B.Sc. Part I Examination, 2023

ZOOLOGY

THEORY

Max. Marks: 150 (Min. Pass Marks: 54)

Paper I: Animal Diversity and Evolution – 50

Paper II: Biology of Non chordates – 50

Paper III: Cell Biology and Genetics - 50

PRACTICALS :

Max. Marks: 75 (Min Pass Marks: 27)

Duration of each theory paper - 3 hours

Duration of practical examination - 5 hours

Note: Each theory paper is divided in three parts i.e. Section-A, Section–B and Section–C.

Section-A: Will consist of 10 compulsory questions. There will be two questions from each unit and answer of each question shall be limited up to 30 words. Each question will carry of 1 mark.

Section –B: Will consist of 10 questions. Each unit will be having two questions; students will answer one question from each Unit. Answer of each question shall be limited up to 250 words. Each question carries 3.5 Marks.

Section-C: will consist of total 05 questions. Students will answer any 03 questions and answer of each question shall be limited up to 500 words. Each question carries 7.5 Marks.

PAPER I

Animal Diversity and Evolution

Functional morphology of the types included with special emphasis on the adaptations to their modes of life and environment. General characters and classifications of all invertebrate phyla up to class with examples emphasizing their biodiversity, economic importance and conservation measures where required.

Unit 1: General principles of taxonomy, concept of the five-kingdom, Concept of Protozoa, Metazoa and Levels of organization. Basis of classification of non-chordata: Symmetry, coelom, segmentation and embryogeny, Characters and Classification of Protozoa and Porifera upto classes with examples.

Unit 2: Salient features and classification of Coelenterata, Ctenophora, Platyhelminthes, Aschelminthes, Annelida, Arthropoda, Mollusca and Echinodermata with their suitable examples.

Unit 3: Origin of Life, Miller's experiment, Lamarckism and Darwinism, Natural Selection, genetic basis of evolution, speciation, Evidences of organic evolution.

Unit 4: Variations, Isolation and Adaptations, Geological time scale and animal distribution in different era.

Unit 5: Principal zoogeographical regions of the world with special reference to their mammalian fauna, Factors affecting the large scale animal distribution, Origin and evolution of man.

PAPER II

Biology of Nonchordates

Unit 1: *Euglena:* Ultrastructure of flagellum and flagellar movement, osmoregulation and behaviour, reproduction.

Paramecium: Locomotion, nutrition, osmoregulation and reproduction. *Sycon*: Cellular organization, canal system, reproduction and development.

Unit 2: *Obelia:* Structure of polyp and medusa, sense organs and reproductive systems, life cycle.

Fasciola: Digestive, excretory and reproductive systems, developmental stages and life cycle.

Taenia: Structure of body wall, excretory and nervous systems, reproduction and developmental stages in life cycle.

Unit 3: *Nereis:* Parapodial locomotion, digestive, blood vascular, excretory, nervous and reproductive systems, development and metamorphosis.

Hirudinaria: Digestive, haemocoelomic, excretory, nervous and reproductive systems, sense organs.

Unit 4: *Palaemon:* Appendages, Digestive, respiratory, blood – vascular, excretory, nervous, sense organs and reproductive systems.

Pila: Digestive, respiratory, blood vascular, nervous and reproductive systems, sense organs

Unit 5: *Lamellidens*: Digestive, respiratory, blood–vascular, excretory and nervous systems, sense organs, reproduction and development.

Asterias: Water – vascular system, digestive, circulating and nervous systems, sense organs, reproduction, life history and regeneration.

PAPER III

Cell Biology and Genetics

Unit 1: Characteristics of prokaryotic and eukaryotic cells, Characteristics of cell membrane molecules, fluid-mosaic models of Singer and Nicolson, passive and active transport, Structures and functions of endoplasmic reticulum, ribosome, Golgi complex, lysosome, mitochondria, centriole, microtubules and nucleus.

Unit 2: Structure of Chromatin and Chromosomes, semiconservative mechanism of replication, elementary idea about topoisomerases, replication forks, leading and lagging strands, RNA primers and Okazaki fragments, RNA structure and types, mechanism of transcription, Genetic Code and protein synthesis.

Unit 3: Interphase nucleus and cell-cycle including regulation.

Mitosis: Phases and process of mitosis, structure and function of spindle apparatus, Theories of cytokinese.

Meiosis: Phases and process of meiosis, synaptonemal complex, formation and fate of chiasmata recombination and significance of crossing over.

Unit 4: Mendelism: Brief history of genetics and Mendel's work: Mendelian laws, their significance and current status, linked gene inheritance.

Chromosomal aberration: Structural - translocation, inversion, deletion and duplication; Numerical - haploidy, diploidy, polyploidy, aneuploidy, euploidy, polysomy and genetic implications.

Unit 5: Genetic interaction: supplementary genes, complementary genes, duplicate genes, multiple gene interaction, ABO blood groups and their genotypes, Multiple alleles.

PRACTICALS

1. Demonstration of dissection:

   Palaemon: Study of appendages, general anatomy, digestive and nervous systems

   Pila: General anatomy and nervous system

   Lamellidens / *Unio*: General anatomy and nervous system

2. Permanent preparations of the following: Protozoa: *Paramecium*

   Porifera: Sponge spicules, fibres and gemmules Coelenterata: *Obelia* colony, *Obelia* medusa Annelida: *Nereis* parapodia

   Arthropoda: *Palaemon*: Statocyst and hastate plate along with comb plates, *Cyclops* and *Daphnia*

   Mollusca: *Pila*: Gill lamella, radula and L. S. Osphradium, *Lamellidens*: Gill-lamella

3. Identification, systematic position up to order and general study of the following animal forms, microscopic slides / museum specimens:

   Protozoa: *Amoeba, Entamoeba, Euglena, Noctiluca, Trypanosoma, Trichomonas, Foraminifera* (Oozes)*, Opalina, Balantidium, Nyctotherus, Paramecium, Paramecium* binary fission and conjugation and, *Vorticella* [Whole mounts].

   Porifera: *Leucosolenia, Grantia, Scypha, Hyalonema, Euplectella, Spongilla* and *Euspongia*

   Coelenterata: *Obelia* (colony and medusa), *Physalia, Porpita, Aurelia, Rhizostoma, Alcyonium, Corallium, Gorgonia, Tubipora, Pennatulla* and *Madrepora*

   Ctenophora: *Beroe*

   Platyhelminthes: *Dugesia, Fasciola* and *Taenia*

   Nematoda: *Ascaris, Ancylostoma, Dracunculus, Wuchereria, Trichinella, Schistosoma* and *Enterobius*

   Annelida: *Nereis*, Phase Heteronereis, *Aphrodite, Arenicola, Pheretima, Pontobdella, Branchellion* and *Hirudinaria*

   Onychophora: *Peripatus*

   Arthropoda : *Limulus, Araneus, Palamnaeus, Apus, Lepas, Balanus, Sacculina, Palaemon, Lobster, Eupagurus, Carcinus, Lepisma, Odontotermes, Pediculus, Schistocerca, Papilio, Bombyx, Xenopsylla, Apis, Julus* and *Scolopendra*

   Mollusca: *Chiton, Dentalium, Patella, Pila, Turbinella, Aplysia,* Slug*,* Snail*, Mytilus, Ostrea* (pearl oyster)*, Lamellidens, Teredo, Nautilus, Sepia, Octopus*

   Enchinodermata: *Pentaceros, Asterias, Ophiothrix, Echinus, Holothuria* and *Antedon*

4. Study of sections, developmental stages and isolated structures from microscopic slides

   Porifera: L. S. and T. S. of *Scypha* / *Grantia*

   Coelenterata: *Hydra,* Sections of *Hydra,* Developmental stages of *Aurelia*

   Platyhelminthes: Transverse sections of *Dugesia, Fasciola* and *Taenia*, mature and gravid proglottids of *Taenia*, developmental stages of *Fasciola* and *Taenia* Annelida: Transverse sections of *Nereis* and *Hirudinaria*, Trochophore larva of Nereis, Parapodium of *Nereis* and *Heteronereis*

   Arthropoda: Crustacean larvae (*Nauplius, Zoea, Megalopa* and *Mysis*), mosquito larva & pupa

   Mollusca: Transverse sections of *Lamellidens* and Glochidium larva Echinodermata: Pedicellariae of Star fish

5. Experimental Zoology:
   (i) Test for Protein : Biuret
   (ii) Test for Lipids : Sudan IV
   (iii) Test for Carbohydrates : Benedict's
   (iv) Demonstration of catalase enzyme activity in animal tissue
   (v) Living study of *Paramecium*
   (vi) Temporary acetocarmine squash preparations and study of chromosomes

Each regular student is required to keep a record of practical work done by him/her duly checked by the teachers which will be submitted at the time of practical examinations.

Distribution of Marks:

Maximum Marks: 75 Minimum Pass Marks: 27

	Regular	Ex.
Diagrammatic presentation of dissection	05	06
Permanent preparation	10	12
Spots (Ten)	30	30
Experimental Zoology	10	12
Viva-voce	10	15
Practical Record	10	---
Total	75	75

B.Sc. Part II Examination, 2024

ZOOLOGY

There shall be three written papers of three hours duration each.

Theory

Max. Marks: 150 (Min. Pass Marks; 54)

Paper I: Chordate Structure and function - 50

Paper II: Developmental Biology - 50

Paper III: Immunology, Microbiology and Biotechnology 50

Practical:

Max. Marks - 75 (Min. Pass Marks; 27)

Duration of Theory examination - 3 hours

Duration of practical examination - 5 hours

Note: Each theory paper is divided in three parts i.e. Section-A, Section –B and Section – C.

Section-A: Will consist of 10 compulsory questions. There will be two questions from each unit and answer of each question shall be limited up to 30 words. Each question will carry of 1 mark.

Section –B: Will consist of 10 questions. Each unit will be having two questions; students will answer one question from each Unit. Answer of each question shall be limited up to 250 words. Each question carries 3.5 Marks.

Section-C: will consist of total 05 questions. Students will answer any 03 questions and answer of each question shall be limited up to 500 words. Each question carries 7.5 Marks

PAPER I

Chordate Structure and Function

Unit 1: Classification and characters of phylum Chordata (excluding extinct forms) up to orders, Comparisons of habit, habitat, external features and anatomy of *Balanoglossus*, *Herdmania* and *Branchiostoma* (excluding development).

Unit 2: Ascidian tadpole larva and its Metamorphosis, Affinities of Hemichordate, Urochordate and Cephalochordates, Habit, Habitat and salient features of Petromyzon, Ammocoete larva.

Unit 3: Integument including structure and development of placoid scales, feathers and hairs, Jaw suspensorium, limbs and girdles of *Rana, Uromastix, Columba* and *Oryctolagus*.

Unit 4: Heart and aortic arches, respiratory system and alimentary canal of *Scoliodon, Rana, Uromastix, Columba* and *Oryctolagus*.

Unit 5: Brain, urinogenital system (*Scoliodon, Rana, Uromastix, Columba* and *Oryctolagus*), Identification of poisonous and non poisonous snakes. Biting mechanism in snakes, flight adaptations in birds. Adaptations in aquatic mammals.

PAPER II

Developmental Biology

Unit 1: Formation of egg and sperm, vitellogenesis and fertilization. Types of eggs and sperms, parthenogenesis, regeneration.

Unit 2: Planes and patterns of cleavage in chordates, significance of cleavage and blastulation, Morphogenetic cell movement, Fate maps and significance of gastrulation.

Unit 3: Development of *Branchiostoma* (*Amphioxus*) up to gastrulation; chick egg and its development up to the formation of primitive streak, Extra embryonic membranes of chick, development of placenta in rabbit, types and functions of placenta in mammals.

Unit 4: Various types of stem cells and their applications (with special reference to embryonic stem cells),Cloning of animals: nuclear embryonic transfer technique, nuclear transfer technique; Identical, Siemese and fraternal twins and Artificial insemination.

Unit 5: Organogenesis of alimentary canal, eye, kidney, gonads and brain in mammal.

PAPER III

Immunology, Microbiology and Biotechnology

Unit 1: Types of immunity (innate and acquired, humoral and cell mediated), Antigen: Antigenicity of molecules, haptens, Antibody: Structure and functions of each class of immunoglobulins (IgG, IgM, IgD, IgA and IgE), antigen – antibody reactions.

Unit 2: Theory of spontaneous generation; Germ theory of fermentation and diseases: Works of Louis Pasteur, John Tyndal, Rober-Koch and Jenner, Bacteria: Cell membrane, patterns of arrangement; structure of capsule and cell envelops; organization of cytoplasmic membrane of Gram - negative and Gram - positive strains, Genetic material of bacteria: (i) Chromosome (ii) Plasmids.

Unit 3: Asexual and sexual reproduction in Bacteria, Culture of Bacteria: Carbon and energy source, Nitrogen and minerals and Organic growth factors, Effect of environmental factors on bacterial culture: Temperature, hydrogen ion concentration; Medical importance of Gram-negative and Gram-positive bacteria.

Unit 4: Recombinant DNA technology: Introduction and principles, restriction endonucleases, cloning vehicles (plasmids, bacteriophages); methods of gene transfer and applications.

Unit 5: Environmental Biotechnology (outline idea only): Metal and petroleum recovery, pest control, waste-water treatment, Food, Drink and Dairy Biotechnology (outline idea only): Fermented food production: dairy products, alcoholic beverages and vinegar: microbial spoilage and food preservation.

Practical

1. Study of microbes in food material (like curd, etc.)
2. Bacteria culture
3. Demonstraton of dissection:

Scoliodon : General anatomy, alimentary canal, afferent and efferent blood vessels, urinogenital system, brain and cranial nerves – V, VII, IX and X only and internal ear *Labeo / Wallago,* Brain V, VII, IX and X Cranial nerves, afferent and efferent blood vessels, air sacs, and internal ear.

Rattus: General anatomy, digestive, blood vascular and urinogenital systems

4. OSTEOLOGY

Articulated and disarticulated skeleton of *Rana, Varanus, Gallus* and *Oryctolagus*

5. PERMANENT PREPARATIONS

Scoliodon: Placoid scales, Ampulla of Lorenzini.

6. Identification, systematic position and comments of the following animals: Cephalochordata: *Amphioxus,* Hemichordata: *Balanoglossus*

Urochordata: *Salpa, Doliolum* and *Herdmania*

Cyclostomata: Petromyzon and Myxine

Pisces: *Zygaena, Scoliodon, Pristis, Torpedo, Trygon, Protopterus, Labeo, Heteropneustis* (*Saccobranchus*), *Belone, Exocoetus, Anabas* and *Echeneis* Amphibia: *Necturus, Amphiuma, Amblystoma, Axolotal larva, Hyla, Uraeotyphlus* Reptilia: *Trionyx, Chelone, Varanus, Uromastix, Ophiosaurus, Naja, Bungarus, Echis, Hydrophis, Eryx, Ptyas, Crocodilus* and *Gavialis*

Aves: *Columba, Pavo, Choriotis, Francolinus, Streptopelia*

Mammalia: *Meriones, Funambulus, Rattus, Hemiechinus, Suncus, Ptecopus, Presbytis* and *Macaca*

7. Microscopic Study

Hemichordata: Section through proboscis and branchiogenital region *Branch stoma:* T.S. oral hood, pharynx, gonads, intestine and caudal region *Scoliodon*: T.S. gill and scroll valve

Rana: T.S. through various organs, T.S. and L.S. of developmental stages Reptilia: V.S. skin of lizard

Aves: V.S. skin, different types of feathers

Chick embryology: Whole mounts of embryos of 18, 24, 33, 48 and 72 hours Mammalia: T.S. through various organs

Note: Each regular student is required to keep a record of practical work done by him/her duly checked by the teacher which will be submitted at the time of practical examination.

Distribution of Marks

Maximum Marks: 75	Minimum Pass Marks: 27	
	Regular	Ex.
Diagrammatic presentation of dissection	05	06
Permanent preparation	10	12
Spots (Ten)	30	30
Experimental Zoology	10	12
Viva-voce	10	15
Practical Record	10	---
Total	75	75

B.Sc. Part III Examination, 2025

ZOOLOGY

Theory

Max Marks. 150 (Min.Pass Marks;54)

Paper I	:	Animal Physiology and Biochemistry	50
Paper II	:	Ecology and Behaviour	50
Paper III	:	Applied Zoology	50
Practicals	:		75
			(Min.Pass Marks;27)

Duration of each theory paper	3 hours
Duration of practical examination	5 hours

Note: Each theory paper is divided in three parts i.e. Section-A, Section –B and Section –C.

Section-A: Will consist of 10 compulsory questions. There will be two questions from each unit and answer of each question shall be limited up to 30 words. Each question will carry of 1 mark.

Section –B: Will consist of 10 questions. Each unit will be having two questions; students will answer one question from each Unit. Answer of each question shall be limited up to 250 words. Each question carries 3.5 Marks.

Section-C: will consist of total 05 questions. Students will answer any 03 questions and answer of each question shall be limited up to 500 words. Each question carries 7.5 Marks.

PAPER I

Animal Physiology and Biochemistry

Unit 1 : Digestion; digestive enzymes, process of digestion, digestion of protein, carbohydrate and lipid

Blood : Composition and functions, Blood groups, Rh factor and their significance, blood clotting mechanism, blood pressure and cardiac cycle, respiratory pigments, cardiac muscle activity.

Unit 2 : Muscle : Structure of various types of muscles and mechanism of muscle contraction

Excretion : Structure of kidney, types of nephron, mechanism of urine formation and its eliminationand arginine, ornithin cycle.

Unit 3 : Respiration : Structure of lung, mechanism of respiration, respiratory pigment, exchange and transport of oxygen and carbon dioxide.

Nervous System : Structure of neuron and its classification, Nerve impulse, impulse conduction and reflex action.

Unit 4 : Endocrine glands : Structure and functions of various endocrine glands, diseases caused by hormonal deficiency ; Mechanism of hormone action.

Unit 5 : Structure of Protein and Carbohydrates; oxidation of glucose through glycolysis, Krebs cycle and oxidative phosphorylation, deamination, transamination and decarboxylation.

PAPER II

Ecology and Behaviour

Unit 1: Introduction of ecology, definition, history, sub division and scope of ecology. Envirnmental factors; physical factors- soil, water, air and temperature. Biotic factors- interspecific and intraspecific relations, neutralism, mutualism, commensalism, antibiosis, parasitism, predation, competition. Concept of limiting factors, Liebig's law of minimum, Shelfords law of tolerance, combined concept of limiting factors.

Unit 2: Population and community ecology, measurement of population density. Factors affecting population growth, growth factors, dispersal, characteristic of community, concept of ecosystem and niches.
Food chain, food web, Ecological pyramid. Energy flow in an ecosystem, biogeochemical cycles of CO_2, N_2, O_2, S and P. Prospects and stratigies of sustainable development.

Unit 3: Brief introduction to the major ecosystem of the world and ecological succession, conservation of natural resources; Ecology in relation to Thar desert.
Brief account of environmental pollution, global warming and its impact upon Human race.

Unit 4: General survey of various types of animal behaviour; Methods of studying animal behaviour, Role of hormones and pheromones in behaviour, Biological rhythms.

Unit 5: Learning and Memory – Conditioning, Habituation, Insight learning, Association learning, Reasoning and Communication; Wildlife of Rajasthan and its conservation.

PAPER III

Applied Zoology

Unit 1 : Poultry keeping – Types of poultry breeds, poultry housing, farm and farm management, system of poultry farming; Grading, handling and marketing of eggs. Poultry diseases and Vermiculture; Methodology and products.

Unit 2 : Sericulture : Different kinds of silk producing insects in India and its potentialities. Host plants of silk insects. Grainage, rearing and life cycle. Breeding and various diseases of silkworm. Reeling and fibre technology. Economics of sericulture.

Unit 3 : Apiculture : Different kinds of honey bees found in India and, their identification. Identification of Queen, worker and drone. Importance of keeping bees in artificial hives and different kinds of hives. Care and management of bee colonies. Bee enemies and their control. Extraction and processing of honey from the comb. Utility and economics of production of honey. Honey bees and pollination strategy in agricultural crops.

Unit 4 : Pest Management : Insect pests of important crops (cotton, Rice, sugar cane & pulses), insect pest of veterinary and medical importance, pest outbreaks and assessment of losses caused by the insect pests on crops; population dynamics of insect pests; Principles of Biological, mechanical and cultural methods of pest control. Integrated Pest Management (IPM). Principles of pest control by pesticides.
Important vertebrate pests; birds and mammals with special reference to rodents and their management.

Unit 5 : General principles of aquaculture; transportation of fish seed and brooders. Induced Breeding, Composite fish culture, Lay out of fish farm and its management, By-products of fishing industry; Prawn culture; Management of water bodies for aquaculture.

Practicals

1. Haemoglobin estimation of mammalian blood
2. Preparation of heamin crystals
3. Osmotic effect of R.B.C.
4. Preparation of mammalian blood film and identification of different types of blood cells
5. Determination of blood groups and Rh-factor
6. To determine the rate of oxygen consumption of rat
7. Analysis of urine for sugar, protein and pH
8. Estimation of E.S.R.
9. Demonstration of amylase activity
10. Estimation of packed cell volume [PCV]
11. Demonstration of working of pH meter
12. Demonstration of working of colorimeter
13. Measurement of blood pressure
14. Study of different spraying and dusting equipment
15. Use of pesticides and precautionary measures
16. Measurement of temperature and relative humidity
17. Estimation of soil moisture
18. Estimation of water holding capacity of different soils
19. Ecosystem study : Aquarium
20. Pond water study to identify zoo-planktons and their permanent preparations
21. Permanent preparation of any two stored grain pests. Two parasitic insects and termites
22. Honey bee : Permanent preparation of pollen basket and mouth parts
23. Permanent preparation of mouth parts of butterfly, moth, mosquito and cockroach
24. Project report based upon study of local fauna
25. Demonstration of dissection of nervous system of cockroach

Distribution of Marks

Maximum Marks : 75 Minimum Pass Marks : 27

		Regular	Ex.
Physiology Experiment		12	15
Ecology Experiment		12	15
Spots (Seven)		14	20
Diagrammatic presentation of dissection		05	08
Project report on local fauna		07	--
Permanent preparation		05	07
Viva-voce		10	10
Record		10	--
	Total	75	75