

**Department of Zoology**

**B.Sc. (Zoology)**

**Course Contents & Syllabus**



**Sri Dev Suman Uttarakhand Vishwavidhyalay,  
Badshahithaul, Tehri Garhwal, Uttarakhand 249 199.**

# B.Sc. Course in Zoology

Sri Dev Suman Uttarakhand Vishwavidhyalay, Badshahithaul,  
Tehri Garhwal, Uttarakhand 249 199.

## Syllabus: Theory

The B.Sc. examination will be spread over three years (six semester). There shall be two theory papers and one practical examination every semester. Each theory paper has been divided into four units. Each paper will be of 100 marks (Theory-80, Sessional-20). Likewise, each practical will be of 50 marks (Theory-40, Sessional-10).

## Course Contents & Teaching Schedules:

	No. of Lectures	MM
<b>B.Sc. First Year</b>		
<b>1<sup>st</sup> Semester</b>		
Paper 1 : Non-Chordata	36	100
Paper 2 : Cell Biology & Genetics	36	100
Practical: Based on paper 1 and 2	72	50
<b>2<sup>nd</sup> Semester</b>		
Paper 3: Chordata	36	100
Paper 4: Taxonomy, Evolution	36	100
Practical: Based on paper 3 and 4	72	50
<b>B.Sc. Second Year</b>		
<b>3<sup>rd</sup> Semester</b>		
Paper 5: Physiology & Biochemistry	36	
Paper 6: Developmental Biology & Endocrinology	36	
Practical: Based on paper 5 and 6	72	
<b>4<sup>th</sup> Semester</b>		
Paper 7: Ecology and Environment	36	100
Paper 8: Animal Behaviour & Conservation Biology	36	100
Practical: Based on paper 7 and 8	72	50
<b>B.Sc. Third Year</b>		
<b>5<sup>th</sup> Semester</b>		
Paper 9: Molecular Biology and Biotechnology	36	100
Paper 10: Microbiology and Immunology	36	100
Practical: Based on paper 9 and 10	72	50
<b>6<sup>th</sup> Semester</b>		
Paper 11: Economic Zoology	36	100
Paper 12: Biostatistics and Computer	36	100
Practical: Based on paper 11 and 12	72	50



**B.Sc. 1<sup>st</sup> Year (Zoology)-1<sup>st</sup> Semester**  
**Paper I: Animal Diversity (Non-Chordata)**

	<b>No. of Lectures</b>
<b>UNIT-I</b> 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.	9.0
<b>UNIT-II</b> 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 <i>Ascaris lumbricoides</i> and <i>Taenia solium</i> and their parasitic adaptations.	9.0
<b>UNIT-III</b> Annelida: General characters and classification up to classes; Metamerism in Annelida; Trochophore larva and its significance.  Arthropoda: General characters and classification up to classes; Zoological importance of <i>Peripatus</i> and <i>Limulus</i> . Metamorphosis in Insects.	9.0
<b>UNIT-IV</b> Mollusca: General characters and classification up to classes; Torsion in Gastropoda; Pearl formation  Echinodermata: General characters and classification up to classes; Water vascular system in star fish; Echinoderm larvae and their significance.	9.0

**Books Recommended:**

1. Kotpal, Agrawal & Khetrapal: Modern Text-book of Zoology, Invertebrates.11/E. Rastogi publication.
2. Marshall & William: Text book of Zoology, Vol I (Parker & Haswell, 7th ed.) Macmillian,.
3. 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,



**B.Sc. 1st Year (Zoology)-1<sup>st</sup> Semester  
Paper 2: Cell Biology and Genetics**

	<b>No. of Lectures</b>
<b>UNIT-I</b> Generalized structure of Pro- & Eukaryote cell. Elementary knowledge of the structure & function of plasma membrane. Introduction to the organelles constituting endo-membrane system (Endoplasmic reticulum, Golgi complex, Lysosome).	9.0
<b>UNIT-II</b> Nucleus & nucleolus; Ribosome; Mitochondria. Introduction to cytoskeleton. Cell Division-Mitosis & Meiosis. Basic features of Cell cycle; Elementary idea of cell transformation and cancer.	9.0
<b>UNIT-III</b> Mendel's law; Exceptions to Mendel's law. Incomplete dominance and Co-dominance, Multiple alleles, Lethal alleles, Epistasis. Sex-linked inheritance; Extra chromosomal inheritance.	9.0
<b>UNIT-IV</b> Linkage & Crossing over. Sex determination. Chromosome structure; Euchromatin; Heterochromatin; Histones. Polytene & lampbrush chromosomes, Eugenesis,	9.0

**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. Gupta P.K. : Cell And Molecular Biology, Rastogi Publications
5. Sarkar B : Cell Structure and Function, Medtech
6. Verma & Agarwal: Cell Biology, genetics, Molecular Biology. S.Chand & Company

## PRACTICAL SYLLABUS B.Sc. 1<sup>st</sup> SEMESTER (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  
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 Linkage, recombination, gene mapping using the data.
6. Study of Human Karyotypes (normal and abnormal).

### Distribution of marks:

Duration 4 hrs.

1. Spotting (10) (Protozoa to Echinodermata)	20
2. Exercise on Cell Biology	05
3. Exercise on Genetics	05
4. Record and Collection	05
5. Viva Voice	05
6. Sessional Marks	10
<b>Total</b>	<b>50</b>

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**B.Sc. 1<sup>st</sup> Year (Zoology)-2<sup>nd</sup> Semester  
Paper 3: Chordata**

	<b>No. of Lectures</b>
<b>UNIT- I</b>	
Protochordates: General features and Phylogeny of Protochordats. Body organization of <i>Balanoglossus</i> , <i>Herdmania</i> and <i>Amphioxus</i> .	9.0
<b>UNIT- II</b>	
Agnatha: General features of Agnatha and classification of cyclostomes up to Classes, Comparison between Lampreys and Hagfishes.	9.0
Pisces: General features and Classification up to orders; Scales and fins of fishes, Hill stream adaptations	
<b>UNIT- III</b>	
Amphibia: General features and Classification up to orders; Parental care; Neoteny	9.0
Reptiles: General features and Classification up to orders; Poisonous and non-poisonous snakes; Biting mechanism in snakes; Venum and antivenum.	
<b>UNIT- IV</b>	
Aves: General features and Classification up to orders; Feathers in Birds; Adaptations for aerial mode of life;	9.0
Mammalia: Origin of mammals; General organization, 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.

**B.Sc. 1st Year (Zoology) - 2<sup>nd</sup> Semester  
Paper 4: Taxonomy and Evolution**

	<b>No. of Lectures</b>
<b>UNIT-I</b> Taxonomy: Definition & scope; relationship with Systematic Zoological nomenclature: Binominal & Trinominal; ICZN. Components of classification: Linnaean hierarchy. Concepts of species: Typological, Nomenalistic & Biological	9
<b>UNIT-II</b> 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. Evolution of Horse.	9
<b>UNIT- III</b> 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), Artificial selection	9
<b>UNIT-IV</b> Species Concept: Biological species concept (Advantages and Limitations); Modes of speciation (Allopatric, Sympatric), Macro-evolutionary principles (example: Darwin's Finches), Role of extinction in evolution	9

**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.

## PRACTICAL SYLLABUS B.Sc. 2<sup>nd</sup> SEMESTER (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. COMPARATIVE ANATOMY

#### 1. Osteology:

- a. Disarticulated skeleton of fowl and rabbit
- b. Carapace and plastron of turtle /tortoise
- c. Mammalian skulls: One herbivorous and one carnivorous animal.

### 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 Natural History Museum, submission of report

### Distribution of marks:

Duration 4 hrs.

1. Spotting (10) (Protochordate to Mammals, Bones)	20
2. Exercise on Evolution	05
3. Permanent slide making (Fish scale, )	05
4. Record and Collection	05
5. Viva Voice	05
6. Sessional Marks	10

**Total** **50**



**B.Sc. 2nd Year (Zoology)- 3<sup>rd</sup> Semester  
Paper-5 Animal Physiology and Biochemistry**

	<b>No. of Lectures</b>
<b>UNIT- I</b>	
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,	9
<b>UNIT- II</b>	
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.	9
<b>UNIT- III</b>	
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.	9
<b>UNIT – IV</b>	
Carbohydrates Metabolism: Glycolysis, Kreb’s Cycle, Gluconeogenesis, Glycogenesis and Glycogenolysis; Lipids: Biological significance, structure and classification. Proteins: Transamination, Deamination and Urea Cycle Enzymes: Mechanism of enzyme Action, Kinetics, Inhibition and Regulation.	9

**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

**B.Sc. 2nd Year (Zoology)- 3<sup>rd</sup> Semester**  
**Paper-6 Developmental biology and Endocrinology**

	<b>No. of Lectures</b>
<b>UNIT- I</b> Gametogenesis: Spermatogenesis in mammals, Morphology of mature mammalian spermatozoon: Oogenesis in mammals, Vitellogenesis in birds. Fertilization: external (amphibian), Internal (mammals), Block to polyspermy.	9
<b>UNIT- II</b> 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. Fate Map, Fate of germ layers. Neurulation in frog embryo, Extra embryonic membranes,	9
<b>UNIT- III</b> Implantation of embryo in human; Types of placenta on the basis of histology; Formation of human placenta and its functions. Fundamental process in development (brief idea): gene activation, determination, Elementary concept of primary organizer; Induction. Differentiation and organogenesis of vertebrate eye. Metamorphic events in frog life cycle and its hormonal regulation	9
<b>UNIT – IV</b> 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	9

**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> SEMESTER (Zoology)

### A. Physiology

1. Preparation of hemin crystals
2. Estimation of Haemoglobin percentage
3. Blood group test
4. Examination of permanent slides of spinal cord, duodenum, liver, lung, kidney, bone, cartilage etc.

### B. BIOCHEMISTRY

1. Identification of unknown carbohydrates in given solutions (Starch, Sucrose, Lactose, Galactose, Glucose, Fructose)
2. Colour reactions to identify functional group in the given solution of proteins
3. Study of activity of salivary amylase under optimum conditions

### C. DEVELOPMENTAL BIOLOGY and Endocrinology

1. 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.
2. Study of the different types of placenta- histological sections through permanent slides or photomicrographs.
3. Study of placental development in humans by ultrasound scans.
4. Examination of gametes -sperm and ova (frog/mammals) through permanent slides or photomicrographs.
5. Examination of histological section of Pituitary, Thyroid, Parathyroid, Pancreas, Adrenal, Testes, Ovary.

### Distribution of marks:

Duration 4 hrs.

7. Spotting (10) (Histology, Endocrine glands and Embryology)	20
8. Exercise on Physiology	05
9. Exercise on Biochemistry	05
10. Record and Collection	05
11. Viva Voice	05
12. Sessional Marks	10
<b>Total</b>	<b>50</b>



**B.Sc. 2<sup>nd</sup> Year (Zoology)- 4<sup>th</sup> Semester**  
**Paper 7: Ecology and environment**

	<b>No. of Lectures</b>
<b>UNIT-I</b> Ecology: Definition, scope and importance, Introduction to laws of Limiting factors: Liebig's law of the minimum, Shelford's law of tolerance. Factor interaction. Biogeochemical cycles: Concept and types of biogeochemical cycle (Water, Carbon, Nitrogen and Phosphorus cycle)	9
<b>UNIT-II</b> 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,	9
<b>UNIT-III</b> Population: Definition; Biotic potential; Density, Natality, Mortality & population growth curves; Carrying capacity. Community: Definition, concept and characteristics; Density, Dominance; Diversity and stratification.	9
<b>UNIT-IV</b> Environmental pollution: Definition, Types, Sources & effect (Air, Water, solid waste & Radioactive pollution). Green house effect, Climate change, Acid rain, Ozone layer depletion, Environmental Impact assessment	9

**Books recommended:**

1. Odum, E.P.: Fundamentals of Ecology, Saunders Co. Publ. 1971/1993 Indian ed.
2. Chapman & Reiss: Ecology.
3. Smith, R.L.: Ecology & Field Biology.
4. Singh & Kumar: Ecology and Environmental Science, Vishal Publ. Co., 2004.

**B.Sc. 2<sup>nd</sup> Year (Zoology)- 4<sup>th</sup> Semester**  
**Paper 8: Animal Behaviour & Conservation Biology**

	<b>No. of Lectures</b>
<b>UNIT I:</b> The science of behaviour: History, scope and terminology. Proximate and ultimate causes of behaviour. Instinct: Definition and Characteristics (sign stimuli and Fixed Action Pattern). Learning behaviour: Definition. Spatial learning. Associative learning, classical conditioning, operant conditioning, language learning. Imprinting. Kin recognition. Instinct versus learning behaviour.	9
<b>UNIT II:</b> Biological rhythms. The Biological Clock. Circadian rhythms and their Synchronization. Seasonal rhythms. Photoperiodism. Communication: Visual, olfactory, acoustic. Chemoreception: Chemicals (pheromones) as signals in insects, fish and mammals. Hormonal Control of behaviour. Cooperation and conflict. Evolution of altruism.	9
<b>UNIT III</b> Conservation Biology: Definition & scope. Concept of biodiversity; Biodiversity as a resource; Biodiversity loss and its Causes. Conservation & Management of Biodiversity. Concept of Protected Areas: <i>Ex-situ</i> & <i>In-situ</i> Conservation. Biodiversity hot spots.	9
<b>UNIT IV</b> India's wildlife: Habitats & Distribution; Protected areas: National Parks & Sanctuaries. National Organizations involved in wild life conservation; Wild life Legislation: Wild life Protection act - 1972, its amendments and implementation; Zoogeography of India. Vertebrate fauna of Garhwal Himalaya (Distribution, habitat preference, adaptive features).	9

**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.

## PRACTICAL SYLLABUS of B.Sc. 4<sup>th</sup> SEMESTER (Zoology)

### A. Ecology & Environment

1. Models Based on different aspects of ecology.
2. Population study of available terrestrial and aquatic animals
3. Physico-chemical study of soil and water (pH, DO, Free CO<sub>2</sub>, Turbidity etc)
4. Study of an ecosystem, its biotic components and food chains

### B. Animal Behavior & Conservation Biology

1. Models Based on different aspects of animal behavior.
2. Identification of flora, mammalian fauna, avian fauna, herpeto-fauna through photographs/models
3. Study of Birds Nest showing Nesting Behaviour
4. Experiments related to learning behaviour/conditional learning.

### Distribution of marks:

Duration 4 hrs.

13. Spotting (05) (Ecological adaptation, Wildlife, Animal behaviour)	15
14. Exercise on Ecology/ Conservation Biology	10
15. Exercise on Animal Behaviour	05
16. Record and Collection	05
17. Viva Voice	05
18. Sessional Marks	10
<b>Total</b>	<b>50</b>



**B.Sc. 3<sup>rd</sup> Year (Zoology)- 5<sup>th</sup> Semester**  
**Paper-9: Molecular Biology and Biotechnology**

	<b>No. of Lectures</b>
<b>UNIT I</b> Structure of DNA: nucleosides, nucleotides, polynucleotide chain, Watson and Crick DNA double helix model. DNA as genetic material, Packaging of DNA, Types of DNA.	9
<b>UNIT II</b> 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:	9
<b>UNIT III</b> 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.	9
<b>UNIT IV</b> 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.	9

**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.)

**B.Sc. 3<sup>rd</sup> Year (Zoology)- 5<sup>th</sup> Semester  
Paper-10: Microbiology and Immunology**

	<b>No. of Lectures</b>
<b>UNIT – I</b> General account of different groups: Cyanobacteria, fungi, yeast, viruses, Bacteria: Structure, classification, nutrition and reproduction.	9
<b>UNIT-II</b> Microbiology Techniques: Media preparation, sterilization, pure culture and staining techniques. General structure and multiplication of Viruses; General characteristics of bacteriophages.	9
<b>UNIT-III</b> Overview of the immune system- Introduction to basic concepts in immunology, Components of immune system, principles of innate and adaptive immune system; Cells and organs of the immune system: Haematopoeisis, primary and secondary lymphoid organs.	9
<b>UNIT-IV</b> Antigens- Basic properties of antigens, B and T cell epitopes, haptens and adjuvants; Antibodies- Structure, classes and function of antibodies, monoclonal antibodies.	9

**SUGGESTED READINGS**

1. Delves, Martin, Burton, Roitt, 2006. Roitt's Essential of Immunology. XI Ed., Blackwell Publi.
2. Kindt, Goldsby, Osborne, Kuby, 2006. Immunology. VI Ed. W.H. Freeman and Company.
3. Parija- Text book of Microbiology
4. Tortora- Microbiology: an Introduction



## PRACTICAL SYLLABUS of B.Sc. 5<sup>th</sup> SEMESTER (Zoology)

### A. Molecular biology and Biotechnology:

1. Study of Watson & Crick Model of DNA through model/photographs
2. Study of Clover leaf structure of tRNA through model/photographs
3. Isolation of chromosomal DNA from bacterial cells.
4. Agarose gel electrophoresis of genomic DNA & plasmid DNA
5. Preparation of restriction enzyme digests of DNA samples

### B. Microbiology and Immunology:

1. Media preparation and sterilization,
2. Inoculation
3. Gram's staining of Bacterial Cell
4. Study of lymphoid organs- Thymus, Spleen etc (by slides or photo micrographs)
5. Study of different classes of antibodies through photographs
6. ABO blood group determination
7. Demonstration of immunoelectrophoresis

### 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
<b>Total</b>	<b>50</b>

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**B.Sc. 3<sup>rd</sup> Year (Zoology)- 6<sup>th</sup> Semester  
Paper 11: Economic Zoology**

	<b>No. of Lectures</b>
<b>UNIT I</b> Elementary knowledge of Sericulture, Apiculture and Lac culture. Elementary knowledge of Poultry Keeping.	9
<b>UNIT II</b> Elementary Knowledge of Fish culture; Genetic improvements in aquaculture industry; Induced breeding and transportation of fish Seed. Elementary knowledge of Animal Husbandry, Preservation and artificial insemination in cattle.	9
<b>UNIT III</b> Parasitic protozoa and human diseases (Life history and pathogenicity of <i>Plasmodium vivax</i> and <i>trypanosoma gambiense</i> ), Parasitic helminthes and human diseases (Life history and pathogenicity of <i>Schistosoma</i> , and <i>Wuchereria bancrofti</i> )	9
<b>UNIT IV</b> Life cycle, medical importance and control of <i>Anopheles</i> , <i>Aedes</i> , and <i>Xenopsylla cheopis</i> . Biology, Control and damage caused by <i>Helicoverpa armigera</i> and <i>Pyrrilla perpusilla</i> , Safe storage of stored grains. Integrated Pest Management (IPM)	9

**Books Recommended:**

1. Arora and Arora: *Medical Parasitology*. II Edition. CBS Publications and Distributors.
2. Atwal (1986). *Agricultural Pests of India and South East Asia*, Kalyani Publishers.
3. Dunham (2004). *Aquaculture and Fisheries Biotechnology Genetic Approaches*. CABI publications, U.K.
4. Hafez (1962). *Reproduction in Farm Animals*. Lea & Fabiger Publisher
5. Jabde.: *Text Book of Applied Zoology: Vermiculture, Apiculture, Sericulture, Lac Culture, agricultural Pests and their Control*. Discovery Publishing House.
6. Park :*Preventive and Social Medicine*. XVI Edition. B.B Publishers.
7. Pedigo (2002). *Entomology and Pest Management*, Prentice Hall.
8. Ravindranathan: *Economic Zoology*. Vedant eBook (P) Ltd. New Delhi.
9. Shukla & Upadhyay: *Economic Zoology*. 4th Ed. Rastogi Publ., Meerut.
10. Sobti: *Medical Zoology*. Sobhan Lal Nagin Chand & Co. Jallendhar.

**B.Sc. 3<sup>rd</sup> Year (Zoology)- 6<sup>th</sup> Semester  
Paper 12: Biostatistics & Computer**

	<b>No. of Lectures</b>
<b>UNIT-I</b> Biostatistics as a tool in research. Data collection: Random & non-random sampling. Data tabulation; Data presentation (Graph, Frequency Polygon, Histogram, Bar diagram, Scatter diagram).	9
<b>UNIT-II</b> Measures of central tendency- Calculation of Mean, Mode, Median, Geometric mean, Harmonic mean	9
<b>UNIT-III</b> Measure of dispersion- Variability and statistics of dispersion, Range, Mean deviation, Standard deviation, Coefficient of variation, Standard error of means.	9
<b>UNIT-IV</b> Capabilities and limitations of computers; 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.	9

**Books Recommended:**

1. D. Rajaraman & V. Rajaraman: Computer Primer (2nd ed.) Prentice Hall of India, New Delhi.
2. Mahajan: Methods in Biostatistics, (4th ed.) Jaypee Bros. 1984.
3. Roger Hunt & John Shelley; Computer and Commonsense, Prentice Hall of India, New Delh
4. Zar: Biostatistical Analysis, Pearson Education (3rd Indian Reprint) 2005

## PRACTICAL SYLLABUS of B.Sc. 6<sup>th</sup> SEMESTER (Zoology)

### A. Economic Zoology

1. Study of permanent slides/photomicrographs and specimens of *Plasmodium vivax*, *Entamoeba histolytica*, *Trypanosoma gambiense*, *Schistosoma haematobium*, *Ancylostoma duodenale* and *Wuchereria bancrofti*
2. Study of arthropod vectors associated with human diseases: *Pediculus*, *Culex*, *Anopheles*, *Aedes* etc
3. Study of insect damage to different plant parts/stored grains through damaged products/photographs.
4. Identifying feature and economic importance of *Helicoverpa (Heliothis) armigera*, *Papilio demoleus*, *Pyrilla perpusilla*
5. Visit to poultry farm or animal breeding centre. Submission of visit report
6. Maintenance of freshwater aquarium

### B. Biostatistics

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

### 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) (Economic zoology)	20
2. Exercise on Biostatistics	05
3. Exercise on Computer Application	05
4. Record and Collection	05
5. Viva Voice	05
6. Sessional Marks	10

**Total**

**50**

