mosby, Elsevier Publication.
14. **P.K. Gupta**, “Text Book of Biotechnology”
15. **Satguru Prasad**, “Biostatistics”

#### **B.Sc. Part III**

#### **ZOOLOGY PRACTICAL SYLLABUS**

- Permanent Preparation of: *Euglena*, *Paramecium* and rectal protozoans from frog.
- Stool examination for different intestinal parasites.
- Study of prepared slides/ specimens of *Entamoeba*, *Giardia*, *Leishmania*, *Trypanosoma*,

*Plasmodium, Fasciola, Cotugnia, Taenia, Rallietina, Polystoma  
Paramphistomum, Schistosoma, Echinococcus, Dipylidium, Enterobius,  
Ascaris and Ancylostoma;*

- Permanent Preparation of *Cimex* (bed bug)/ *Pediculus* (Louse), *Haematopinus* (cattle louse), fresh water annelids, arthropods; and soil arthropods.
- Larval stages of helminths and arthropods.
- Permanent mount of wings, mouth parts and developmental stages of mosquito and house fly. Permanent preparation of ticks/ mites, abdominal gills of aquatic insects viz. Chironomus larva, dragonfly and mayfly nymphs, preparation of antenna of housefly.
- Collection and identification of pests.
- Life history of silkworm, honeybee and lac insect.
- Different types of important edible fishes of India.
- Prepared slides of plant nematodes.
- Demonstration of counting of cells (blood and protozoan) by haemocytometer, haemoglobinometer, pH meter, Colorimeter
- Microbiological Techniques: Media Preparation and sterilization, inoculation and Monitoring.
- Study of an aquatic ecosystem, its biotic components and food chain.
- Preparation of chromosomes, Test for carbohydrate Photochemical demonstration of proteins and lipids, using hand sections using hand sections, endocrine glands (Neurosecretory cells) of cockroach.
- Demonstration of developmental stages of chick.
- Project Report/ model chart making.
- **Dissections :**
- **Cockroach :** Central nervous system
- **Wallago :** Afferent and efferent branchial vessels, Cranial nerves, Weberian ossicles.
- Practical exercises based on Biostatistics, Microbiology, Immunology, Biotechnology, Animal Behavior, Pollution & Toxicology.

**Suggested manuals**

1. **S.S.Lal**, Practical Zoology – Invertebrata
2. **P.S.Verma**, A manual of Practical Zoology – Chordata