

# Department of Zoology

Sri Dev Suman Uttarakhand University, Badshaithaul

New Tehri



## Course Contents & Syllabus

Based on

Annual System

for

Undergraduate Course

**BOS held on 7<sup>th</sup> 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>B.Sc. 1<sup>st</sup> Year</b>			<b>Weekly</b>	<b>Total</b>	<b>MM</b>
Paper-1 <sup>st</sup>	Non-Chordata (Animal Diversity)	50	1.5	37.5	50
Paper 2 <sup>nd</sup>	Cell Biology and Genetics	50	1.5	37.5	50
Paper 3 <sup>rd</sup>	Taxonomy, Evolution, Biostats & Computer	50	1.5	37.5	50
Practical based on paper 1,2 &3		100	03	75	50
<b>B.Sc. 2<sup>nd</sup> Year</b>			<b>Weekly</b>	<b>Total</b>	<b>MM</b>
Paper 4 <sup>th</sup>	Chordata	50	1.5	37.5	50
Paper 5 <sup>th</sup>	Animal Physiology and Biochemistry	50	1.5	37.5	50
Paper 6 <sup>th</sup>	Molecular Biology, Microbiology and Biotechnology	50	1.5	37.5	50
Practical based on paper 4,5 &6		100	03	75	50
<b>B.Sc. 3<sup>rd</sup> Year</b>			<b>Weekly</b>	<b>Total</b>	<b>MM</b>
Paper-7 <sup>th</sup>	Endocrinology and Applied Zoology	50	1.5	37.5	50
Paper 8 <sup>th</sup>	Ecology, Conservation biology and Animal Behaviour	50	1.5	37.5	50
Paper 9 <sup>th</sup>	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.)

**Sri Dev Suman University, Badshahithaul, Tehri Garhwal**  
**B.Sc. 1st Year (Zoology)**  
**Paper 3<sup>rd</sup>: 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, Nomenalistic & 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. 2<sup>nd</sup> Year (Zoology)**  
**Paper 4<sup>th</sup>: 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.

**Sri Dev Suman University, Badshahithaul, Tehri Garhwal**

**B.Sc. 2<sup>nd</sup> Year (Zoology)**

**Paper 5<sup>th</sup>: 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



**Sri Dev Suman University, Badshahithaul, Tehri Garhwal**  
**B.Sc. 2<sup>nd</sup> Year (Zoology)**  
**Paper 6<sup>th</sup>: 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. 2<sup>nd</sup> 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**

**Sri Dev Suman University, Badshahithaul, Tehri Garhwal**  
**B.Sc. 3<sup>rd</sup> Year (Zoology)**  
**Paper 7<sup>th</sup>: 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.

**Sri Dev Suman University, Badshahithaul, Tehri Garhwal**  
**B.Sc. 3<sup>rd</sup> Year (Zoology)**  
**Paper 8<sup>th</sup>: 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.

**Sri Dev Suman University, Badshahithaul, Tehri Garhwal**  
**B.Sc. 3<sup>rd</sup> Year (Zoology)**  
**Paper 9<sup>th</sup>: 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. 3<sup>rd</sup> 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 CO<sub>2</sub>, 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**