

B.Sc. : Two Papers Patterns from Academic Session –2020
Annual Mode(*)

B.Sc. Zoology : Part – I

Paper - I: Animal Diversity – I (Non-Chordata) - Max. Marks - 50

Paper - II: Cytology, Genetics, Taxonomy and Evolution - Max. Marks - 50

Paper - III: Practical's - Max. Marks - 50

B.Sc. Zoology : Part – II

**Paper – I: Animal Diversity – II (Chordata), Developmental Biology and
Palaeontology - Max. Marks - 50**

**Paper – II: Ecology, Animal Behaviour and Applied Zoology- Max. Marks -
50**

Paper – III: Practical's - Max. Marks - 50

B.Sc. Zoology : Part – III

**Paper–I: Microbiology, Biological techniques, Biostatistics and
Bioinformatics - Max. Marks - 50**

**Paper – II: Animal Physiology, Biochemistry, Histology and Toxicology -
Max. Marks - 50**

Paper – III: Practical's - Max. Marks - 50

*** Hindi as Mandatory subject for all schedule in first year this is subject to
the final instruction for the University with Gradation/Marks Detail.**

B.Sc. Zoology : Part – I

Paper - I: Animal Diversity – I (Non-Chordata) Max. Marks - 50 **UNIT - I**

Salient features and outline classification (upto orders) of various Lower Non-chordate Phyla and related type study and topics as covered under respective Phyla.

Protozoa: *Paramecium* with particular reference to locomotion, nutrition, osmoregulation and reproduction.

Life History, pathogenicity and control measures of *Trypanosoma*, *Leishmania* and *Entamoeba histolytica*.

UNIT - II

Porifera: *Sycon* with reference to structure, reproduction and development. Canal system and affinities of Porifera.

Coelenterata: *Aurelia* with reference to structure, reproduction and development. Polymorphism in Coelenterata. A brief account of Corals and Coral reefs.

UNIT - III

Helminthes: Life cycle, pathogenicity and control measures of *Fasciola*, *Taenia solium*, *Ascaris*. Parasitic adaptations in Helminthes.

UNIT - IV

Salient features and outline classification (upto orders) of various Higher Non-chordate Phyla and related type study and topics as covered under respective Phyla.

Annelida: *Nereis*- External features, excretory organs and reproduction. Metamerism in Annelida, its origin and significance. Trochophore larva and its significance. Parasitic adaptations in Hirudinaria.

UNIT - V

Arthropoda: *Palaemon*- External features and reproduction

Peripatus: Its distribution and zoological importance.

Mollusca: *Pila*- External features, Organs of Pallial complex and reproduction. A brief account of torsion in Gastropoda.

Echinodermata: *Asterias*- External features. Water vascular system. Mode of feeding and reproduction.

Paper - II: Cytology, Genetics, Taxonomy and Evolution

Max. Marks - 50

UNIT - I

Prokaryotic and Eukaryotic cells; Ultrastructure of eukaryotic cell; Plasma membrane (Ultrastructure, chemical composition, models of plasma membrane and functions of plasma membrane).

Structure and functions of cell organelles: (a) Mitochondria (b) Ribosomes (c) Lysosomes (d) Centrioles (e) Golgi Complex (f) Endoplasmic reticulum. Structure and functions of Nucleus and nucleolus.

UNIT - II

Cell division – (a) Cell cycle (b) Mitosis (Process of mitosis, mitotic poisons and significance of mitosis), (c) Meiosis (Process of meiosis, structure and functions of synaptonemal complex, significance of meiosis).

Eukaryotic chromosomes- Structure, chemical composition, classification and uninematic and multinematic concept of chromosome structure.

Structure and functions of polytene and lampbrush chromosomes.

UNIT - III

Mendel's life, Pre-Mendelian experiments, symbols and terminologies, Laws of dominance, segregation and independent assortment.

Linkage: Coupling and repulsion hypothesis, Morgan's view of linkage, kinds of linkage, chromosome theory of linkage.

Crossing over: Types of Crossing over, kinds of crossing over, mechanism and its significance.

Determination of sex: chromosome mechanism, genetic balance theory and effects of external environment on sex determination.

Sex linked inheritance: Inheritance of X-linked gene (Colour blindness and haemophilia in man), Sex linkage in *Drosophila*.

Mutation: Historical background, chromosomal aberrations and gene mutations.

UNIT - IV

Introduction to taxonomy and systematics their relationship and significance. Rules of nomenclature- Binomial and Trinomial . Components of classification – Linnean hierarchy. Species concept – species as a category, kinds of species. Taxonomic methodology and tools.

UNIT - V

Brief concept and evidences of evolution. Lamarckism, Darwinism, Synthetic theory of evolution, Evolution at Molecular level (Evolution of proteins and nucleotide sequences). Variations and Speciation. Evolution of man.

B.Sc. Zoology : Part – II

Paper – I: Animal Diversity – II (Chordata), Developmental Biology and Palaeontology **Max. Marks - 50**

UNIT - I

Salient features and outline classification (up to order) of various Lower chordate groups.

Protochordata: Salient features body organisation, systematic position and affinities of *Balanoglossus*, *Hardmania* and *Amphioxus*.

Agnatha: External features of *Petromyzon*.

Pisces: Scales and fins in fishes. Migration in fishes. Parental care in Fishes.

Amphibia: General characters and affinities of Gymnophiona . Parental care in Amphibia.

UNIT - II

Salient features and outline classification (up to order) of various Higher chordate groups.

Reptilia A brief knowledge of extinct reptiles. Poisonous and non- poisonous snakes. Poison apparatus of snake. Snake venom and anti-venom. Adaptive radiation in reptiles.

Aves: Flightless birds and their distribution. Flight adaptations in birds.

Mammalia: General organisation, distribution and affinities of Prototheria, Adaptive radiation in aquatic mammals.

UNIT - III

Gametogenesis: Spermatogenesis and Oogenesis. Types of eggs.

Fertilization: Types of fertilization, approximation of gametes, capacitation, acrosome reaction, formation of fertilization membrane, egg activation and blockage to polyspermy.

Cleavage: Types of cleavage and chemical changes during cleavage, totipotency.

Blastulation and gastrulation in frog and chick.

Fate maps, their formation and significance.

UNIT - IV

Foetal membranes: Their formation and functions in chick.

Retrogressive metamorphosis: As exhibited by an ascidian.

Regeneration: Morphallaxis and Epimorphosis, Blastema and its significance, mechanisms as exhibited by invertebrates (*Hydra* and *Planaria*) and Vertebrates (Limb regeneration in Amphibia).

Placentation in mammals.

UNIT - V

Kinds of fossils and their significance. Formation of fossils. Methods for determining the age of fossils. Geological time scale. Palaeontological history of horse.

Paper – II: Ecology, Animal Behaviour and Applied Zoology

Max. Marks - 50

UNIT - I

Definition and scope of Ecology.

Environmental Factors: Abiotic factors, biotic factors, edaphic factors.

Concept of ecosystem with reference to pond ecosystem. Energy flow in ecosystem. Pyramids of number, biomass and energy. Food chain- grazing and detritus, Food web and trophic levels.

UNIT - II

Biosphere: Hydrosphere, Lithosphere and Atmosphere. Biogeochemical cycles: Carbon and Nitrogen cycles.

Population: Definition and characteristics: density, natality, mortality, migration, emigration and immigration, growth and growth-curves. Dispersion and aggregation. Negative and positive interactions including commensalism, mutualism, predation, competition and parasitism.

UNIT - III

Biodiversity: Conservation and management of biodiversity.

Brief introduction to the concept of protected areas- Sanctuary, National Parks and Biosphere Reserves. IUCN and Red data book.

Pollution and its control: Air, Water, Soil pollution, Green house effect, Global warming, Climate change, Acid rain, Ozone layer depletion.

Bio-accumulation and Biomagnifications.

UNIT - IV

Patterns of behaviour: Stereotype innate behaviour: Kinases, Taxes and Reflexes. Concepts of (i) Fixed action patterns (FAPs) (ii) Sign stimulus or releasers and (iii) Innate releasing

mechanism, Instinctive behaviour. Learned behaviour: Habituation, Conditioned reflexes, Selective learning, Insight learning, Imprinting and Birds songs.

Communication: Chemical, Visual, Auditory, Electric and tactile, Dance language of honey bees, Biological clocks. Bird migration. Introduction to Socio-biology.

UNIT - V

Introduction to:

- (a) Pisciculture: Cultivable fishes.
- (b) Sericulture: *Bombex mori*, types of silk worm and its rearing.
- (c) Apiculture: Types of honey bees, typical honey and culture of *Apis mellifera* and natural enemies.
- (d) Lac culture
- (e) Pearl culture
- (f) Piggery
- (g) Poultry
- (h) Vermiculture

Bionomics and control measures of the common pests of fruits (*Papilio demoleus* and *Quadraspidiotus perniciosus*), Vegetables (*Thrips tabaci* and *Aulacophora foveicollis*) and stored grains (*Callosobruchus chinensis* and *Trogoderma granarium*). Polyphagous pests (Locust and Termites).

Pest management, including insect pest control and integrated pest management.

B.Sc. Zoology : Part – III

Paper–I: Microbiology, Biological Techniques Biostatistics and Bioinformatics

Max. Marks - 50

UNIT - I

Introduction to microbiology: Types of microbes, typical structure of a bacterium, (Gram positive and Gram negative bacteria), phages and viruses.

Pathogenic microbes: Mycobacterium, Rickettsia, Actinomycetes and Mycoplasma.

A brief knowledge of HIV: Modes of transmission and control.

UNIT - II

Microbial bioremediation.

Industrial microbiology: Dairy products, fermented food, alcoholic beverages, microbial spoilage.

Introductory account of prebiotic, probiotic and antibiotics.

UNIT - III

Introductory knowledge of the application of following biological techniques:

- (a) Spectrophotometry
- (b) Chromatography (Paper and thin layer)
- (c) Electrophoresis (Agarose and PAGE)
- (d) Microscopy (Light and compound of microscopy, Phase contrast microscopy)
- (e) A Brief knowledge of PCR machine (Thermal cycler) and its significance.

UNIT - IV

Data collection- Random and non-random sampling, data tabulation and data presentation (Graph, Histogram, Scatter diagram),

Concept of mean, mode, median and of standard deviation and standard error.

UNIT - V

Elementary knowledge of computers: Organisation of computer, input and output devices.

Elementary idea of biological databases: Protein and nucleotide data bases.

Paper – II: Animal Physiology, Biochemistry, Histology and Toxicology
Max. Marks - 50

UNIT - I

Nutrition: Food constituents, intracellular and extracellular digestion, Digestion and absorption of carbohydrate, fat and protein in mammals.

Respiration: Pulmonary ventilation, respiratory pigments, gaseous transport and control of respiration in mammals.

Blood vascular system: Haemopoiesis, composition and functions of blood, blood coagulation. A brief account of immunity. Types of heart, origin and conduction of heart beat.

UNIT - II

Muscular System: Mechanism of muscle contraction. A brief idea of tetanus and fatigue.

Nervous system: Transmission of nerve impulse through axon and synapse.

Excretion: Concept of ammonotelic, ureotelic and guanotelic animals, urine formation in mammal.

UNIT - III

Endocrine system: A brief knowledge of the structure and hormonal functions of the glands- Pituitary, Thyroid, Pancreas, Adrenal, Testis and Ovary.

Elementary knowledge of the Dwarfism, gigantism, acromegaly, diabetes insipidus , Goitre, Cretinism, Myxoedema, Diabetes mellitus and Addison's disease.

Introduction to biological molecules: Carbohydrates, Protein and Lipids (structure, classification and significance).

Enzymes, Vitamins and Minerals.

UNIT - IV

Histology: Structure of epithelium, connective tissue, cartilage, bone, smooth,, striped and cardiac muscles, and nervous tissue.

Histological structure of liver, lung, pancreas, kidney and gonads of rabbit.

UNIT - V

Introduction and brief history of toxicology: General principles of toxicology.

Environmental toxicology (kinds and sources of toxic agents- animal toxins, plant toxins, pesticides, metals and food additives).

Dose response relationship: Frequency and cumulative responses, determination of TL_m values, Ld_{50} , Lc_{50} , margin of safety, threshold limits.

B.Sc. Zoology: Part-I, Practical's

A complete record of laboratory work will be maintained by every student. The practical work will consist of the following:

Study of living animals: *Amoeba*, *paramecium*, *Euglena*, *Hydra*, and rectal ciliates

Study of Nervous-system/General anatomy with the help of charts/models and simulation of *Earthworm*, *Prawn*, *Pila*, *Unio*.

Permanent preparation of Obelia colony: Ovary, setae in situ, pharyngeal and septal nephridium of earthworm, parapodia of Nereis and Heteronereis, gill radula and osphradium of Pila, salivary glands, mouth parts and trachea of cockroach; gill lamina of Unio, statocyst and hastate plate of prawn.

Study of permanent slides/museum specimens/models belonging to following phyla

Protozoa: Amoeba, Paramecium, Euglena, Ceratium and Noctiluca.

Porifera: T.S. and L.S. of Sycon, Euplectella, Hyalonema and Spongilla.

Coelenterata: Medusa of Obelia, larval stages of Aurelia, Physalia, Porpita, Vellela, Tubipora, Millepora, Aurelia, Gorgonium, Pennatula, Alcyonium, Adamsia.

Annelida: T.S. of earthworm and Nereis through different body regions. Nereis Heteronereis, Arenicola, Chaetopterus,

Arthropoda: Mouth parts of insects, Pupa and larva of mosquito Daphnia Cyclops and larval stages of Crustaceans. Crab, hermit crab, Lepas, Balanus, Astaxus, Squilla, millipede, mantis, cricket, stic insect, waterbug, beetle, locust, moth and butterfly, scorpion, spider, kingcrab and peripatus.

Mollusca: Various larval stages, T.S. of Unio through gills; Chiton, Doris, Aplysia, Aeolis, Dentalium, Octopus, Loligo, Sepia, Nautilus, Terebratulina, Ostrea, Pecten.

Echinodermata: Various larval stages, T.S. of arm of starfish; Echinus, Ophiothrix, Holothuria, Asteria, Antedon.

Study of following with the help of permanent slides/ museum specimens/ models/ Pictures for spotting

Study of Parasites:

(a) **Protozoa:** Plasmodium, Monocystis, Trypanosoma, Leishmania, Entamoeba, Giardia.

(b) **Helminthes:** Fasciola, Taenia, Ascaris, Schistosoma and filarial including larval stages.

- (c) **Annelida:** Leeches
- (d) **Arthropod:** Sacculina, lice, flea, bedbug, tick and mites.
- (e) Life Cycle of the following:-

Entamoeba

T. Solium

A. Lumbricoides

F. hepatica

Schistosoma

Taxonomy and Evolution

- (a) Animal collection techniques:
- (b) Appliances such as cyanide bottle, aspirator, insect nets, fishing nets, Berlese funnel, Spreading board.
- (c) Kinds and use of keys.
- (d) Study of evolution of man with the help of Model/chart.

Cytology experiments:

- (b) Study of mitosis and meiosis using available material
- (c) Study of permanent slides showing stages of cell division, giant chromosome, mitochondria, Golgi body etc.

(d) Genetics

- (e) (i) Experiments on Mendelian and non- Mendelian inheritance.
- (f) (ii) Study of mutants of *Drosophila*.

B.Sc. Zoology: Part-II, Practical's

A complete record of laboratory work will be maintained by every student. The practical work will consist of the following:

Ecology:

Estimation of the pH of water/ soil sample.

Determination of dissolved oxygen and carbon dioxide in water sample.

Study of adaptations in animals inhabiting different ecological environments.

Animal behaviour: Study of different kinds of behaviour with the help of photographs.

Palaeontology: Study of different Era/Periods of Geological Time scale based on charts & models.

Applied Zoology:

Specimens / slides of Apis, silk moth, Lac insect, phytoparasitic nematodes, major carps. Study of life cycles and control measures of insects of economic importance (Stored grains pests, pest of fruits and vegetables); and study of structural organization of Bee hive. Picture of commercially important varieties of poultry and cattle.

Developmental biology:

Study of the permanent slides of the chick embryos (whole mounts) and those showing the embryology of frog.

Lower and Higher Chordate diversity:

Protochordata: Study of permanent slides of *Amphioxus* and *Balanoglossus* passing through different body regions, *Doliolum*, *Salpa*, *Oikopleura*. Museum specimens of *Herdmania*, *Ciona* and *Balanoglossus*.

Cyclostomata: Museum specimens of *Petromyzon* and *Myxine*.

Fishes: Dissections only with the help of Simulations, charts/models of general anatomy, afferent and efferent branchial arteries, cranial nerves and internal ear of *Scoliodon*. Preparation of permanent slides of ampulla of Lorenzini, placoid, Cycloid and ctenoid scales. Study of permanent slides of shark T.S. passing through different body regions and different kinds of scales of fish. Museum specimens of *Sphyrna*, *Pristis*, *Torpedo*, *Trygon*, *Acipenser*, *Polypterus*, *Hippocampus*, *Exocoetus*, *Anguilla*, *Echeneis*, *Diodon*, *Protopterus*, *Synaptura* and *Chimaera*.

Amphibia: Dissections only with the help of Simulations, charts/models of cranial nerves , hyoid apparatus , brain and columella of frog. Study of museum specimen of *Salamandra*, *Proteus*, *Amphiuma*, *Nectures*, *Siren*, *Ambyostoma*, Axolotl larva. *Rhacophorus*, *Alytes*, *Hyla*, *Pipa* and *Bufo*. Study of skeleton of frog and permanent histological slides of Amphibia .**Reptilia:** Study of the skeleton of *Varanus*. Study of museum specimen of following:

Varanus, *Heloderma*, *Hemidactylus*, *Phrynosoma*, *Chameleon*, *Draco*, *Calotes*, Cobra, Pit-viper, Pitless –viper, Rattle snake, Krait, Dhaman, Typhlops and marine snake; Alligator, Crocodile, Gavialis, Turtle and tortoise.

Aves: Permanent preparation of filoplume and down feather. Study of the skeleton of fowl. Study of museum specimens of *Psittacula*, *Corvus*, *Pavo*, *Bubo*, and model of Archaeopteryx.

Mammalia: Dissection only with the help of Simulations, charts/models of the general anatomy and blood vascular system of a mammal. Study of permanent slides of mammals . Study of the skeleton of rabbit . Study of the museum specimens of *Tachyglossus* and *Ornithorynchus* (models) *Pangolin* , *Funambulus*, *Pteropus*, Hedgehog and Loris.

B.Sc. Zoology: Part-III, Practical's

Environment Biology:

- I. Study of wild animals with the help of stuffed preparations/ models/ charts/ photographs.
- II. Study of indicator organisms of different kinds of water pollution
- III. Simple experiments on the effect of environmental pollution on animals.

Microbiology:

- (i) Cleaning of glassware and sterilization
- (ii) Preparation of liquid and solid media for cultivation of bacteria
- (iii) Preparation of media for the culture of fungi.
- (iv) Isolation of microorganisms from soil.
- (v) Gram staining of bacteria
- (vi) Micrometry of microorganisms

Toxicology:

Calculation of LC_{50} with the help of data provided. Study of behavioural responses (in fish, insects or any other locally available animal) to some important toxicants.

Histology:

Study of the permanent slides of cartilage, bone, epithelium, connective tissue, nervous tissue, blood, striped and unstriped muscles, liver, kidney, lungs, pancreas, pituitary, thyroid, and adrenal of mammals. Preparation of smooth and striped muscles.

Biostatistics:

- (i) Calculation regarding mean, median, SD and SE from given data.
- (ii) Preparation of histogram and pie diagram with the help of data provided.

Bioinformatics: Brief knowledge of computer and its application.

- a. Laminar flow
- b. Autoclave
- c. Elisa reader

- d. PCR machine
- e. Refrigerated centrifuge
- f. Transilluminator

Biological Techniques

Instruments and techniques regarding:

- (i) Photometry
- (ii) Chromatography
- (iii) Electrophoresis
- (iv) Radioimmunoassay

Animal Physiology / Biochemistry:

- (i) Preparation of haemin crystals from human blood
- (ii) Determination of clotting and bleeding time
- (iii) Counting of RBCs in human blood
- (iv) Counting of WBCs in human blood
- (v) Determination of haemoglobin percentage in human blood
- (vi) Qualitative identification of carbohydrate, protein and lipoid.
- (vii) Analysis of urine for identification of sugar, albumin, ketone bodies , etc.
- (viii) Study of the action of salivary amylase on starch.
- (ix) Study of endocrine glands and related disorders with the help of slides/photographs/
charts/ models.

B.Sc. Part – I: ZOOLOGY PRACTICAL

EXERCISES AND DISTRIBUTION OF MARKS IN PRACTICAL EXAMINATION

The duration of practical will be 3¹/₂ hours and distribution of marks will be as following:-

Time: 3½

Max. Marks: 50

1. Study of Nervous-system/General anatomy with the help of Chart/models of <i>Prawn</i> , <i>Pila Unio</i> , <i>Earthworm</i>	-	10
2. Identification of spots: (Specimens: 10 and slides: 05)	-	15
3. Permanent preparation of <i>Neries</i> parapodia and <i>Obelia</i>	-	05
4. Exercise on life-cycle of parasites	-	05
5. Cytology Experiments	-	05
6. Sessional record	-	05
7. Record and Minor project: 3+2	-	05
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	Total marks	50
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B.Sc. Part – II: ZOOLOGY PRACTICAL

EXERCISES AND DISTRIBUTION OF MARKS IN PRACTICAL EXAMINATION

The duration of practical will be 3¹/₂ hours and distribution of marks will be as following:-

Time: 3½

Max. Marks: 50

1. Spots (Specimens-2, slides-2, Bone-2, Developmental biology-2, Applied Zoology-2)		20
2. Exercise on internal anatomy (simulations): (Cranial nerves of a fish, frog, internal ear of a fish)		05
3. Exercise on the life – cycle and control measure of insects of economic importance (stored grain pests, pests of fruits and vegetables); study of cultivable fishes.		05
4. Ecology experiment:		05
5. Exercise on Animal Behaviour		05
6. Viva voce:		05
7. Record and Minor project:	3+2	05
	Total	<hr/> 50 <hr/>

B.Sc. Part – III: ZOOLOGY PRACTICAL

EXERCISES AND DISTRIBUTION OF MARKS IN PRACTICAL EXAMINATION

The duration of practical will be 3¹/₂ hours and distribution of marks will be as following:-

Time: 3½

Max. Marks: 50

1. Physiology and biochemistry experiments (Two):		15
2. Spots on Biological techniques :02 and Histology:03		10
3. Microbiology experiment:		05
4. Exercise on Toxicology:		05
5. Exercise on Biostatistics		05
6. Viva voce:		05
7. Record and Minor project:	3+2	05
	Total	<hr/> 50 <hr/>