



BACHELOR OF SCIENCE (B.Sc.)

(THREE YEAR DEGREE COURSE)

SUBJECT

ZOOLOGY

B.Sc. (ZOOLOGY)

COURSE STRUCTURE

FIRST YEAR

PAPER – 101: Lower Non Chordata (<i>Protozoa- Helminths</i>)	50 MARKS
PAPER – 102: Higher Non Chordata (<i>Annelida- Echinodermata</i>)	50 MARKS
PAPER – 103: Cell Biology and Genetics	50 MARKS
PAPER – 104: PRACTICAL (Based on Paper 101, 102, 103)	50 MARKS

SECOND YEAR

PAPER – 201: Chordata	50 MARKS
PAPER – 202: Animal distribution, Evolution and Developmental Biology	50 MARKS
PAPER – 203: Physiology and Biochemistry	50 MARKS
PAPER – 204: PRACTICAL (Based on Paper 201, 202, 203)	50 MARKS

THIRD YEAR

PAPER – 301: Applied and Economic Zoology	50 MARKS
PAPER – 302: Biotechnology, Immunology, Biological Tools & Techniques and Biostatistics	50 MARKS
PAPER – 303: Ecology, Microbiology, Animal Behavior, Pollution and Toxicology	50 MARKS
PAPER – 304 : PRACTICAL (Based on Paper 301, 302, 303)	50 MARKS

B.Sc. (ZOOLOGY)
FIRST YEAR DETAILED SYALLBUS

PAPER – 101

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:

Unit-I

Protozoa - *Euglena, Monocystis*

Unit-II

Porifera - *Sycon*

Unit-III

Coelenterata - *Obelia*

Ctenophora - Salient features

Unit-IV

Platyhelminthes - *Fasciola* (liver fluke) and *Taenia* (tape worm)

Nematehelminthes - *Ascaris*

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FIRST YEAR DETAILED SYLLBUS

PAPER – 102

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:

Unit-I

Annelida - *Nereis*

Unit-II

Arthropoda - *Palaemon* (prawn)

Unit-III

Mollusca - *Pila* (apple-snail)

Unit-IV

Echinodermata - *Asterias*

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FIRST YEAR DETAILED SYALLBUS

PAPER – 103

Cell Biology & 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.

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FIRST YEAR DETAILED SYLLABUS

PAPER – 104

PRACTICAL

1-	Dissection (Major)	12 Marks
2-	Dissection (Minor)	06 Marks
3-	One Permanent Mount	06 Marks
4-	Cytology & Genetics Preparation/Prepared slides	06 Marks
5-	Identify and Comment upon spots (1-10)	10 Marks
6-	<i>Viva-Voce</i>	05 Marks
7-	Practical class record	05 Marks
	Total	50 Marks

SYLLABUS – B.SC. (PART 1) PRACTICAL

PROTOZOA

- (a) **Amoeba** : Examination of culture. Prepared Slide *Amoeba proteus* and *A. verrucosa*.
- (b) **Euglena** : Culture examination for *Euglena*.
- (c) **Monocystis** : Prepared slides.
- (d) **Plasmodium** : 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, Ceratium.***
- (i) Prepared slides of Upaline, Balontidium and Nyctotherum.

PORIFERA

- (a) **Sycon** : General characters, Spicules glycerine preparation. Transverse and longitudinal sections-prepared slides.
- (b) Gemmule of *Spongilla* permanent preparation.
- (c) Different kinds of sponge spicules and sponging fibres of *Euspongia*-prepared slides.
- (d) *Euplectella* (Venus, 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**
Colony-prepared slide.

Medusa-prepared slide.
- (c) **Aurelia**
General morphology.

Tentaculocyst-prepared slide.

Prepared slides and models of life-history stages.
- (d) ***Physalia*** (Portuguese man of war), *Corallium* (red coral),
Fungia (Mushroom coral), *Madrepora* (staghorn coral),

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

PLATHYHELMINTHES :

(a) Fasciola

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, Schistosma, Echinococcus Cysticercus (Bladder worm) and Cysticercoid.

NEMATHELMINTHES

(a) Ascaris

External characters.

Dissected specimens of male of female.

Transverse section of male and female-prepared slides.

(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 through multimedia / models.

Slides of setae *in situ* and brain.

Slides of ovary and septal nephridia.

Prepared slides of transverse section through various regions.

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

ARTHROPODA

(a) ***Palaemon***

External characters; Examination of appendages.

Dissections through multimedia / models

(b) ***Periplaneta***

External characters. Differences between male and female.

Dissections through multimedia / models

Circulation of blood in the wing of cockroach.

Slides of mouth appendages, salivary glands and trachea.

Slides of salivary glands, Malpighian tubules, ovaries and testes.

(c) ***Anopheles and Cules***

Permanent preparation of mouth parts of male and female. Wings-prepared slides.

Life history-prepared slides.

Difference between *Anopheles* and *Culex*

(d) ***Musca***

External characters.

Slides 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 *Thyroglutus* (millipede), *Scolopendra* (centipede). *Lycosa* (wolf-spider), *Lxodes* (tick), *Limulus* (King crab).

MOLLUSCA

(a) *Lamellidens*

External characters

Dissection through multimedia / models

Slides of gill lamella.

Transverse section through middle region of body-prepared slides.

Glochidium (larva) prepared slides.

(b) *Pila*

External characters.

Dissection through multimedia / models

Slides of gill lamella and osphradium.

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

ECHINODERMATA

(a) *Asterias*:

External characters

Dissected specimens.

Pedicellaria-prepared slides.

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

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SECOND YEAR DETAILED SYLLBUS

PAPER – 201

Chordata

Unit- I

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

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

Unit -II

Urochordata: Classification, affinities 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, parental care in amphibia.

Unit-IV

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

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SECOND YEAR DETAILED SYALLBUS

PAPER – 202

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 Extra embryonic membranes of chick. Placentation and types of Placenta.

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SECOND YEAR DETAILED SYALLBUS

PAPER – 203

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

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SECOND YEAR DETAILED SYLLBUS

PAPER – 204

PRACTICAL

1-	Dissection (Major)	10 Marks
2-	Permanent Mount	05 Marks
3-	Comment upon Physiology Apparatus	05 Marks
4-	(i) Suitable preparation of Hemin crystals from the blood	05 Marks
	(ii) Detect the Sugar /albumin / acetone from urine sample	
5-	Slides of (i) Striped or Unstriped muscles	05 Marks
	(ii) Cartilage (hand cut Section)	
	(iii) Blood film/Aereolar tissue	
5-	Identify and Comment upon spots (1-10)	10 Marks
6-	<i>Viva-Voce</i>	05 Marks
7-	Practical class record	05 Marks
	Total	50 Marks

SYLLABUS – B.SC. (PART 2) PRACTICAL

Urochordata

(a) Herdmania

- (i) External characters
- (ii) Dissection through multimedia / models
- (iii) (a) Slides of branchial wall
(b) Section of test and glycerine prepration of spicules.

Slides of 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) Slides 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 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 through multimedia / models
 - (a) Digestive system
Examination of the folds of stomach and “scroll valve”

- (b) Vascular system, 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) 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), ***Torpedo*** (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), *Angulla* (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 models
- (b) Urodela : *Necturus*, *Ambystoma* and Axolotal larva
- (c) Anura : *Bufo*, *Rhacophorus* (tree frog), *Alytes* (midwife toad).
- (d) Gymnophiona : *Ichthyopnis*

Reptillia

- (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 : Dermal 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* (man).

Histology

- (i) Tissues: Slides 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
 - (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) Nervous: Neurons
 - (e) 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.

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THIRD YEAR DETAILED SYALLBUS

PAPER – 301

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.

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THIRD YEAR DETAILED SYALLBUS

PAPER – 302

Biotechnology, Immunology, Biological Tools & 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

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THIRD YEAR DETAILED SYALLBUS

PAPER – 303

Ecology, Microbiology Animal Behavior and Pollution & 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.

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THIRD YEAR DETAILED SYLLBUS

PAPER – 304

PRACTICAL

1-	Dissection (Major)	10 Marks
2-	Permanent Mounting	06 Marks
3-	Identify and Comment upon Spots (1-8)	08 Marks
4-	Economic Zoology (<i>Comments on a suitable Specimen/ life cycle of Silk worm, Honey bee, Lac insect & Food Fishes</i>) (02)	08 Marks
5-	Ecology/ Pollution/ Toxicology (Exercise or Comment	06 Marks
6-	<i>Viva-voce</i>	05 Marks
7-	Practical Class record / Project / Collection	07 Marks
	Total	50 Marks

SYLLABUS – B.SC. (PART 3) PRACTICAL

- Permanent Preparation of: *Euglena, Paramecium*
- Study of prepared slides/ specimens of *Entamoeba, Giardia, Leishmania, Trypanosoma, Plasmodium, Fasciola, Cotugnia, Taenia, Rallietina, Polystoma Schistosoma, Echinococcus, 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.
- Identification of pests.
- Life history of silkworm, honeybee and lac insect.
- Different types of important edible fishes of India.
- Slides of plant nematodes.
- Demonstration of counting of cells (blood and protozoan) by haemocytometer, haemoglobinometer, pH meter, Colorimeter
- 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.
- Project Report/ model chart making.
- **Dissections** : through multimedia / models
- **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.