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SCHEME OF EXAMINATION  
AND  
COURSES OF READING  
FOR

**B.Sc. (HONOURS) EXAMINATION IN ZOOLOGY**

- Part I 1998 Examination  
Part II 1999 Examination  
Part III 2000 Examination



Syllabi applicable for students seeking admission to the  
B.Sc. (Hons.) Zoology Course in the academic year 1997-98

Price 10.00

## B.Sc. (Honours) in Zoology

### SCHEME OF EXAMINATION

#### PART I EXAMINATION 1998

	Duration (Hours)	Max. Marks
Paper I—Nonchordata	3	75
Paper II—Developmental Biology and Histology	3	75
Practicals relating to papers I and II	5	75

*Note* :—The Practical tests shall be of five hours' duration conducted in one session. Laboratory records shall carry 25% of the marks allowed for the practical test. The practical test shall include viva-voce.

#### PART II EXAMINATION, 1999

Paper III—Chordata	3	75
Paper IV—Animal Ecology and Zoogeography	3	75
Practicals relating to Papers III and IV	5	75

*Note* :—The Practical test shall be of five hours' duration conducted in one session. Laboratory records shall carry 25% of the marks allotted for the practical test. The practical test shall include viva-voce.

#### PART III EXAMINATION 2000

Paper V—Physiology and Physiological Chemistry	3	75
Paper VI—Cell Biology	3	75
Paper VII—Evolution and Genetics	3	75
Paper VIII—Applied Zoology	3	75
Practicals relating to Papers V to VIII (two sessions each of 5 hours duration).	10	150
Total		<hr/> 900 <hr/>

*Note* :—The Practical Test shall be conducted in two sessions each of five hours duration, the laboratory record shall carry 25% of the marks allotted for the Practical Test. Practical Test shall include viva-voce.



**DETAILED COURSES OF READING**  
**B.Sc. (Hons.) Part Ist (1st Year) 1998**  
**PAPER I—NONCHORDATA**

**Protozoa :**

Distinguishing characters and classification up to Orders.  
 Structural organizations in different Classes.

Locomotion, Osmoregulation, Nutrition and Reproduction in Protozoa.

**Metazoa :**

Introduction to Metazoa.

Origin of Metazoa.

Metamerism.

Symmetry.

**Porifera :**

Distinguishing characters and classification up to Orders.  
 Structural organization in different Classes.

**Coelenterata :**

Distinguishing characters and classification up to Orders.  
 Structural organization in different Classes.

Polymorphism in Hydrozoa, corals and coral reefs

**Ctenophora :**

Structural organisation and affinities.

**Platyhelminthes :**

Distinguishing characters and classification up to Orders.  
 Structural organization in different Classes.

Reproduction, Parasitism (parasitic adaptations and evolution of parasitism).

**Nemathelminthes :**

Distinguishing characters and classification up to Orders.  
 Structural organization.

Parasitism (along with Platyhelminthes).

**Annelida :**

Distinguishing characters and classification up to Orders  
 Structural organization in different Classes.  
 Excretory system and Coelome.

**Mollusca :**

Distinguishing characters and classification up to Orders  
 Structural organization in different Classes.  
 Torsion and detorsion in Gastropoda.

**Onychopora :**

Structural organization  
 Affinities.

**Arthropoda :**

Distinguishing characters and classification up to Orders.  
 Structural organization in different Classes.  
 Larval forms in Crustacea, Metamorphosis in Insects.  
 Social life in Insects, Vision in Arthropoda, Trilobites.

**Echinodermata :**

Distinguishing characters and classification up to Orders.  
 Structural organization in different Classes.  
 Larval forms, Affinities.

**General characters of the following Phyla :**

Mesozoa, Nemertinea, Rotifera, Acanthocephala, Entoprocta,  
 Sipunculida, Echiurida, Penstastomida, Bryozoa (Ectoprocta),  
 Brachyopoda, Phoronida, Pogonophora and Chaetognatha.

**PAPER II—DEVELOPMENTAL BIOLOGY AND HISTOLOGY****Part A : Development Biology**

Gametogenesis with particular reference to differentiation of spermatozoa; Vitellogenesis; role of follicle/nurse cell in oogenesis; egg maturation; egg membranes; polarity of egg.

Fertilization; parthenogenesis.

Types of animal eggs; patterns of cleavage and gastrulation; germ layers, their derivatives and homologies; cell lineage and fate maps.



Structure and development of extra-embryonic membranes; types and physiology of placenta.

Organogenesis of central nervous system, sense organs, heart and kidney

Tissue interactions (inductions) in development; Regeneration in invertebrates and vertebrates; Metamorphosis and its physiological control in Anura and Insecta. Epigenetics.

### **Part B : Histology**

Microscopic anatomy of the following organs of a mammal: skin, oesophagus, stomach, ileum, duodenum, large intestine, rectum, pancreas, liver, lung, trachea, bronchus, bronchioles, alveoli, kidney, urinary bladder, spinal cord, nerves, heart, arteries, veins, capillaries, lymph node, Peyer's patches, tonsils, lymph, spleen, thymus, testis, ovary, uterus.

## **PRACTICAL EXERCISES IN PAPERS I AND II**

### **Non-Chordata**

#### **Protozoa :**

Examination of living protozoans—*Paramecium*, *Amoeba*, *Euglena*, *Vorticella*.

Mounts of *Monocystis*, rectal ciliates of frog, and Trypanosomes of rat's blood. Study of the following from slides:

*Amoeba*, *Arcella*, *Globigerina*, Foraminiferan ooze, *Noctiluca*, *Ceratium*, *Euglena*, *Balantidium*, *Vorticella*, *Paramecium* (fission and conjugation stages), *Plasmodium*.

#### **Porifera :**

Mounts of spicules, gemmules, spongin fibres. Microscopic slides of sections of sponges. Study of the following from slides or specimens: *Leucosolenia*, *Sycon*, (or *Grantia*) *Spongilla* and *Hylomena*.

#### **Coelenterata :**

Study of the following from specimens and slides.

*Hydra*, *Tubularia*, *Obelia*, *Sertularia*, *Verticillium*, *Porpita*, *Physalia*, *Millepora*, *Aurelia*, *Ephyra*, *Strobilating*, *Scyphistoma*. See anemones, *Tubipora*, *Alcyonium*, *Gorgonia*, *Corallium*, *Fungia*, *Acropora*, *Ctenophore*. Sections of Sea-anemones from different regions.

**Platyhelminthes :**

Study of the specimens and life history stages of *Fasciola* and *Taenia*. Sections of *Fasciola* and *Taenia*.

**Nemathelminthes :**

Study of the following from specimens and slides :

*Oxyuris*, *Anyclostoma*, *Ascaris*—Entire and Transverse sections.

**Annelida :**

**Earthworm :** Dissections to display alimentary canal, reproductive system and nervous system;

T.S. through pharynx, gizzard, seminal vesicles, intestine and prostate glands.

Mounts of ovaries, septal and pharyngeal nephridia.

**Leech :**

Dissection to display digestive, reproductive-cum-excretory system.

T.S. through crop and caecum regions.

Mounts of jaw, and nephridium. ✕

**Nereis :**

T.S. body. Temporary mount of parapodium.

Study of the following from specimens and slides :

*Aphrodite*, *Heteronereis*, *Chaetopterus*, *Serpula*, *Spiroribis Arenicola*, *Sabella*, *Terebella*, *Tubifex*, *Eutphoeus*, *Tomopteris*, *Pontobdella*, *Glossiphonia*.

**Arthropoda :**

**Cockroach :** Dissections of digestive, reproductive and nervous systems. Mounts of mouth parts, salivary apparatus, testis and ovary.

**Prawn :** Dissection of digestive and nervous systems.

Mounts of statocyst and hastage plate.

Study of appendages and respiratory apparatus.

Study of the following from specimens and slides :

*Triops*, *Daphnia*, *Cypris*, *Cyclops*, *Sacculina*, *Gammarus*, *Lepas*, *Balanus*, *Eupagurus*, Crustacean larvae, Centipede, Millipede, *Lepisma*, Grasshopper, *Gryllus*, Termite (different castes), Bedbug, *Aphid*, *Dysdercus*, Water-scorpion, body louse, *Thrips*, Butterfly, Silk moth, Mouth parts of cockroach, butterfly, housefly, and *Dysdercus*, *Buthus*, *Palamnaeus*, spiders ticks and mites.



**Mollusca** : Dissections of digestive and nervous systems of *Lamellidens Pila, Sepia*.

Mounts of pedal ganglion of *Lamellidens*, Radula of *Pila*, ctenidium of *Sepia*.

Study of the following from specimens and slides :

*Chiton, Patella, Triton, Doris, Limnaea, Helix, Limax, Dentalium, Mytilus, Pecten, Ostrea, Teredo, Loligo, Octopus, Nautilus, Glochidium larva.*

**Echinodermata** :

Study of the following from specimens and slides :

*Pentaceros, Astropecten, Astrophyton, Clypeaster, Echinocardium, Spatanus, Cucumaria, Molpadida, Synapta, Antedon, Echinoderm larvae.*

Preparation of Pedicellaria and Aristotle's Lantern of Sea-urchin.

**Minor Phyla** :

Study of one specimen each of the minor phyla listed above.

**Developmental Biology** :

Study of the developmental stages of frog : cleavage stages, gastrula, neurula, tadpole; study of whole mounts of chick embryos in different Hamburger & Hamilton stages 4-7, 11, 14, 34, 38. Preparation of whole mount of the chick embryo (any convenient stage).

Sections of chick embryos to study organogenesis of central nervous system, sense organs, pharyngeal apparatus; sections of chick embryos to show the development of extra embryonic membranes; section of placenta.

**Histology** :

Preparation of temporary mounts using suitable animals: squamous and ciliated epithelium; non-striated, and skeletal striated muscle; nerve cells, spermatozoa, areolar tissue; blood film. Examination of permanent slides (mammalian); salivary gland, oesophagus, stomach duodenum, ileum, rectum, liver pancreas, trachea, lung, kidney, spinal cord, thymus, spleen, skin, bone and cartilage.

B.Sc. (Hons). Part II (2nd Year 1999

PAPER III—CHORDATA

Origin and general characters of Chordata.

**Protochordata :** Structural organisation of Hemichordata, Urochordata, and Cephalochordata. Classification upto orders. Post-embryonic development of *Balanoglossus*, *Herdmania*, and *Amphioxus*. Inter-relationships of protochordate.

**Agnatha :** General characters and classification upto orders.

**Fishes :** General characters classification up to orders of Chondrichthyes, and Osteichthyes. Migration, Airbladder, extra branchial respiratory organs, Parental care.

**Amphibia :** Origin and evolution of land vertebrates. General characters and classification of Amphibia up to orders. Parental care.

**Reptilia :** General characters and classification up to sub-orders. Affinities of *Sphenodon*.

Identification of poisonous snakes, poisonous snakes of India, biting mechanism in snakes. Extinct reptiles.

**Birds :** Origin of birds;

Principles of bird flight,

Flight adaptations,

Bird migration.

**Palaeognathae :** Distribution and classification up to families. General characters & classification of **Neognathae** up to orders with special emphasis on beaks & claws.

**Mammals :** General characters & classification of different groups of mammals : Prototheria, Metatheria up to families : Eutheria up to suborders. Origin of mammals.

COMPARATIVE ANATOMY

**Integumentary system :** Comparative account of integument and its derivatives. Use of Integument.

**Digestive System:** Comparative account of the alimentary canal and associated glands.



**Circulatory System:** General plan of circulation in various groups of chordates. Evolution of heart, aortic arches, evolution of venous system, lymphatic system.

**Respiratory system:** Comparative account of respiratory organs and mechanism of breathing.

**Skeletal System:** Comparative account of jaw suspensorium, visceral arches, vertebral column, girdles and limbs.

**Nervous System:** Comparative anatomy of brain, spinal cord and nerves of chordates. Peripheral.

**Sense Organs:** Classification of receptors; structure and working of ear and eye.

**Urinogenital System:** Succession of kidney; evolution of urinogenital ducts

## PAPER IV—ECOLOGY AND ZOOGEOGRAPHY

### Ecology

#### *Organisms*

Concepts of evolution, natural selection and adaptation as related to ecology.

Ecology in relation to Climate in India;

temperature-precipitation patterns, vegetation, soil types, monsoon—causes and consequences.

Morphological, physiological and behavioral adaptations to external factors such as temperature, moisture, salinity and light:

Thermoregulatory mechanisms of ectotherms and endotherms to deserts and polar environments; osmotic adaptations of brackish water animals. Photoperiodism, concept of limiting and controlling factors.

#### *Populations*

Attributes of animal populations.

Population density, natality, mortality, immigration, emigration, age pyramids, sex ratio, dispersal and dispersion.

#### *Population growth:*

Exponential growth of populations, Verhulst-Pearl logistic growth equation, innate capacity to increase and carrying capacity of the environment, laboratory studies on population growth.

**Regulation of population density:**

Fluctuations and balance of numbers in nature; effects of density-dependent and density-independent factors on population density.

**Competition:**

Examples of intraspecific and interspecific competition in nature : Gause's Principle of Competitive Exclusion ; Niche concept : Example of a laboratory study on competitive exclusion.

**Predation :**

Examples of predation and its effects on ecological communities ; Evolution of prey-predator strategies ; plant-herbivore relationships.

**Parasitism :**

Ecological aspects of host-parasite relationship ; evolution of parasitism.

**Commensalism and mutualism :****Communities & Ecosystems :**

Components of an ecosystem.

**Ecosystem energetics :**

energy flow through trophic levels, primary production and factors affecting its secondary production ; community metabolism ; food pyramids.

**Biogeochemical cycles :**

water, oxygen, carbon, nitrogen and nutrient cycles ; role of organisms in recycling.

**Community development**

ecological succession ; climax community, ecotone ; edge effect.

**Major Biomes— structure and function :**

Desert, tropical rain forest, fresh water biomes (including streams, lakes and rivers); major flora and fauna of the above biomes in India.



**Human Ecology :**

Human population growth.

Wildlife management with particular reference to India :

Conservation of renewable resources, protection of endangered species, wildlife sanctuaries and their representative fauna.

Environmental pollution :

Sources of water and air pollution ; biological consequences ; approaches to pollution control.

**Zoogeography :**

Introduction : history of zoogeography, influence on evolutionary theory, role of fossils.

Concepts of parallelism, endemism, homology etc.

Factors influencing large-scale animal distribution : barriers, dispersal.

**Classical Zoogeography :**

Classification of zoogeographical realms, faunal peculiarities with emphasis on mammals, relation to climate and vegetation ; Indian fauna including freshwater fishes, aspects of marine zoogeography.

Evolution of zoogeographical realms : Theories pertaining to distribution.

Dynamic aspect of zoogeography in the light of plate tectonics and continental drift.

Island zoogeography.

**PRACTICAL EXERCISES IN PAPERS III & IV****Chordata****Lower Chordata:**

Specimens : Branchiostome, Balanoglossus, Herdmania, Salpa, Doliolum, Botrylus, Clona, Pyrosoma.

Prepared slides : Amphioxus : Sections of pharyngeal region, pharynx with gonads, intestinal region, caudal region, velum

(W. M.) Oral hood (W.M.). Sections through Balanoglossus - Proboscis region, collar-region, Branchio-genital region. Ascidian: branchial wall (W.M.), Ascidian tadpole (W.M.).

Preparation of spicules of *Herdmania*

**Dissections:** Afferent branchial arteries, efferent branchial arteries, cranial nerves; eye muscles and their innervation, Internal ear and brain of *Scoliodon*.  
**Temporary mounts:** Ampulla of Lorenzini, placoid scales, cycloid and ctenoid scales.

**Dissection of *Mystus*:** Weberian ossicles and air bladder.

**Museum specimens:** A cyclostome, *Chimaera*, *Pristis*, *Sphyrna*, Embryo of shark with yolk-sac, egg case of shark, *Rhynobatus*, *Echinis*, Sting-ray, Electric ray, *Ophiocephalus*, *Clarias*, *Heteropneustes*, *Mystus*, *Wallago*, pipefish, Seahorse, Eel, Puffer fish, Coffercodder, *Diodon*, flat fish, ribbon fish, *Catla*, *Rohu*, *Notopterus*, *Belone*, *Gambusia*, *Hemirhamphus*, *Amphipnous*, *Anabas*, butterfly fish, *Lophius*, flying fish and hill stream fish. Skeleton of *Scoliodon* and *Laber*.

**Accessory branchial organs** in *Anabas*, *Clarias* and *Heteropneustes* (to be studied from dissected specimens).

### **Amphibia:**

**Dissection of Cranial nerves;** arteries, veins, urogenital systems of frog. Mount of hyoid apparatus.

**Museum specimens:** *Hyla*, toad, *Rhacophorus*, salamander, *Alytes*, *Ureotyphlus*, *Necturus*.

### **Reptilia:**

**Anatomy of lizard and snake** to be studied from dissected specimens.

**Skeleton:** *Varanus*, snake, tortoise. Skulls of cobra and Python and crocodile.

**Museum Specimens:** *Calotes*, *Hemidactylus*, *Uromastix*, *Varanus*, *Mabuia*, *Chamaeleon*, *Draco*, limbless lizard, python, *Eryx*, cobra, viper, krait, rat snake, water snake, tree snake, sea snake. *Lessymys*, *Trionix*, *Chelone*, *Testudo*, crocodile, *Gavialis*.



**Aves:** Dissection : Flight muscles, arteries, veins, brain, perching mechanism of pigeon.  
 Temporary Mounts : Pecten from eye of pigeon.  
 Barbs & barbules, columella.  
 Museum Specimens: Assorted skins of common birds from Delhi region.  
 Skeleton: Skeleton of fowl. Different types of plates in birds (duck, crow, fowl).

**Mammals :** Dissection : arteries, veins, urinogenital system, neck region, ear ossicles, and brain of rat.  
 Museum specimens: Shrew, frugivorous bat, insectivorous bat, Loris, hedgehog, porpoise rabbit, squirrel, *Herpestes*.

Skull of the following mammals:

Cow or goat, dog, horse, camel, *Loris*, langur or *Macaqua*, cat, mongoose, squirrel, hedgehog, shrew, bat and man.

### **Ecology**

Field work to understand the basic ecological concepts.

**B.Sc. (Hons.) Part III (3rd Year) 2000**

### **PAPER V—PHYSIOLOGY AND PHYSIOLOGICAL CHEMISTRY**

**Elements of cell physiology :**

Solutions, osmotic pressure, diffusion, hydrogen ion concentration, buffers.

Permeability of membranes.

**Chemical composition of living matter :**

Chemistry of carbohydrates, lipids, proteins and nucleic acids.

**Enzymes :**

Nature, function, classification.

Co-enzymes and prosthetic groups.

Mode of action of enzymes with special reference to the induced fit theory.

**Intermediary metabolism:**

**Carbohydrates**

The Embden—Meyerhof pathway.

The Hexose-monophosphate shunt.

The Tricarboxylic acid cycle.

Glycogenolysis and Glycogenesis.

Gluconeogenesis and the role of the dicarboxylic acid shuttle.

**Biological oxidations :**

Dehydrogenases, Electron-transfer enzymes.

Oxidases.

Mixed function oxygenases.

Dioxygenases.

Coupled phosphorylations.

Substrate-level phosphorylations.

**Lipids :**

$\beta$ -oxidation of fatty acids.

Fate of glycerol-gluconeogenesis.

Ketone—body formation and utilisation.

**Proteins :**

Metabolism of amino acids : oxidative deamination, transamination decarboxylation.

Enzymology of the urea cycle.

Fate of the glucogenic and ketogenic amino acids.

Interrelationships of metabolic pathways.

Physiology of the following systems with special reference to a mammal :—

Digestion of the dietary constituents :

Composition, function and regulation of salivary, gastric, pancreatic, bile and intestinal juices.

Absorption.

Nutrition : Balanced diet including vitamins, minerals and trace elements.

**Blood:**

Composition and function of blood and lymph.

Blood groups, Rh factor.



**Blood coagulation.**

**Structure and function of haemoglobin.**

**Heart;**

**Structure.**

**Origin, conduction and regulation of heart beat.**

**Cardiac cycle.**

**Electrocardiogram.**

**Peripheral circulation:**

**Blood pressure, capillary pressure, regulation of blood pressure.**

**Respiration:**

**Mechanism and control of breathing.**

**Transport of oxygen and carbondioxide, Oxygen, dissociation curves of haemoglobin and myoglobin, Bohr effect, chloride shift.**

**Structure and function of the kidney:**

**Physiology of urine formation.**

**Role of the kidney in the regulation of water, salt and acid-base balance.**

**Muscle:**

**Ultrastructural, chemical and physiological basis of skeletal muscle contraction. Molecular mechanisms in muscle contraction.**

**Nerve impulse:**

**Nature, origin and propagation along a neurone, synapse and myoneural junction**

**Integrative functions of the central Nervous system.**

**Structure and function of sensory organs concerned with vision, sound perception, taste, smell and touch.**

**Structure and function of:**

**Hypothalamus, pituitary, thyroid, parathyroid, adrenal, pancreas and gonads.**

**Reproduction:**

**Homeostasis:**

**Glucose metabolism, water and temperature regulation as examples.**

## PAPER VI—CELL BIOLOGY

### History of Cell Biology.

#### Chemical organization of the cell:

Inorganic and organic constituents. Macromolecules in the cell. Colloid nature of the protoplasm.

#### Techniques in Cell Biology:

Principles of microscopy. Different types of optical systems for the study of cellular organization. Fundamentals of electron microscopy. Chemistry of fixation and staining. Cytochemical techniques to study nucleic acids, proteins, lipids and carbohydrates. Principles of histochemistry and histochemistry of enzymes. Tissue culture methods. Use of radioactive precursors and autoradiography. Cell fractionation and characterization of cellular constituents.

#### Structure of cellular constituents:

"Plasma membrane, endoplasmic reticulum, ribosomes, lysosomes, Golgi complex, Mitochondria, centrioles, basal granules, cilium and flagellum"

#### Cell Physiology:

Cellular respiration, cell permeability, endocytosis, lysosomes, kinetic elements and cellular movements, cell secretion.

#### Nucleus:

Nuclear membrane, nucleolus, chromatin, Chromosomes prokaryotes and eukaryotes, chromosome replication, Chromosomal movements in mitosis and meiosis.

#### Cell cycle and its regulation.

Chromosomes and differentiation. Polytene and lampbrush chromosomes.

Sex-chromosomes and chromosomal basis of sex-determination.

#### Molecular basis of cell function:

Gene structure, D. N. A. replication,

Genetic code, transcription and translation.

Control mechanisms in cell metabolism.



## PAPER VII—EVOLUTION AND GENETICS

### Part A : Evolution

Origin of Life.

History of evolutionary thought upto Charles Darwin.

Sources and nature of Organic Variations in (a) Micro-organisms and (b) Higher organisms.

Natural selection; Directional, stabilising and disruptive type.

Coloration and Mimicry.

Selection in Micro-organisms.

Hardy-Weinberg Law.

Snell—Wright effect

Isolating mechanisms and their role in evolution.

Concept of micro, macro- and megaevolution.

Concept of species, sub-species and infra-subspecific categories:

Fossils and fossil formation, age determination and significance

Determination of evolutionary rate through fossils.

Phylogeny of Man.

Origin and Evolution of Man.

### Part B : Genetics

History of Genetics.

Mendelian inheritance patterns.

Incomplete dominance and quantitative inheritance.

Linkage and Linkage maps in Eukaryotes and Prokaryotes.

Gene interactions (Epistasis; Position effect; Atavism; Lethal genes).

Multiple alleles.

Mutations, Point mutations, chromosomal aberrations, chromosomal number, form and rearrangement with reference to speciation in *Drosophila* polyploidy (Molecular basis of mutations).

Non-chromosomal inheritance.

Human Genetics; Diseases of single gene inheritance.

Normal and abnormal karyotypes. Genetic counselling.

Somatic cell genetics. Cell fusion in relation to gene mapping and differentiation.

Elementary aspects of plasmids, DNA splicing and recombinant DNA.

### PAPER VIII—APPLIED ZOOLOGY

The students will opt for *One* of the following courses:

- (A) Medical Zoology      (C) Agriculture  
 (B) Applied Entomology    (D) Reproductive Biology and Human Welfare.

#### Medical Zoology

Introduction to Parasitology (pertaining to various terminologies used).

Brief introduction to pathogenic microbes: Viruses, Rickettsiae, Spirochaetes and Bacteria.

Brief accounts of life history, mode of infection and pathogenicity of the following pathogens with reference to man, prophylaxis and treatment:

- (a) Pathogenic protozoans: Entamoeba, Trypanosoma, Leishmanis, Giardia Trichomonas Plasmodium.  
 (b) Pathogenic helminths: Fasciolopsis, Schistoma, Echinococcus Ancylostoma, Trichinella, Wuchereria, Dracunculus, Oxyuris.

Brief account of arthropods as direct agents of disease or discomfort; accidental injury to sense organs; blood loss; entomophobia; dermatosis; myiasis; allergy and venoms.

Arthropods as vectors of human diseases; Malaria (*Anopheles stephensi* A. culicifacies); yellow fever and Dengue haemorrhagic (*Aedes aegypti* A. albopictus); Filariasis (*Culex pipiens fatigans* *Mansonia* sp.); Japanese B. Encephalitis (*C. tritaeniorhynchus*) Plague (*Ctenocephalides cheopis*) and Epidemic typhus (*Pediculus*).

Distribution biology and control of the above mentioned vectors. Histopathological changes in organs in relation to diseases such as liver cirrhosis, nephrosis; tumours, cancers.

Epidemic diseases, such as typhoid, cholera, small pox: their occurrence and eradication programmes.

Brief introduction to human defence mechanisms. Antigens and antibodies.

General account of drug therapy and drug resistance.



**(B) Applied Entomology**

Elementary knowledge of collection, preservation and culture of insects.

Bionomics of the following insect pests:

**Crops**

- Cotton — *Earias Vittella*, *Pectinophora gossypiella*.
- Wheat — *Sesamia inferens*.
- Paddy — *Leptocoria acuta*, *tryporyza incertellus*.
- Pulses — *Heliothis armigera*.
- Sugar Cane — *Scripophage nivella*, *Pyrrills perpusilla*.
- Vegetables — *Raphidopalpa foveicollis*, *Leucionodes orbonalis*.
- Fruits — *Rapilio demoleus*, *Aspidiotus perniciosus*.
- Castor — *Achoes janata*.

**Stored Grains**

- Rice — *Sitophilus oryzae*, *Corcyra cephalonica*.
- Wheat — *Trogoderma granarium*, *Cadra Cautella*.
- Pulses — *Callosobruchus chinensis*.

Safe storage of food grains.

Bionomics and control of locusts and termites.

House hold pests and their control.

Economic importance of Fleas, mosquitoes, bed bugs, lice, sand flies and house flies.

Outlines of sericulture, apiculture, Lac culture.

Principles of insect control: mechanical, cultural, chemical, biological, sterile male technique, genetics, quarantine, integrated approach to pest management.

**(c) Aquaculture**

1. General introduction to Aquaculture.
2. Types of Aquaculture :
  - (i) Pond Culture.
  - (ii) Fish Culture in sewage-fed waters.
  - (iii) Brackish water fish culture.
  - (iv) Mariculture-prospects of coastal aquaculture.

### **Pond Culture**

(i) Construction and preparation of hatching, nursery, rearing and stocking ponds:

- (a) Selection of site.
- (b) Dimensions and area.
- (c) Source of water and drainage facilities
- (d) Physicochemical characteristics of water and soil.
- (e) Plankton, its classification and distribution; Productivity of culture waters.
- (f) Fertilization, manuring and artificial feeding.
- (g) Growth rates
- (h) Common diseases of cultured fishes (fin rot, furunculosis, Ichthyophthiriasis and Argulus infection).
- (i) Induced breeding of cultivated fishes.
- (ii) Monoculture and composite fish culture.
- (iii) Airbreathing fish culture.
- (iv) Economics of pond culture; cost-benefit ratio.

#### **4. Fish-culture in sewage-led waters**

- (a) Sewage and its treatment
- (b) Use of treated as additive in fish pond
- (c) Suitable species for culture.
- (d) Scope of this low-input technology.

#### **5. Fish-Culture in Brackish Water**

- (a) Suitable species-emphasis on mullets and milkfish.
- (b) Collection of hatchlings from natural sources.
- (c) Management
- (d) Marketing and export potential

#### **6. Mariculture**

- (a) Edible and pearl oyster culture
- (b) Prawn culture.

### **(D) Reproductive Biology and Human Welfare**

Development, structure and physiology of human male and female reproductive systems.

Hormonal regulation of ovulation, fertilization, implantation, abortion gestation, parturition and lactation.

Nutrition and Reproduction.



**Birth Control : The need. Motivation, Implementation. Psychological and sociological aspects.**

**Contraception and modern contraceptive technology : Natural methods, mechanical methods, chemical and immunological methods, surgical methods, medical termination of pregnancy.**

**Male & Female infertility-its natural history major causes and management.**

**Reproductive biology in relation to :**

- (i) Egg Production in poultry.
- (ii) increased fertility in farm animals including techniques of artificial insemination.
- (iii) induction of early puberty in cattle.
- (iv) milk yield.

## **PRACTICAL EXERCISES RELATING TO PAPERS V-VIII**

### ***Physiology and Physiological Chemistry***

**Experiments to show diffusion and dialysis.**

**Effects of isotonic, hypotonic and hypertonic solutions on erythrocytes.**

**Study of haemolysis—haemolytic effects of acid and alkali.**

**Enumeration of red blood corpuscles using the haemocytometer.**

**Estimation of haemoglobin mammalian blood.**

**Total and differential count of white blood corpuscles.**

**Preparation of haemin and haemochromogen crystals.**

**Coagulation of blood.**

**Colour reactions and general tests for the identification of carbohydrates, lipids and proteins.**

**Study of reflex action and reflex time in the frog.**

**Study of the action of salivary amylase and of pepsin, trypsin and pancreatic lipase from tissue extracts.**

**Effects of PH, temperature and inhibitor on the enzymatic activity of salivary amylase.**

**Recording simple muscle twitch with mechanical, thermal and chemical stimulation of the gastrocnemius muscle-sciatic nerve preparation of frog.**

Study *in vitro* of biological oxidation using tissue extracts and methylene blue.

Perfusion of the excised frog heart.

Recording of the frog's heart beat *in situ* and with the perfused heart.

Demonstration of the effect of acetylcholine/atropine/epinephrine on the heart beat.

Measurement of dissolved oxygen content in water by Winkler's method.

Dissection of the endocrine glands in rat

Study of sections of pituitary, thyroid, adrenal, pancreas, testis

and ovary from prepared slides.

#### **Cell Biology:**

Mitosis: Onion root—tip: permanent squash preparations.

Meiosis: Grasshopper testis temporary and permanent squash preparations.

Salivary gland chromosomes of *Drosophila* and *Chironomus* temporary and permanent squash preparations.

Cytochemical staining to demonstrate nucleic acids, proteins and mucopolysaccharides.

Sex-chromatin demonstration.

Study of the prepared slides showing the following: Autosomes and Sex-chromosomes of a Grasshopper & Mammal.

#### **Genetics:**

Construction of a familial pedigree utilizing inheritance pattern of a single character (dry lab.)

Probability exercises in Genetics (dry lab)

#### **Microtomy:**

##### **(A) Medical Zoology: Practicals**

Preparation of blood film: examination of blood parasites: Trypanosoma and Plasmodium.

Preparation of permanent stained mounts of rectal ciliates of frog.

Study of permanent slides and specimens of parasitic protozoans, helminths and arthropods mentioned in the theory syllabus.



**Anopheles:** dissection of female adult mosquitoes for sporozites and oocytes.

Collection of helminth parasites from vertebrates; their preservation and staining.

Staining of bacteria.

Study of slides showing histopathological changes in liver and kidney in respect of cirrhosis and nephrosis respectively.

Analysis of blood Groups: A, B, O and Rh.

Pathological examination of sputum, blood, urine and stool.

Blood: Erythrocyte sedimentation rate (ESR); Haematocrit; bleeding time; coagulation time; prothrombin time.

Experimental induction of diabetes in rat. Quantitative estimation of blood glucose

Colorimetric estimation haemoglobin

R. B. C., W. B. C. counts.

Medicolegal tests for blood: Benzidine test, precipitin test and complement fixation test.

### (B) *Applied Entomology (Practicals)*

Collection and preservation of insects. Classification of insects upto orders. Identification and life history of economically important insects listed in the syllabus for Theory. Study of damage caused by insects.

Rearing and culture of any one insect of economic importance.

Bioassay of any one insecticide using mosquito larvae and adults of house fly/a stored grain pest.

Acquaintance with insecticide dusting and spraying equipment and its working

Acquaintance with Bee culture techniques.

### ) *Aquaculture :*

1. Identification of following aquaculture animals catla, catla, Labeo rohita, Labeo Calbasu, Cirrhina mrigala, Cirrhina reba, Cyprinus carpio, Ctenopharyngodon idella, Hypothalmichthys molitrix, Osphronemus goramy, Ophicephalus sp. Notoperus sp. Pangassius sp., Heteropneustes fossilis, Clarias batrachus Wallago attu, Mystus sp. Chanos chanos, Mugil sp. Lates

*Lates calcarifer*, *Tilapia mossambica*, *Mytilus*, Oyster, Pearl oyster, *Scylla serrata*, *Macrobrachium* sp. *Penaeus indicus*, *Penaeus monodon*, *Matapenaeus monoceros*, *Panulirus* sp. *Artemia* sp.

2. Study of maturity stages, estimation of fecundity in *Hypophthalmichthys* *pneustes fossilis*, *Labeo rohita*, *Catla catla* by volumetric method.

3. Demonstration of artificial induction of spawning with fish pituitary extract.

4. Demonstration of preparation and maintenance of display aquaria.

5. Physico-chemical analyses of the following parameters from aquaculture ponds; temperature, pH., dissolved oxygen, free carbon dioxide, alkalinity and hardness.

6. Identification of the following specimens of phytoplankton, zooplankton and aquatic insects :

Phytoplankton	Zooplankton	Aquatic Insects
<i>Synedra</i>	<i>Nauplius</i> Larvae	<i>Gerris</i>
<i>Fragilaria</i>	<i>Daphnia</i>	<i>Ranatra</i>
<i>Navicula</i>	<i>Cyclops</i>	<i>Orectochilus</i>
<i>Cyclotella</i>	<i>Simocephalus</i>	<i>Dytiscus</i>
<i>Pinnularia</i>	<i>Bosmina</i>	Nymphs of
		Odonata &
		Ephemeroptera
<i>Oscillatoria</i>	<i>Asplachna</i>	Dipteran Larvae
<i>Microcystis</i>	<i>Keratella</i>	
<i>Anabaena</i>	<i>Philodina</i>	
<i>Scenedesmus</i>	<i>Brachionus</i>	
<i>Pediastrum</i>		
<i>Staurastrum</i>		

7. Identification of the following aquatic macrophytes : *Eichornia*, *Pistia*, *Hydrilla*, *Potamogeton*, *Nymphyaca*, *Nelumbium*, *Ceratophyllum*, *Typha*, *Phragmites*.

8. Laboratory culture and maintenance of *Cyclops* and *Daphnia*.

9. Film shows and visit to Shahdara Fish Farm to acquaint students with aquacultural practices.



**(D) Reproductive Biology and Human Welfare**

1. Study of vaginal smears of human menstrual cycle or oestrous cycle from prepared slides.
  2. Examination of vaginal smears from rat.
  3. Study of the histological sections of the female reproductive tract from prepared slides in rat and human.
  4. Examination of foetus, placenta and resorbed sites from the pregnant rat.
  5. Ovariectomy castration, vasectomy hysterectomy in rat.
  6. Demonstration of the technique for hormonal implants.
  7. Study of histological sections of male reproductive tract and accessory glands in rat and human.
  8. Parameters of male fertility in rat :
    - (a) Detection of fructose in the male accessory glands.
    - (b) Sperm motility in different regions of male reproductive tract.
    - (c) Sperm counts in different regions of epididymis.
9. *Field work*
- (a) Techniques of data collection in demography at centres of family welfare.
  - (b) Demonstration of various contraceptives and surgical techniques at family welfare clinics and National Institutes of Family Welfare in and neighbourhood of Delhi.
  - (c) Demonstration of techniques of preservation of semen, and artificial insemination at suitable centres.
    1. *Calcarifer, Tilapia mossambica, Mytilus, Oyster, Pearl oyster, Scylla serrata, Macrobrachium sp. Penaeus indicus, Penaeus monodon, Matapenaeus monoceros, Panulirus sp. Artemia sp.*
    2. Study of maturity stages, Estimation of Fecundity in *Heteropneustes fossilis, Labeo rohita, Catla catla* by volumetric method.
    3. Demonstration of artificial induction of spawning with fish pituitary extract.
    4. Demonstration of preparation and maintenance of display aquaria.