

B.Sc. Zoology Syllabus in Semester System (2019 onwards)

Semester	Type of Paper	Paper	Title
I	Subjective	1	Lower Non-Chordata (Protozoa to Helminths)
	Subjective	2	Higher Non-Chordata (Annelida to Echinodermata)
II	MCQ	3	Cell Biology & Genetics
	PRACTICAL		Practical
III	Subjective	4	Chordata
	PRACTICAL		Practical
IV	MCQ	5	Animal Physiology & Biochemistry
	MCQ	6	Evolutionary Biology & Developmental Biology
V	Subjective	7	Animal behaviour, Chronobiology, Endocrinology and Neurobiology
	Subjective	8	Economic Zoology
	PRACTICAL		Practical
VI	MCQ	9	Molecular Biology & Immunology
	MCQ	10	Bioinstrumentation, Biotechnology, Bioinformatics and Biostatistics
	MCQ	11	Environmental Biology, Wildlife & Toxicology

B.Sc. Zoology Semester Pattern Syllabi

SEMESTER-I

Paper 1- Lower Non Chordata-I (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*, *Plasmodium*, *Monocystis* and *Paramecium*.

Unit-II

Porifera: *Sycon*

Unit-III

Cnidaria: *Obelia* and *Aurelia*

Ctenophora: Salient features

Unit-IV

Platyhelminthes: *Fasciola* (Liver fluke) and *Taenia* (Tape worm)

Nemathelminthes: *Ascaris* and *Ancylostoma* (Hook worm).

Paper 2- Higher Non-Chordata (Annelida to Echinodermata)

Unit-I

Annelida: *Nereis* and *Hirudinaria* (Leech).

Unit-II

Arthropoda: *Palaemon* (prawn) and *Schistocerca* (Locust)

Unit-III

Mollusca: *Lamellidens* (fresh water mussel) and *Pila* (Apple snail)

Unit-IV

Echinodermata: *Pentaceros* (Excluding development)

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Semester-II

Paper 1- Cell Biology & Genetics

Unit-I

Cell Biology I

Structure and function of cell, Ultra structure and function of cell membrane, Golgi body, ribosome, nucleus and endoplasmic reticulum.

Unit-II

Cell Biology II

Structure and function of mitochondria, lysosome and peroxisome. Cell Division: Mitosis and Meiosis.

Unit-III

Genetics I

Structure of chromosomes, Watson & Crick Model of DNA, Differences between DNA and RNA. 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.

Unit-IV

Genetics II

Sex determination, sex differentiation, Sex-linked characters, Sex influenced characters. Chromosomal aberrations (structural and numerical), Mutation, Genetic diseases and abnormalities, Eugenics.

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Practical Syllabus Semester II

PROTOZOA

- (a) Examination of pond water for different kinds of protozoans
- (b) Study of prepared slides: *Amoeba*, *Euglena*, *Vorticella*, *Noctiluca*, *Monocystis*, *Arcella*, *Paramecium*, *Plasmodium*, *Opalina*, *Nyctotherus*, *Balantidium*, *Polystomella*, *Gregarina*, *Trypanosoma*.

PORIFERA

- (a) *Sycon*: Spicules glycerine preparation. Transverse and longitudinal sections-prepared slides.
- (b) Gemmule of *Spongilla* permanent preparation.
- (c) Different kinds of sponge spicules and spongin fibres of *Euspongia*-prepared slides.
- (d) *Euplectella* (Venus's flower-basket), *Spongilla* (fresh-water sponge), *Euspongia* (bath sponge).

CNIDARIA

- (a) *Obelia*: Colony-prepared slide, Medusa-prepared slide.
- (b) *Aurelia*: General morphology, Tentaculocyst-prepared slide. Prepared slides and models of life-history stages.
- (c) *Physalia* (Portugese 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, Larval forms-prepared slides.
- (b) *Taenia*: Mature and gravid proglottids
- (c) *Planaria*, *Polystomum*, *Paramphistomum*, *Schistosoma*, *Echinococcus* and *Dipylidium*, Cysticercus (Bladder worm), mature and gravid proglottids of *Cotugnia* and *Ralletina*.

NEMATHELMINTHES

- (a) *Ascaris*: External characters of male and female. Transverse section of male and female-prepared slides.
- (b) *Ascaris lumbricoides*, *Enterobius vermicularis*, *Ancylostoma duodenale* prepared slides.

ANNELIDA

- (a) *Nereis*: Parapodium-permanent preparation. Transverse sections-prepared slides.
- (b) *Pheretima*: Glycerine preparations of setae in situ and brain. Permanent preparations of Septal nephridia.
- (c) *Heteronereis*, *Arenicola*, *Aphrodite*, *Lumbricus*, *Dero*, *Branchellion*, *Haemadipsa*, *Bonellia* (female).

ARTHROPODA

- (a) *Palaemon*: Appendages, Dissection of Central Nervous System, Glycerine preparation of hastate plate. Glycerine preparations of statocysts.
- (b) *Anopheles* and *Culex*: Mouth parts of male and female.
- (c) *Musca*: Glycerine preparation of proboscis.
- (d) *Daphnia*, *Cyclops*, *Balanus*, *Eupagurus* (hermit crab) *Scylla* (crab), *Sacculina* (on crab). Larval forms (Nauplius, Zoea), *Lepisma* (Silver fish), *Schistocerca* (locust), *Odontotermes* (white ant), *Apis* (honey- bee), *Xenopsylla* (rat flea), *Thyroglutus* (millipede), *Scolopendra* (centipede). *Lycosa* (wolf-spider), *Ixodes* (tick), *Limulus* (King crab).

MOLLUSCA

- (a) *Lamellidens*: Dissection, Permanent preparations of gill lamella. Transverse section through middle region of body-prepared slides. Glochidium (larva) prepared slides.
- (b) *Pila*: Dissection. Permanent preparations of gill lamella and osphradium.
- (c) *Chiton*, *Teredo*, *Turbinella* (Shankh), *Laevicaulis* (slug), *Doris*, *Aplysia*, *Dentalium* *Nautilus*, *Sepia* and *Pinctada margaritifera* (Black lip pearl oyster)

ECHINODERMATA

- (a) *Pentaceros*: 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

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Semester III

Paper 1- Chordata

Unit- I

Hemichordata: General characters of Hemichordata and affinities of *Balanoglossus*

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

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

Pisces: Classification and detailed study (habit, morphology, anatomy and physiology) of *Scoliodon*.

Unit -II

Amphibia: General Characters, Classification up to order and examples.

Reptilia: General Characters, Classification up to order and examples.

Aves: General Characters, Classification up to order and examples. Flying adaptations.

Mammalia: General Characters, Classification up to order and examples.

Unit-III

Comparative anatomy of vertebrates

Histology (types of tissues). Comparative study of integument and skeleton.

Unit-IV

Comparative study of vertebrates

Digestive, respiratory, circulatory, nervous, receptor and urinogenital systems.

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Practical Syllabus Semester III

Semester III

Urochordata

- (a) *Herdmania*: Larva and metamorphosis- prepared slides.
- (b) Ascideacea: *Herdmania*
- (c) Thaliacea: *Pyrosoma*, *Doliolum*
- (d) Larvacea: *Oikopleura*.

Cephalochordata

- (a) *Branchistoma* (= *Amphioxus*): Permanent preparation of the pharyngeal wall, Oral hood and velum- prepared slides, Transverse section through the body – prepared slides, Models illustrating development

Pisces

- (a) Cyclostomata: *Petromyzon* (Lamprey) and *Myxine* (Hagfish)
- (b) **Fish**: External characters, Glycerine and permanent preparation of scales, Dissection, Heart, ventral aorta, dorsal aorta, arterial arches (afferent and efferent), Cranial nerves, Internal ear, Ampullae of Lorenzini
- (c) Embryo with yolk-sac placenta
- (d) *Pristis* (Saw fish), *Astrape* (Indian electric ray) *Chimaera* (rabbit fish), *Acipenser* (sturgeon), *Lepidosteus* (gar-pike), *Hippocampus* (sea hourse) *Antennarius* (Indian angler), *Anguilla* (eel), *Pleuronectes* (sole), *Exocoetus* (flying fish), *Clarius* (cat fish), *Anabas* (climbing perch), *Neoceratodus*, *Protopterus* (lungfish), Different kinds of scales- prepared slides

Amphibia

- (a) Urodela : *Necturus*, *Ambystoma* and Axolotl larva
- (b) Anura : *Bufo*, *Rhacophorus* (tree frog), *Alytes* (midwife toad).
- (c) Gymnophiona : *Ichthyophis*

Reptilia

- (a) *Varanus*: Axial and Appendicular Skeleton
- (b) Lacertilla: *Varanus* (Indian monitor), *Heloderma* (poisonous lizard), *Hemidactylus* (wall lizard), *Chamaeleon* (garden lizard), *Draco* (flying lizard).
- (c) Ophidia: *Naja* (cobra), *Bungarus* (common krait), *Vipera* (viper), *Typhlops* (burrowing snake) and *Python*.
- (d) Chelonia : Dermal armature
- (e) Crocodilia : *Alligator*, *Crocodylus* and *Gavialis*.
- (f) Extinct reptiles (Models) *Dimetrodon*, *Diplodocus*, *Pteranodon*, *Tyrannosaurus* and *Ichthyosaurus*

Aves

- (a) *Gallus*: Axial and Appendicular skeleton
- (b) Archaeornithes-*Archaeopteryx* (cast)
- (c) Palaeognathae: *Struthio* (ostrich);
- (d) Neognathae: *Gallus* (fowl), *Anser* duck, *Corvus* (crow) , *Psittacula* (parrot) and *Pavo* (peacock).
- (e) Types of feathers, beaks and feet of birds
- (f) Whole mount of 24, 36, 48 and 72 hour's chick embryo

Mammalia

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

Histology

- (a) Tissues: Preparation of
 - i. Epithelial: Squamous (Oral), Ciliated, and Stratified
 - ii. Muscular: Striped and Unstriped muscles.
 - iii. Cartilage
 - iv. Blood
 - v. Neurons
 - vi. Histology of various organs-prepared slides.

Physiology

- (a) 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).
- (b) Detection of amino acids in blood of an animal by paper chromatography.

B.Sc. Zoology Semester Pattern Syllabi

Semester-IV

Paper 1- Animal Physiology and Biochemistry

General physiology (in outline) with special reference to mammals.

Unit-I

Physiology of digestion, respiration, blood and its circulation (blood coagulation, transport of O₂ and CO₂).

Unit-II

Physiology of excretion and osmoregulation, nervous and muscular system and thermoregulation.

Unit-III

Classification of carbohydrates, lipids and proteins.
Classification of Enzymes: Michaelis-Menten kinetics.

Unit-IV

Cellular biochemistry: glycolysis, Krebs cycle, Electron Transport System, gluconeogenesis, glycogenolysis, glycogenesis.

Paper 2- Evolutionary Biology and Developmental Biology

Unit-I

Theories of Evolution

Origin of Life

Historical Review of Evolutionary concept: Lamarckism, Darwinism (Natural, Sexual and Artificial Selection)

Modern Synthetic theory of Evolution

Patterns of Evolution (Divergence, Convergence, Parallel and Coevolution)

Unit-II

Processes of Evolution

Microevolution and Macroevolution, Speciation, Population Genetics (Hardy Weinberg Law)

Genetic Death, Extinction, Bioinvasion

Unit-III

Developmental Biology I

Gametogenesis, Fertilization, Egg: structure and types. Types and patterns of cleavage. Stem Cell and its potency. Fate Map

Unit-IV

Developmental Biology II

Morula, Blastulation and Gastrulation. Development of Chick up to formation of Primitive streak and mammal (*in outline*)

Extra embryonic membranes of chick.

Placentation and types of Placenta.

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Semester V

Paper 1- Animal Behaviour, Chronobiology Endocrinology and Neurobiology

Unit I

Animal Behaviour

Introduction to Ethology

Patterns of Behaviour: Stereotyped Behaviours (Orientation, Reflexes); Individual Behavioural patterns

Instinct vs. Learnt Behaviour

Learning: Imprinting, Habituation and sensitization, Associative learning; Punishment and Reward Learning, trial and Error Learning; Taste Aversion Learning, Cache Retrieval; Social Learning

Gene-Environment Effect on Behaviour

Unit II

Chronobiology

Introduction and History of Chronobiology

Biological Rhythms: definition, types and their characteristics

Free run, Entrainment

Seasonal rhythms, Photoperiodism

Biological clocks and human health

Unit III

Endocrinology

Structure of endocrine glands and their functions (pineal, pituitary, thyroid, adrenal, pancreas, gonads)

Endocrine disorders

Unit IV

Neurobiology

Basic organization of Nervous system

Neurons and Glia, Synapses

Neural transmission

Neurotransmitters: general categories and function

Paper 2- Economic Zoology

Unit-I

Parasitology

Structure, life cycle, Pathogenicity, including diseases, causes, symptoms and control of the following parasites of domestic animals and humans: *Trypanosoma*, *Giardia*, *Diphyllobothrium*, *Hymenolepis*, *Dracunculus*, *Wuchereria*, *Paragonimus*, *Fasciolopsis*.
Plant Nematodes, nature of their damage and control measures including *Meloidogyne*.

Unit-II

Vectors and pests

Vectors: mosquito, house fly, bed bug, louse and their control.

Pests and their types.

Characteristic features, life cycle, nature of damage and control of termite, cockroach, cloth moth, grain moth, wax moth, gundhi bug, sugarcane leaf-hopper and rodents

Unit-III

Animal culture I

Sericulture, Apiculture, Lac-culture.

Unit IV

Animal Culture II

Aquaculture, Pisciculture, Poultry, Vermicomposting

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Practical Syllabus Semester V

Semester V

1. Permanent Preparation of: *Euglena*, *Paramecium* and rectal protozoans from frog.
2. Stool examination for different intestinal parasites.
3. Study of prepared slides/ specimens of *Entamoeba*, *Giardia*, *Leishmania*, *Trypanosoma*, *Plasmodium*, *Fasciola*, *Cotugnia*, *Taenia*, *Rallietina*, *Polystoma*, *Paramphistomum*, *Schistosoma*, *Echinococcus*, *Dipylidium*, *Enterobius*, *Ascaris* and *Ancylostoma*;
4. Permanent Preparation of *Cimex* (bed bug)/ *Pediculus* (Louse), *Haematopinus* (cattle louse), fresh water annelids, arthropods; and soil arthropods.
5. Larval stages of helminths and arthropods.
6. Permanent mount of wings, mouth parts and developmental stages of mosquito and house fly.
7. Permanent preparation of ticks/ mites, abdominal gills of aquatic insects, viz. *Chironomus* larva, dragonfly and mayfly nymphs, preparation of antenna of housefly.
8. Collection and identification of pests.
9. Life history of silkworm, honeybee and lac insect.
10. Different types of important edible fishes of India.
11. Prepared slides of plant nematodes.
12. Demonstration of counting of cells (blood and protozoan) by haemocytometer, haemoglobinometer, pH meter, Colorimeter
13. Microbiological Techniques: Media Preparation and sterilization, inoculation and Examination.
14. Staining of bacteria.
15. Study of an aquatic ecosystem, its biotic components and food chain.
16. Preparation of chromosomes, Test for carbohydrate Photochemical demonstration of proteins and lipids, using hand sections. Endocrine glands (Neurosecretory cells) of cockroach.
17. Demonstration of developmental stages of chick.
18. Project Report/ model chart making.
19. Dissection:
Cockroach: Central nervous system
Wallago: Afferent and efferent branchial vessels, Cranial nerves, Weberian ossicles.
20. Practical exercises based on Biostatistics, Microbiology, Immunology, Biotechnology, Animal Behavior, Pollution & Toxicology.

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Semester VI

Paper 1- Molecular Biology and Immunology

Unit I

Chromatin organization and DNA replication

Genome structure, chromatin, and the nucleosome.

DNA replication: Initiation and proteins in DNA replication.

Structure and versatility of RNA.

Unit II

DNA processing and gene regulation

Fine structure of gene

RNA synthesis and Processing Protein Synthesis and Processing

Regulation of gene expression in prokaryotes (Operon Concept) and eukaryotes

Unit III

Basic Immunology

Concepts of immunity

Types of immunity

Structure and functions of different classes of immunoglobulins

Antigen and Antibodies and their interactions

Unit IV

Immunological Mechanisms and Applications

Major Histocompatibility Complex

Cytokines: Properties and functions

Vaccines of different diseases and immunological reactions

Hybridoma technology, Monoclonal antibodies

PAPER 2- Bioinstrumentation, Biotechnology, Bioinformatics and Biostatistics

Unit I

Bioinstrumentation

Principles and uses of instruments: pH Meter, Colorimeter, Spectrophotometer and Centrifuge.

Microscopy (light, transmission and scanning electron microscopy),

Introduction to Chromatography and Electrophoresis

Unit II

Biotechnology

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

Unit III

Bioinformatics

Concept of homepages and websites, World Wide Web, URLs, Search engines. Databases: Nucleic acids, Protein sequences and structures, Genomes, Literature. Data Retrieval databases: Entrez system, SRS.

Unit IV

Biostatistics

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

Paper 3- Environmental Biology, Wildlife and Toxicology

Unit I

Ecosystem structure and function

Ecosystem: concept, components and fundamental operations (energy flow, energy transformation, nutrient cycling)

Trophic levels, Food chain and food web

Population: Characteristics, dynamics and regulation

r- and k-strategies

Unit II

Ecological Processes and Adaptations

Ecological succession

Ecological niche

Adaptations (aquatic, volant, arboreal, cursorial, fossorial and desert)

Animal Distribution and Zoogeographical Realms

Unit III

Wildlife and Its Conservation

IUCN Categories; Basis of Categorization

Wildlife conservation and Biodiversity acts

In situ conservation: Sacred groves, Reserve Forests, Wildlife Corridors, Heritage sites, National Parks, Sanctuaries, Biodiversity Parks and Biosphere reserves (special emphasis on Dudhwa National Park, Kukrail Gharial Breeding Centre, Katarniaghat Wildlife Sanctuary, Bakhira Bird Sanctuary, Pilibhit Tiger Reserve)

Ex situ conservation

Unit IV

Pollution and Toxicology

Concept, sources, types (air, water, soil, noise & radiation), and control of environmental pollution.

Environmental Problems (Acid rain, ozone depletion, global warming) and Priorities, Environmental Ethics

Exposure of toxicants (routes of exposure, and duration and frequency of exposure); dose-response relationship, toxic effects and antidotal therapy.