Department of Zoology
DDU Gorakhpur University, Gorakhpur
Syllabus for Three Year Degree Course

B.Sc. Part –I (Theory)

The examination shall comprise three theory papers and a practical test:

Theory

Paper – I: Lower Non-Chordata ……	45 Marks
Paper – II: Higher Non-Chordata……..	45 Marks
Paper – III: Elements of cell biology, evolution and ecology…	45 Marks
Practical	65 Marks
Total:	200 Marks

Candidate must obtain minimum pass marks in theory and practical examination separately.

Paper –I: LOWER NON-CHORDATA (PROTOZOA-HELMINTHES)

General survey and outline classification (up to orders only) of Protozoa, Porifera Coelenterata, Platyhelminthes and Nemathelminthes and the classification, habits, structure and life-history of the representatives mentioned below.

PORTOZOA: *Entamoeba; Euglena; Paramecium; Monocystis*.
Protozoa and diseases.
PORIFORA: *Sycon.*
COELENTERATA: *Obelia and Aurelia.*
PLATYHELMINTHES: *Planaria, Fasciola and Taenia*.
NEMATHELMINTHES: *Wuchereria bancrofti.*
Helminthes and diseases.

PAPER – II : HIGHER NON-CHORDATA (ANNELIDA-ECHINODERMATA)

General survey and outline classification (upto orders only) of Annelida, Arthropoda, Mollusca and Echinodermata and the classification, habits and life-history of the representatives mentioned below.

ANNELIDA: *Neries,* and *Hirudinaria*
ARTHROPODA: *Palaemon,* Scorpion and Grasshopper
Useful and harmful insects
MOLLUSCA: *Lamellidens* and *Pila*
ECHINODERMATA: Sea Star

PAPER – III: ELEMENTS OF CELL BIOLOGY, EVOLUTION AND ECOLOGY,

SECTION-A

CELL BIOLOGY

Ultrastructure and molecular organization of cell-components in relation to basic functions; Structure and types of chromosomes; Mitosis and meiosis; Mendel's Laws of inheritance; Linkage and crossing over; Principles of chromosomal mapping.

SECTION-B

EVOLUTION

Theories and evidences of evolution; Lamarckism, Neolamarckism, Darwinism, Neo-Darwinism, Mutation theory, Modern Synthetic theory and evidences of evolution.

SECTION-C

ECOLOGY

Concept of ecosystem; Energy flow, abiotic ecofactor (temperature, light and moisture) and biotic (food-web as in fresh water lakes and ponds) primary ecological divisions and their fauna.

Zoogeographicals realms and their characteristics vertebrate fauna.

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B.Sc. Part –I (Practical)

Candidates shall be required to show knowledge of classification, dissections and micro preparations of the types mentioned above, in addition to those prescribed for intermediate examination of U. P. Board. Note books containing a complete record of the laboratory work done during the session must be produced at the practical examination. **The duration of the practical examination shall be 3½ hours.**

The distribution of marks shall be as follows:

Exercise

Major dissection		15 Marks
Minor dissection		05 Marks
Preparation		08 Marks
Spots (10)		25 Marks
Viva-voce		05 Marks
Class records		07 Marks
	Total	65 Marks

The scope of practical work is indicated from the exercises given below:

Protozoa:
Feeding experiment with congo-red; Prepared slides of structure, binary fission and conjunction.
Gregarine and Verticella:
Examination of ciliates (*Opalina, Balantidium* and *Nyctotherus*) from the rectum of frog.
Porifera:
Permanent preparation of spicules and gemmules.
Study of prepared slides of transverse and longitudinal sections of *Sycon*, Spongin fibres of *Euspongia*, different kinds of spicules and gemmules of *Spongilla*.
Meseum specimens: *Euplectella* skeleton; *Spongilla; Euspongia; Cliona*.
Coelenterata:
Permanent preparation of *Obelia* colony.
Study of prepared slides of *Obelia* colony and medusa.
Meseum specimens: *Physalia; Porpita; Vellala; Corallium; Fungia; Tubipora; Pennatula; Gorgonia; Sea-anemone*.
Plathyehelminthes:
Planaria*:* Examination of living flat worms; Study of prepared slides of entire specimens and transverse sections.
Fasciola**:** Examination of specimens insitu; Study of prepared slides of entire specimen, transverse sections and larval forms.
Teania**:** Study of prepared slides of scolex, mature and gravid proglottids and transverse sections of mature proglottid.
Study of prepared slides of *Polystomum, Paramphistomum, Schistosoma* and *Echinococcus.*

Museum specimens: Tapeworm; Cysticercus larva.

Nemathelminthes:

***Ascaris*:** External characters; Study of prepared slides of transverse sections of male and female.

Annelida:

***Neries*:** External characters; Study of prepared slides of transverse sections; Permnent preparation of parapodium.

***Hirudinaria*:** External characters; Dissections; Preparation of Jaws, nephridium and salivary glands; study of prepared slides salivary glands, nephridium and transverse sections through different regions.

Meseum specimens: *Heteronereis; Arenicola; Chaetopterus; Aphrodite; Pheretima; Branchllion; Bonnelia* female.

Arthropoda:

Palaemon: External characters; Permanent preparation of statocyst.

Scorpion: External characters; Dissections; Permanent preparation of book-lung and pectin.

***Periplanata*:** Dissection; Permanent preparation of salivary apparatus and trachea.

Grasshopper: Dissections.

Study of prepared slides of mouth-parts of male and female *Anopheles* and *Culex*, life-history of *Anopheles* and C*ulex,* Nauplius and Zoea larva, *Daphnia, Cyclops* and *Xenopsylla*.

Museum specimens: *Peripatus; Thyroglutus; Scolopendra; Balanus; Pagurus; Scylla; Sacculina* on crab; *Limulus; Schistocerca; Bombyx mori; Apis; Polistes;* Life-history of termite.

Mollusca:

***Pila*:** External characters; Dissections; Permanent preparation of radula and gill filaments; Study of prepared slides of gill lamella and osphradium.

Lamellidens: External characters; Dissections; Permanent preparation of gill lamella; Sections of gill lamella and glochidium larva; Study of prepared slides of glochidium and transverse sections through ctenidium, shell and different regions of the body.

Museum specimens: *Chiton; Turbinella; Doris; Aplysia; Vaginula; Mytilus; Teredo; Dentalium; Octopus; Loligo; Sepia; Nautilus; Pearl oyster.*

Echinodermata:

***Asterias*:** External characters; Study of prepared slides of transverse and longitudinal sections of the arms.

Museum specimens: *Echinus; Ophiothrix; Holothuria; Antedon*.

Cytogenetics:

Grasshopper testis and onion root-tip squash preparation to study mitosis and meiosis.

Study of prepared slides of cell division.

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B.Sc. Part – II (Theory)

The examination shall comprise three theory papers and a practical test:

Theory

Paper – I: Protochordata, histology and embryology		45 Marks
Paper – II: Vertebrate Zoology		45 Marks
Paper – III: Elements of physiology and biochemistry		45 Marks
Practical		65 Marks
	Total:	200 Marks

Candidate must obtain minimum pass marks in theory and practical examination separately.

Paper – I: PROTOCHORDATA, HISTOLOGY AND EMBRYOLOGY

PROTOCHORDATA:

General survey and outline classification (up to orders only) of Protochordata, and the classification, habits, structure and life-history of the representatives mentioned below.

Urochordata : *Amphioxus.*

HISTOLOGY:

Histology of stomach, intestine, liver, pancreas, bone, pituitary, kidney and gonads of frog and a mammal.

EMBRYOLOGY:

Outlines of development of an Ascidian, *Amphioxus*, frog and chick. Development of placenta in rabbit.

PAPER – II: VERTEBRATE ZOOLOGY

General survey and outline classification (up to orders only) of Craniata, and the classification, habits, structure and life-history of the representatives mentioned below.

CYCLOSTOMATA: External features only.

PISCES: *Scoliodon.*

AMPHIBIA: Parental care and neoteny.

REPTILIA: *Uromastrix* or any other Lizard.
Identification of poisonous and non-poisonous snakes
Biting mechanism of snakes, Snakes venom and antivenin

AVES: *Columba*

MAMMALIA: Osteology of rabbit, Adaptive radiation,General characteristics and affinities of Prototheria, Metatheria and Eutheria.

PAPER – III: ELEMENTS OF PHYSIOLOGY AND BIOCHEMISTRY

Section – A

ELEMENTARY MAMMALIAN PHYSIOLOGY:

Elementary knowledge of digestion and absorption, respiration, circulation, excretion, nerve conduction, muscles, endocrines and pheromones.

Section – B

BIOCHEMISTRY:

Elementary knowledge of functional groups (alcohols, thio-alcohols, acids aldehydes, ketones, and amines) and their reaction; Hydrogen ion concentration and buffering mechanism; classification of carbohydrates; Characteristics of monosaccharides; chemical classification of amino acids; Peptide Linkage; Types of Lipids; Hydrolysis of fats; Types of enzymes; Conditions for enzymatic activity; types of vitamins and micronutrients.

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B.Sc. Part –II (Practical)

Candidates shall be required to show knowledge of classification, dissections and micro preparations of the types mentioned below. Note books containing a complete record of the laboratory work done during the session must be produced at the practical examination. **The duration of the practical examination shall be 4½ hours.**

The distribution of marks shall be as follows:

Exercise

Dissection	18 Marks
Preparation	05 Marks
Physiology experiment	05 Marks
Spots (10)	25 Marks
Viva-voce	05 Marks
Class records	07 Marks
Total	65 Marks

The scope of practical work is indicated from the exercises given below.

Hemichordata:

***Balanoglossus*:** External charatcters; Study of prepared slides.

Urochordata:

***Herdmania*:** External characters; Glycerine and permanent preparation of spicules and branchial wall; Study of prepared slides of larva and metamorphosis.

Museum specimen: *Herdmania; Pyrosoma; Doliolum Oikopleura*.

Cephalochordate:

***Amphioxux*:** External characters; Study of prepared slides of oral hood, velum and sections through various regions of the body.

Cyclostomata:

Petromyzon: Larva: External characters.

Pisces:

***Scoliodon*:** External characters; Dissections; Permanent preparation of placoid scales and ampulla of Lorenzini; Study of prepared slides of different kinds of scales and development of placoid scales.

Museum specimens:

Elasmobranchii: *Heptranches; Sphyrna; Pristis; Toredo; Sting-ray*.

Holocephall*: Chimaera*.

Teleostomi: *Acipencer; Lepidosteus; Hippocampus; Anguilla; Pleuronecles; Exocoetus; Clarias; Anabas; Amia; Arius; Polyodon*.

Dipnoi: Any lung-fish.

Amphibia:

Frog: Dissections; Permanent preparation of blood film and chromatophores; Study of prepared slides of histology and development; Study of articulated and disarticulated skeleton.

Museum specimens: *Salamender; Proteus; Amphiuma; Amblyostama; Axolotal* larva*; Cryptobranchus; Siren.*
Anura: *Rhacophorus; Alytes ; Hyla.*
Reptilia:
***Uromastrix* or any other lizard:** external characters; Dissections; Permanent preparation of blood film.
Study of articulated and disarticulated skeleton of *Varanus.*
Museum specimens:
Chelonia: Turtles and Tortoises.
Lacertilia: *Varanus; Heloderma; Hemidactylus; Chamelion; Draco; Calotes; Lygosoma; Ophiosaurus* or *Anguis*.
Ophidia: *Naja; Vipera; Crotalus; Bungarus; Ptyas*; Biting mechanism of poisonous snakes (Models).
Crocodilia: Alligator; Crocodileus; Gavialis.
Extinct reptiles (models): *Rhamphorhyncus; Brontosaurus; Iguanodon; Stegosaurus*.
Aves:
Columba livia intermedia: External characters; Dissections; Permanent preparation of pecten, filoplume and blood film; Structure of feathers.
Study of prepared slides of chick embryo.
Study of articulated and disarticulated skeleton of fowl.
Museum specimen:
Archaeornithes: *Archaeopteryx*. (cast and model).
Neornithes: *Gallus; Anser*; *Corvus; Psittacula*.
Mammalia:
Rat or any other mammal: External characters; Dissection of vascular and urinogenital systems.
Study of prepared slides of histology.
Study of articulated and disarticulated skeleton of rabbit.
Museum specimens:
Prototheria: *Tachyglossus* and *Ornithorhynchus,* if available.
Metatheria: *Macropus*, if available.
Eutheria: *Manis; Platinasta; Felis domestica* or any other cat; *Mus; Hystrix; Lepus*; *Erinaceous*; Crocidura; Pteropus or any other bat; lemur or a monkey.
Physiology Experiment:
Action of salivary amylase, pepsin and trypsin.
Oxygen consumption of a rat.
Total count of R.B.C. and W.B.C.
Differential count of W.B.C.
Bleeding and clotting time.
Formation of hemin crystals.
Estimation of haemoglobin.
Effect of asmolarity of salt solutions and hemolytic agents on R.B.C., Clinical tests of sugar, ketone and urea in urine.
Kymographic recording of muscle contraction in nerve-muscle preparation of frog.
Kymographic recording of muscle heart beat of frog and effect of drugs on it.

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B.Sc. Part – III (Theory)

The examination shall comprise three theory papers and a practical test:

Theory

Paper – I : Environmental biology and toxicology	50 Marks
Paper – II : Economic Zoology and elementary biostatistics	50 Marks
Paper – III : Regulatory mechanism in vertebrates	50 Marks
Paper – IV : Cell physiology and elements of Biotechnology	50 Marks
Practical :	100 Marks
Total :	300 Marks

Candidates must obtain minimum pass marks in theory and practical examination separately.

PAPER – I: ENVIRONMENTAL BIOLOGY AND TOXICOLOGY

Section – A

ENVIRONMENTAL BIOLOGY :

Ecosystem : General organization; Trophic structure; Energy flow; Ecological pyramids; Basic types of biogeochemical cycles (chiefly nitrogen, phosphorus and sulphur).

Community : Basic structure; Species diversity, dominance, distribution and succession.

Population : Interspecific and intraspecific relations.

Population in relation to public health.

Conservation of natural resources with particular reference to wild life conservation in India (chief endangered species and concept of wild life reserves).

Section – B

ENVIRONMENAL TOXICOLOGY :

Introduction and scope of toxicology. Survey of environmental toxicants and their biology and ecological ill-effects.

Dose-response relationship: Graded, quantal and cumulative responses. Outline of toxicological testing methods : Mortality tests (LC_{50}/LD_{50} and safety margins/Limits); Acute, subacute and chronic testing of local and systemic effects (Skin; Eye; Behavioural; Biochemical; Physiological; Histopathological; Heamatological; Reproductive; Teratogenic; Carcinogenic).

Translocation of chemicals :

Membrane barriers; Storage depots; Biotransformation sites; Mixed multifunction oxidases.

Selective toxicity in relation to translocation and biotransformation factors.

Outline of antidotal procedures.

PAPER – II: ECONOMIC ZOOLOGY AND ELEMENTARY BIOSTATISTICS

Section –A

ECONOMIC ZOOLOGY:

General survey of economically important Phytoparasitic nematodes and insects.
Pathology/Damage caused, Prevention and control of *Leishmania*, *Trypanosoma*, *Heterodera* and *Tribolium.*
Diseases transmitted and control of mosquitoes and housefly.
General features, Life-History and useful products of *Apis*, *Bombyx* and *Tachardia.*
Brief outline of fish-culture, poultry and dairy-farming.
Economic importance of fishes.
General survey of important food-fishes and their diseases.
Rat menace and its control.

Section – B

BIOSTATISTICS:

General representation of frequency distribution:
Histograms; Frequency polygon; Cumulative frequency *graph/ogive.*
Measurement of central tendency:
Mean; Median; Mode.
Measures of variability:
Standard deviation.
Normal probability curve:
Basic features.

PAPER – III: REGULATORY MECHANISMS IN VERTEBRATES

Nutritional Physiology:
Nutritive requirements (concept of balanced diet); Regulation of hunger; Satiety; Food movement; Secretion of digestive juices.
Respiration:
Regulation of breathing and transport of gases. Automobile industrial emissions, food additives, Pesticides (Insecticides & Rodenticides), Heavy metals, radioactive substances.
Blood and circulation:
Regulation of heart beat; Vasomotor control; Hemodynamics (Physical characteristics of blood with reference to haematocrit and viscocity; Blood flow and resistance; Fluid energies; Blood pressure; Blood volume; Cardiac output).
Excretion and Osomoregulation:
Regulation of kidney function; Cellular Permeability, diffusion and active transport; Salt and Water balance.
Muscular system:
Innervation of muscles, excitation and contraction coupling; Chemical basis of muscle contraction.
Nervous system:
Role of autonomic nervous system in regulatory mechanism.
Endocrines:
Hypothalamo-hypophysial system; Regulatory action of hormones at cellular level; Thermoregulation in homeotherms.

Paper IV: CELL PHYSIOLOGY AND ELEMENTS OF BIOTECHNOLOGY

Section – A

CELL PHYSIOLOGY:

Glycolysis; Kreb's cycle; Electron transport system; Synthesis of nucleic acids; Protein synthesis and its regulation; Immune responses.

Section – B

BIOTECHNOLOGY:

Basics of recombinant D.N.A. technology.

Biotechnological Processes:

Cellular interaction and production of hybrids; Nuclear cloning.

Elementary knowledge of genetic engineering and its application towards human welfare.

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B.Sc. Part –III (Practical)

The practical examination shall comprise two sittings of 3 hours each. The distribution of marks shall be as follows:

Exercise

Paper –I:	
Ecology exercise	08 Marks
Toxicology exercise	08 Marks
Spots (5)	10 Marks
Paper – II and III:	
Dissection	08 Marks
Exercise	08 Marks
Spots (9)	18 Marks
Paper – IV:	
Major exercise	15 Marks
Minor exercise	05 Marks
Paper I – IV:	
Viva-voce	10 Marks
Class records	10 Marks
Total :	100 Marks

Note-books containing a complete record of the laboratory work done during the session must be produced at the practical examination.

The scope of the practical work is indicated from the exercises given below.

Paper – I:

Recording of physical eco factors: Atmospheric pressure, temperature and humidity.
Estimation of dissolved oxygen content of freshwater samples by Winkler's method.
Estimation of free carbon dioxide in freshwater samples.
Estimation of alkalinity of freshwater samples.
Study (qualitative and quantitative) of freshwater plankton.
Effect of light on colour changes in frog.
Animal associations: Mutualism; Commensalism; Parasitism.
Particular effect of organo phosphorus insecticide in rat.
Precipitation of protoplasm of buccal epithelium cells by mercuric chloride in rat.
Study of signs and symptom of ammonia poisoning in rat.
Behaviorural rat responses of fish/insect to different doses of pesticide exposure.
Determination of LC_{50} values from provided data.
Study of prepared skeleton of toxicology related histopathology.
Comparative study of chemical characteristics of polluted and non-polluted freshwater samples.

Paper II:

Study of prepared slides and/or museum specimens of the following from the view point of their economic importance with respect to man:

Entamoeba; *Leishmania*; *Trypanosoma*; *Plasmodium; Giardia; Trichomonas; Schistosoma*; Miracidia; Redia and Cercaria; *Taenia; Echinococcus; Hymenolepis; Dipylidium*; Bladderworm; Hydatid cyst; Ascaris; *Enterobius; Ancylostoma; Wuchereria; Dracunculus*; *Trichinella* larva; *Microfilariae*; *Cimex, Pedicules, Xenopsylla, Culex, Anopheles, Musca, Tribolium, Corcyra, Pyrilla; Chilo; Leptocorisa; Hieroglyphus; Dysdercus; Earias; Aulacophora;* Termite (all castes); *Apis* and *Bombyx* life-history; *Tachardia*; *Palaeomon; Microbrachium; Ostrea; Hilsa; Notopterus; Catla; Cirrhinus; Labeo; Wallago; Mystus; Rita; Hetropneustes; Clarias; Anabas*.

Selected larvivorous fishes; *Rattus*.

Study of specimens of plant material damaged by nematodes and insects.

Study of fish by-products.

Study of devices/equipment used for the administration of pesticides to control phytoparasites and pests (sprayers; dusters; blowers); for netting of juvenile and adult fishes and for feeding chicks at poultry farms.

Paper III:

Kymographic recording of muscle twitch.

Study of the effect of drugs on heart.

Dissections for the display of various endocrine glands.

Osmolarity of salt solutions on R.B.C.

Study of the effect of salivary amylase on digestion of starch.

Dissection of autonomic nervous system.

Paper IV:

Major exercise:

Separation of amino acids by chromatography.

Minor exercise:

Giant chromosomes of chironomus larva.

Demonstration of nerve cells by methylene blue.

Demonstration of mitosis in bone marrow/onion root-tip.

Mounting of bone marrow for mitosis.

Quantitative estimation of haemoglobin.

Demonstration of mitochondria in human buccal epithelium by supravital staining.

Preparation of *Lactobacillus* or any other useful microbe.