

Department of Zoology

Sri Dev Suman Uttarakhand University, Badshaithaul

New Tehri



Course Contents & Syllabus

Based on

Annual System

for

Undergraduate Course

BOS held on 7th February 2020

Sri Dev Suman University, Badshahithaul, Tehri Garhwal
B.Sc. (Zoology)
(All affiliated colleges)

The BSc examination will be spread over three years. There will be three theory papers and one practical examination every year. Each theory paper has been divided into five units. There will be 12 objective questions (1 mark each) (Multiple choice/true & false, fill in the blanks); Six short answer questions type (3 marks each) and four long answer type (5 marks each). There will be internal choice in short and long answer questions. The total duration of paper will be 2.30 hours.

Course Content and Teaching Schedule:

Class		No of lecture/periods 45 minutes, 25 weeks	Teaching hours		
			Weekly	Total	MM
B.Sc. 1st Year			Weekly	Total	MM
Paper-1 st	Non-Chordata (Animal Diversity)	50	1.5	37.5	50
Paper 2 nd	Cell Biology and Genetics	50	1.5	37.5	50
Paper 3 rd	Taxonomy, Evolution, Biostats & Computer	50	1.5	37.5	50
Practical based on paper 1,2 &3		100	03	75	50
B.Sc. 2nd Year			Weekly	Total	MM
Paper 4 th	Chordata	50	1.5	37.5	50
Paper 5 th	Animal Physiology and Biochemistry	50	1.5	37.5	50
Paper 6 th	Molecular Biology, Microbiology and Biotechnology	50	1.5	37.5	50
Practical based on paper 4,5 &6		100	03	75	50
B.Sc. 3rd Year			Weekly	Total	MM
Paper-7 th	Endocrinology and Applied Zoology	50	1.5	37.5	50
Paper 8 th	Ecology, Conservation biology and Animal Behaviour	50	1.5	37.5	50
Paper 9 th	Developmental Biology and Toxicology	50	1.5	37.5	50
Practical based on paper 7,8 &9		100	03	75	50

20% marks will be on the basis of internal assessment (10% for attendance + 10% for performance in the practical).

Sri Dev Suman University, Badshahithaul, Tehri Garhwal
B.Sc. 1st Year (Zoology)
Paper I: Animal Diversity (Non-Chordata)

UNIT-I

Protozoa: General characters and classification up to classes; locomotion and nutrition in Protozoa.

Porifera: General characters and classification up to classes; Canal system in sponges

UNIT-II

Coelenterata: General characters and classification up to classes; Polymorphism in Coelenterates; Corals and coral reefs.

Helminthes: General characters of Nematelminthes and Platyhelminthes; Life history of *Ascaris lumbricoides* and *Taenia solium* and their parasitic adaptations

UNIT-III

Annelida: General characters and classification up to classes; Metamerism in Trochophore larva and its significance.

Arthropoda: General characters and classification up to classes; Zoological importance of *Peripatus* and *Limulus*. Metamorphosis in Insects.

UNIT-IV

Mollusca: General characters and classification up to classes; Torsion in Gastropoda; Pearl formation.

UNIT-V

Echinodermata: General characters and classification up to classes; Water vascular system in star fish; Echinoderm larvae and their significance.

Books Recommended:

1. Kotpal, Agrawal & Khetrapal: Modern Text-book of Zoology, Invertebrates.11/E. Rastogi publication.
2. Nigam: Biology of Non-Chordates, Nagin Chand,.
4. B.Sc. Zoology Series -Animal Diversity ,Tata McGraw Hill Edu Pvt. Ltd. N.Delhi
5. Jordan E.L. et al.: Invertebrate Zoology. S.Chand & Company Ltd.
6. Barnes: Invertebrate Zoology (4th ed.), Holt-Saunders.
7. Barrington: Invertebrate Structure and Function, Nelson.
8. Iyer: A Manual of Zoology, Part I. Visawanathan

Sri Dev Suman University, Badshahithaul, Tehri Garhwal
B.Sc. 1st Year (Zoology)
Paper 2: Cell Biology and Genetics

Unit -I

Introduction to Cell biology; Cell theory
Comparative study of the Prokaryotic and Eukaryotic Cell.

Unit -II

Elementary knowledge of the structure & functions of plasma membrane;
Introduction to the organelles constituting endomembrane system (Endoplasmic reticulum, Golgi complex, Lysosome & Peroxisome).

Unit -III Nucleus & nucleolus; Ribosome; Mitochondria. Introduction to cytoskeleton.

Cell Division-Mitosis & Meiosis. Basic features of Cell cycle;
Elementary idea of cell transformation and cancer

Unit-IV

Mendel's law; Exceptions to Mendel's law. Incomplete dominance and Co-dominance, Multiple alleles, Lethal alleles, Epistasis.
Sex-linked inheritance; Extra chromosomal inheritance

Unit-V

Linkage & Crossing over. Sex determination.
Chromosome structure; Euchromatin; Heterochromatin; Histones.
Polytene & lampbrush chromosomes, Eugenesis

Books Recommended:

1. Alberts et al.: Molecular Biology of the Cell, Garland Publ., New York, 1989.
2. Strickberger: Genetics, Prentice Hall, 1996.
3. DeRobertis & DeRobertis: Cell & Molecular Biology, 1996
4. Verma, P.S. and Agrwal, V. K. Cell Biology, Genetics, Molecular biology and Evolution (S. Chand & Co.)

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B.Sc. 1st Year (Zoology)
Paper 3rd: Taxonomy and Evolution, Biostat & Ccomputer

Unit -I

Taxonomy: Definition & scope; relationship with Systematic, Zoological nomenclature: Binominal & Trinominal; ICZN.

Components of classification: Linnaean hierarchy. Concepts of species: Typological, Nomenclastic & Biological

Unit -II

Geological distribution of animals, period of evolution and extinction of major groups. Direct Evidences of Evolution: Type of Fossils & fossilization. Dating of fossils. Significance of fossil record.

Unit - III

Evolutionary theories: Lamarckism, Darwinism, Neo-Darwinism;

Processes of Evolutionary Change: Organic variations; Isolating Mechanisms; Natural selection (Example: Industrial melanism); Types of natural selection (Directional, Stabilizing, Disruptive). Evolution of Horse

Unit -IV

Biostatistics as a tool in research. Data collection: Random & non-random sampling. Data tabulation; Data presentation (Graph, Frequency Polygon, Histogram, Bar diagram, Scatter diagram).

Measures of central tendency- Calculation of Mean, Mode, Median

Unit -V

Introduction to computers types; Components of computer (Input unit, Memory, Central Processing Unit, Output unit). Problem solving with computers. Elementary idea of memory (RAM, ROM). Uses of computers in different fields. e.g. Biology, Medical, Environment etc.

Books Recommended:

1. Ashok Verma - Animal Taxonomy
2. Ernst Mayr- Principals of Systematic
3. Simpson- Principals and Practices of Animal Taxonomy
4. Kapoor- Theory and Practices of Animal Taxonomy, Oxford & Ibh
5. Strickberger: Evolution, CBS Publ. 1994.
6. Douglas, J. Futuyma. *Evolutionary Biology*. Sinauer Associate (1997)
7. Jain P.C. : Paleontology, Vishal Publ. Co.
8. Arora M.P.: Organic Evolution, Himalaya Publ
9. Rajaraman & V. Rajaraman: Computer Primer (2nd ed.) Prentice Hall of India, New Delhi.
10. Mahajan: Methods in Biostatistics, (4th ed.) Jaypee Bros. 1984

PRACTICAL SYLLABUS B.Sc. First Year (Zoology)

A. Non-Chordata:

Kingdom Protista: Amoeba, Euglena, Plasmodium, Paramecium

Phylum Porifera: Sycon (including T.S. and L.S.), Hyalonema, and Euplectella

Phylum Cnidaria: Obelia, Physalia, Aurelia, Tubipora, Metridium

Phylum Platyhelminthes: Liver Fluke, Taenia solium and Study of its life history stages (*Liver Fluke, Taenia solium*)

Phylum Nematelminthes: Male and female Ascaris lumbricoides

Phylum Annelida: Aphrodite, Nereis, Pheretima, Hirudinaria

Phylum Arthropoda: Palaemon, Cancer, Limulus, Palamnaeus, Scolopendra, Julus, Apis, Peripatus

Phylum Mollusca: Chiton, Dentalium, Pila, Unio, Loligo, Sepia, Octopus

Phylum Echinodermata: Pentaceros, Ophiura, Echinus, Cucumaria and Antedon

An “animal album” containing photographs, cut outs, with appropriate write up about the above mentioned taxa.

B. Cell Biology and Genetics:

1. Cell Structure and Cell Division- Prepared slides/photographs

2. Preparation of giant chromosome

3. Preparation of onion root tip for the stage of mitosis

4. Using suitable examples of Mendelian Inheritance and gene interactions verify the results through Chi-square test.

5. Study of Human Karyotypes (normal and abnormal).

C. Evolution:

1. Study of fossil evidences from plaster cast models and pictures

2. Study of homology and analogy from suitable specimens/ pictures and charts:

3. Phylogeny of horse with diagrams/ cut outs of limbs and teeth of horse ancestors

4. Darwin’s Finches with diagrams/ cut outs of beaks of different species

5. Visit to Museums, National parks and sanctuaries and submission of report.

B. Biostatistics

Practical application of statistics- Data presentation (Bar diagram, Histogram, Frequency distribution curve and scattered diagram), Measures of central tendency (Calculation of Mean, Mode, Median).

C. Computer application

Practical demonstration –preparation of Power Point presentation, Spread sheet, Chart and Design etc.

Distribution of marks: Duration 4 hrs.

1. Spotting (10) (Protozoa to Echinodermata)

2. Exercise on Cell Biology

3. Exercise on Genetics

4. Record and Collection

5. Viva Voice

6. Sessional Marks

Total 50

Sri Dev Suman University, Badshahithaul, Tehri Garhwal
B.Sc. 2nd Year (Zoology)
Paper 4th: Chordata

Unit- I

Protochordates: General features and Phylogeny of Protochordates. Body organization of *Balanoglossus*, *Herdmania* and *Amphioxus*.

Unit - II

Agnatha: General features of Agnatha and classification of cyclostomes up to Classes, Comparison between Lampreys and Hagfishes.

Pisces: General features and Classification up to orders; Scales and fins of fishes, Hill stream adaptations

Unit - III

Amphibia: General features and Classification up to orders; Parental care; Neoteny

Reptiles: General features and Classification up to orders; Poisonous and non-poisonous snakes; Biting mechanism in snakes; Venum and antivenum.

Unit - IV

Aves: General features and Classification up to orders; Feathers in Birds; Adaptations for aerial mode of life;

Unit - V

Mammalia: General features; Origin of mammals; distribution and affinities of Prototheria, Metatheria and Eutheria; Aerial and aquatic adaptations in mammals.

Books Recommended:

1. Pandey B.N. and Mathur V. Biology of Chordates, PHI Learning, 2018
2. R.L. Kotpal: Modern Text-book of Zoology, Vertebrates. Rastogi Publication.
3. E.L. Jordan and P.S. Verma: Chordate Zoology. S. Chand & Co. Ltd.
4. Hildebrand: Analysis of Vertebrate structure.
5. Romer & Parsons: The Vertebrate Body, Saunders.

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B.Sc. 2nd Year (Zoology)

Paper 5th: Animal Physiology & Biochemistry

Unit - I

Digestion: Intracellular and Extracellular digestion. Digestion and absorption of Carbohydrates, Lipids and Proteins.

Respiration: Pulmonary ventilation, Respiratory volumes and capacities,. Transport of Oxygen and Carbon dioxide in Blood. Dissociation of oxyhaemoglobin

Unit - II

Circulation: Composition of blood; Blood coagulation; Structure of Heart; Origin and conduction of the cardiac impulse, Cardiac cycle.

Excretion: Structure of nephron; Physiology of urine formation

Unit - III

Nervous system: Types of neurons; Myelinated and non-myelinated nerve fibres. Initiation and conduction of nerve impulse; Resting and action potential; Synapse and chemical transmission.

Muscles: Types of muscles; Ultrastructure of skeletal muscles; Molecular and Chemical basis of muscle contraction; Brief idea of tetanus and fatigue

Unit – IV

Carbohydrates Metabolism: Glycolysis, Kreb's Cycle, Gluconeogenesis, Glycogenesis and Glycogenolysis; Lipids: Biological significance, structure and classification.

Unit-V

Proteins: structure and classification; Transamination and Deamination

Enzymes: types and properties, factors affecting their functions. Mechanism of enzyme Action,

Books recommended:

1. Singh & Neeraj: Graduate Animal Physiology & Biochemistry, Vishal Publ
2. Prosser and Brown: Comparative Animal Physiology, Wiley.
3. Nielson: Animal Physiology, Cambridge.
4. Jain A.K: Textbook Of Physiology 6/E, Avichal Publishing Company
5. Conn and Stumpf: Outlines of Biochemistry. John Wiley.
6. Pandey B N: B.Sc. Zoology Series-Biochemistry, Physiology, Endocrinology; Tata McGraw Hill Edu Pvt. Ltd. N. Delhi

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B.Sc. 2nd Year (Zoology)
Paper 6th: Molecular Biology, Biotechnology and Microbiology

Unit I

Structure of DNA: nucleosides, nucleotides, polynucleotide chain, Watson and Crick DNA double helix model. DNA as genetic material, Packaging of DNA, Types of DNA

Unit II

Enzymes involved in prokaryotic and eukaryotic DNA replication; Mechanism & Type of replication.

DNA damage and repair: causes and types of DNA damage, mechanism of DNA repair:

Unit III

RNA: Structure and types of RNA, Clover leaf model of tRNA,

Transcription in prokaryotes: Prokaryotic RNA polymerase, role of sigma factor, promoter, Initiation, elongation and termination of RNA chains.

Processing of pre-mRNA: 5' cap formation, polyadenylation, splicing, rRNA and tRNA splicing.

Unit IV

Biotechnology: Definition and scopes; Enzyme used in genetic engineering, Recombinant DNA technology, DNA fingerprinting. A Brief knowledge of PCR and its significance.

Biotechnological innovations in the area of medical, agriculture, industrial and forensic sciences

Unit V

General account of Cyanobacteria, fungi, yeast and viruses,

Bacteria: Structure, classification, nutrition and reproduction.

Books recommended:

1. Alberts et al.: Molecular Biology of the cell. Garland Publ., New York.
2. De Robertis- Cell and Molecular Biology
3. Friefelder: Molecular Biology. Narosa Publ. House.
4. Smith: Biotechnology. Cambridge.
5. Verma, P.S. and Agrwal, V. K. Cell Biology, Genetics, Molecular biology, Evolution and Ecology (S. Chand & Co.)
6. Tortora- Microbiology: an Introduction

Sri Dev Suman University, Badshahithaul, Tehri Garhwal
PRACTICAL SYLLABUS of B.Sc. 2nd year (Zoology)

A. Chordata:

Protochordata: *Balanoglossus, Herdmania, Branchiostoma, Agnatha: Petromyzon*

Pisces: *Sphyrna, Pristis, Torpedo, Labeo, Exocoetus, Anguilla, Tor putitora*, Hill stream fishes

Amphibia: *Ichthyophis/Ureotyphlus, Salamandra, Bufo, Hyla, Axolotal larva*

Reptilia: *Chelone, Hemidactylus, Chamaeleon, Draco, Vipera, Naja, Crocodylus, Gavialis*

Key for Identification of poisonous and non-poisonous snakes

Aves: Study of six common birds from different orders

Mammalia: *Sorex, Bat, Funambulus, Loris,*

An “animal album” containing photographs, cut outs, with appropriate write up about the above mentioned taxa.

B. Physiology

Preparation of hemin crystals, Estimation of Haemoglobin percentage, Blood group test

Examination of permanent slides of spinal cord, duodenum, liver, lung, kidney, bone, cartilage etc.

C. Biochemistry

Identification of unknown carbohydrates in given solutions (Starch, Sucrose, Lactose, Galactose, Glucose, Fructose)

Colour reactions to identify functional group in the given solution of proteins

Study of activity of salivary amylase under optimum conditions

D. Molecular biology and Biotechnology:

Study of Watson & Crick Model of DNA through model/photographs

Study of Clover leaf structure of tRNA through model/photographs

Agarose gel electrophoresis of genomic DNA & plasmid DNA

Preparation of restriction enzyme digests of DNA samples

E. Microbiology

Media preparation and sterilization, Gram’s staining of Bacterial Cell

Distribution of marks: Duration 4 hrs.

1. Spotting (05) 15
2. Exercise on Molecular Biology/Biotechnology 05
3. Exercise on Immunology 05
4. Exercise on Microbiology 05
5. Record and Collection 05
6. Viva Voice 05
7. Sessional Marks 10

Total 50

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B.Sc. 3rd Year (Zoology)
Paper 7th: Endocrinology and Applied Zoology

UNIT I

Basic idea of endocrine, paracrine & autocrine secretion. Mechanism of action of hormones. Structure and function of Pituitary, Thyroid, Adrenal, Pancreas, Testes and ovary. Hormonal control of menstrual cycle

Unit II

Structure and function of Pituitary, Thyroid, Adrenal, Pancreas, Testes and ovary. Hormonal control of menstrual cycle.

Unit III

Sericulture: Types of silk worms (Mulberry & Nonmulberry), Rearing of Mulberry Silkworm

Lac culture: cultivation practices of host plants, extraction and uses of lac

Unit IV

Medicinal Pests: Identification, Characteristics of Mosquitoes, Housefly, Bedbug, Sand Medicinal Pests fly, Human lice, Tse Tse fly, Rat flea

Unit V

Aquaculture (Fish Culture): Monoculture and composite culture.

Hatchery management – development of fish hatcheries, types of hatcheries, production of spawn, fry and fingerlings, Pond management and fertilization - pre and post stocking management.

Induced breeding with special reference to Indian major carps.

Suggested Readings

Hadley, M.E.: Endocrinology. Pearson Education Pvt. Ltd. Singapore.

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B.Sc. 3rd Year (Zoology)
Paper 8th: Ecology, Conservation Biology and Animal Behaviour

Unit -I

Ecology: Definition, scope and importance,
Introduction to laws of Limiting factors: Liebig's law of the minimum, Shelford's law of tolerance. Factor interaction

Unit -II

Biogeochemical cycles: Concept and types of biogeochemical cycle (Water, Carbon, Nitrogen and Phosphorus cycle)

Unit -III

Ecosystem concept: Component & types (Grassland, Forest, Pond, River); Abiotic, biotic & edaphic factors and their interdependence,
Energy flow in ecosystem. Primary and secondary productivity. Food chains, food web and ecological pyramids

Unit -IV

Conservation Biology: Definition & scope. Concept of biodiversity; Biodiversity as a resource; Biodiversity loss and its Causes.
Conservation & Management of Biodiversity. Concept of Protected Areas: *Ex-situ* & *In-situ* Conservation. Biodiversity hot spots.
India's wildlife: Habitats & Distribution; Protected areas: National Parks & Sanctuaries.

Unit-III

The science of behaviour: History, scope and terminology. Biological rhythms. Biological Clock. Circadian rhythms and their synchronisation seasonal rhythms. Photoperiodism

Recommended Books:

1. Alcock : Animal behaviour Sinaur Associates, Inc. 1989.
2. Drickamer & Vessey: Animal Behaviour: Concepts, Processes and Methods (2nd ed.)1986
3. Goodenough et al.: Perspectives on animal behaviour. Wiley & Sons, New Youk. 1993.
4. Grier : Biology of animal behaviour, Mosby 1984.
5. M P Arora. Anilam behaviour. Himalayan Publishing house
6. Negi: An introduction to Wildlife Management, 1983.
7. Negi: Himalayan Wildlife: Habitat and Conservation. 1992. Indus Publ. Com., New Delhi.
8. Pullin: Conservation Biology, Cambridge, 2002.
9. Rawat & Agarwal : Biodiversity: Concept, threats and conservation.
10. Sharma, High Altitude Wildlife of India. Oxford 7 IBH Publ. Co. Pvt. Ltd. 1994.

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B.Sc. 3rd Year (Zoology)
Paper 9th: Developmental Biology and Toxicology

Unit - I

Gametogenesis: Spermatogenesis in mammals, Morphology of mature mammalian spermatozoon: Oogenesis in mammals, Vitellogenesis in birds.
Fertilization: external (amphibian), Internal (mammals), Block to polyspermy

Unit - II

Early Development of Frog and Human: types of egg; patterns of cleavage; role of yolk during cleavage; Morphogenetic movements; Development up to formation of gastrula.

Neurulation in frog embryo, Extra embryonic membranes.

Unit - III

Implantation of embryo in human; Types of placenta on the basis of histology; Formation of human placenta and its functions.

Elementary concept of primary organizer; Induction. Differentiation and organogenesis of vertebrate eye.

Unit - IV

Definition, history, scope of toxicology.

Classification of toxic agents, natural toxins, food toxins, and chemical toxins

Environmental toxicology of heavy metal (lead)

Unit - V

Air pollution-types of air pollutants, their effects and remedial measures.

Water pollution- types of water pollutants, their effects and remedial measures.

General introduction to pesticides;, herbicides, fungicides, and insecticides

Books recommended:

1. Jain P C . Development Biology.
2. Gilbert, Developmental Biology. 3rd ed. Sinauer, 1991.
3. Berril: Developmental Biology, McGraw-Hill. Indian ed. 1974.
4. Laycock, J.F. and Wise, P.H.: Essential Endocrinology. Oxford University Press.
5. Hadley, M.E.: Endocrinology. Pearson Education Pvt. Ltd. Singapore

PRACTICAL SYLLABUS of B.Sc. 3rd Year (Zoology)

A. Endocrinology

Study of slides; pituitary, adrenal gland, thymus, testes, ovary

B. Ecology

Models Based on different aspects of ecology.

Population study of available terrestrial and aquatic animals

Physico-chemical study of soil and water (pH, DO, Free CO₂, Turbidity etc)

Study of an ecosystem, its biotic components and food chains

C. Animal Behavior &

Models Based on different aspects of animal behavior.

Study of Birds Nest showing Nesting Behaviour

Experiments related to learning behaviour/conditional learning.

Conservation Biology: Definition & scope. Concept of biodiversity; Biodiversity as a resource; Biodiversity loss and its Causes.

D. Conservation Biology

Study of Biodiversity hot spots with the help of maps..

Study of Protected areas: National Parks & Sanctuaries with the help of maps.

D. Developmental Biology

Frog - Study of developmental stages - whole mounts and sections through permanent slides – cleavage stages, blastula, gastrula, neurula, tail bud stage, tadpole-external and internal gill stages.

Study of the different types of placentae- histological sections through permanent slides or photomicrographs.

E. Toxicology

Distribution of marks: Duration 4 hrs.

Spotting (05) 15

(Ecological adaptation, Wildlife, Animal behaviour)

Exercise on Ecology/ Conservation Biology 10

Exercise on Animal Behaviour 05

Record and Collection 05

Viva Voice 05

Sessional Marks 10

Total: 50