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	Teaching Hrs Total Weekly MM
B.Sc. First Year		
1ST Semester		
Paper I : Non-Chordata	36	100
Paper 2 : Cell Biology & Genetics	36	100
Practical: Based on paper 1 and 2	72	50
2nd Semester		
Paper 3: Chordata	36	100
Paper 4 : Taxonomy, Evolution	36	100
Practical: Based on paper 3 and 4	72	50
B.Sc. Second Year		
3rd Semester		
Paper 5: Physiology & Endocrinology	36	100
Paper 6: Biochemistry and Developmental Biology	36	100
Practical: Based on paper 5 and 6	72	50
4th Semester		
Paper 7: Ecology and Toxicology	36	100
Paper 8: Conservation Biology and Animal Behavior	36	100
Practical: Based on paper 7 and 8	72	50
B.Sc. Third Year		
5th Semester		
Paper 9: Molecular Biology and Biotechnology	36	100
Paper 10: Microbiology and Immunology	36	100
Practical: Based on paper 9 and 10	72	50
6th Semester		
Paper 11: Economic Zoology	36	100
Paper 12: Biostatistics and Computer	36	100
Practical: Based on paper 11 and 12	72	50

28/5/18

(Prof. N.K. Agarwal) (Dr. Ravindra Singh) (Dr. A.K. Saxena)

B.Sc. 1st Year (Zoology)-1ST Semester
Paper I: Non-Chordata

No. of Lectures

Introduction to Non-Chordata: General characters; Outline classification up to Classes

UNIT-I

Protozoa: Salient features; Study of *Amoeba, Euglena, Paramecium* and *Monocystis* with reference to structure, locomotion, nutrition and reproduction (life history) — 9.0

Porifera: Salient features; Study of *Leucosolenia* and *Sycon* with reference to structure, reproduction (life history); Canal system in sponges; Skeleton system

UNIT-II

Coelenterata: Salient features; Study of *Obelia* and *Aurelia* with reference to structure and reproduction (life history); Polymorphism & alternation of generation in Coelenterates; Corals and coral reefs. — 9.0

Helminthes: Salient features; Study of *Fasciola, Taenia* and *Ascaris* with reference to structure, reproduction (life-cycle) and parasitic adaptations.

UNIT-III — 9.0

Annelida: Salient features; Study of *Nereis* and *Hirudinaria* with reference to structure and reproduction; Parasitic adaptations of *Hirudinaria*; Trochphore larva and its significance.

Arthropoda: Salient features; Study of *Palaemon* and *Palamnaeus* with reference to structure and reproduction. Zoological importance of *Peripatus* and *Limulus*.

UNIT-IV

Mollusca: Salient features; Study of *Pila* and *Unio* with reference to structure, respiration and reproduction (life-history); Torsion in Gastropoda; Pearl formation — 9.0

Echinodermata: Salient features; Study of *Asterias* with reference to structure, locomotion, water vascular system,

Echinoderm larvae and their significance.

Books Recommended:

1. Barnes: Invertebrate Zoology (4th ed.), Holt-Saunders, 1980.
2. Barrington: Invertebrate Structure and Function, Nelson, 1987.
3. Iyer: A Manual of Zoology, Part I. Visawanathan, 1973.
4. Hickman, Roberts & Hickman: Integrated principles of Zoology (7th ed) Times-Mirror, Mosby, 1984.
5. Kotpal, Agrawal & Khetrapal: Modern Text-book of Zoology, Invertebrates. Rastogi, 1976.
6. Marshall & William: Text book of Zoology, Vol I (Parker & Haswell, 7th ed.) Macmillian, 1972.
7. Nigam: Biology of Non-Chordates, Nagin Chand, 1985.

B.Sc. 1st Year (Zoology)-1st Semester
Paper 2: Cell Biology and Genetics

	No. of Lectures (45 min each)
UNIT-I	
Introduction to Cell theory; Comparison of a generalised Pro- & Eukaryote cell. Elementary idea of cell fractionation; Usage of radioisotopes & antibodies in Cell biology; Light & Phase Contrast Microscopy; Elementary knowledge of the structure & function of plasma membrane.	9.0
UNIT-II	
Introduction to the organelles constituting endomembrane system (Endoplasmic reticulum, Golgi complex, Lysosome, Peroxisome). Nucleus & nucleolus; Ribosome; Mitochondria; Chloroplast. Introduction to cytoskeleton. Basic features of Cell cycle; Mitosis & Meiosis. Elemetary idea of cell transformation and cancer.	9.0
UNIT-III	
Mendel's law; Exceptions to Mendel's law. Sex-linked inheritance & genetic disorders; Physical basis of heredity. Linkage & Crossing over. Sex determination	9.0
UNIT-IV	
Chromosome structure; Euchromatin; Heterochromatin; Histones. Polytene & lampbhrush chromosomes. Fine structure of gene. Interaction of genes, Eugenesis, Immuno-genetics and cancer genetics	9.0

Books Recommended

1. Alberts et al.: Molecular Biology of the Cell, Garland Pulb., New York, 1989.
2. Sharma, V.K.: Techniques in Microscopy and Cell Biology, Tata McGraw Hill, 1991
3. Strickberger: Genetics, Prentice Hall, 1996.
4. DeRobertis & DeRobertis: Cell & Molecular Biology, 1996

28/8/18

B.Sc. ~~2nd~~ 1st Year (Zoology)-2nd Semester
Paper 3: Chordata

No. of Lectures

General characters and outline classification of Chordates. (45 min. each)

UNIT- I

Hemichordata: Classification; General organization with special reference to *Balanoglossus* and its affinities. 9.0

Urochordata: Classification; General organization with special reference to *Herdmania* and its affinities.

Cephalochordata: Classification; Generation organization with special reference *Branchiostoma* (=*Amphioxus*) and affinities. 9.0

UNIT- II

Cyclostomata: Classification; External features of *Petromyzon* and *Myxine*; Comparison between Lampreys and Hagfishes.

Pisces: Origin; General characters; and affinities. 9.0

External features, Digestive, Blood vascular, Nervous and Urinogenital system of *Scoliodon*.

Teleosts: Scales and fins of fishes, Aquatic and aerial respiratory organs, Air bladder in fishes;

Hill stream adaptations; Fish migration.

Dipnoi: Distribution; General characters; and affinities.

UNIT- III

Amphibia: Origin, Parental care, Neoteny and Paedogenesis. 9.0

Reptilia: Origin; Terrestrial Adaptations; General organization, distribution and affinities of Chelonia,

Rhynchocephalia, Ophidia and Crocodilia; Poisonous and non-poisonous snakes; Biting mechanism in snakes; Venum and antivenum.

UNIT- IV

Aves: Origin and General characters; External features, Digestive, Respiratory and Urinogenital System of *Columba*; Feathers in Birds; Adaptations for aerial mode of life; Migration in Birds. 9.0

Mammalia: Origin; General organization, distribution and affinities of Prototheria, Metatheria and Eutheria;

Aerial and aquatic adaptations in mammals; Dentition in mammals.

Books Recommended:

1. R.L. Kotpal: Modern Text-book of Zoology, Vertebrates. Rastogi Publication.
2. E.L. Jordan and P.S. Verma: Chordate Zoology. S. Chand & Co. Ltd.
3. Hildebrand: Analysis of Vertebrate structure.
4. Romer & Parsons: The Vertebrate Body, Saunders.

B.Sc. IInd Year (Zoology) - 2nd Semester

Paper 4: Taxonomy and Evolution

UNIT-I

Taxonomy: Definition & scope; relationship with Systematics — 9.0
Zoological nomenclature: Binominal & Trinominal; ICZN.
Components of classification: Linnaean hierarchy.
Concepts of species: Typological, Nomenalistic & Biological
An elementary idea of molecular taxonomy.

UNIT-II

Palaentology: Fossils & fossilization. Dating of fossils. Significance of fossil record. — 9.0
Geological distribution of animals, period of evolution and extinction of major groups.
Evolution of Horse.

UNIT- III

Lamarckism, Darwinism, Neo-Darwinism; Direct Evidences of Evolution — 9.0
Processes of Evolutionary Change: Organic variations; Isolating Mechanisms;
Natural selection (Example: Industrial melanism); Types of natural selection
(Directional, Stabilizing, Disruptive), Artificial selection

UNIT-IV

Species Concept: Biological species concept (Advantages and Limitations): — 9.0
Modes of speciation (Allopatric, Sympatric) Macro-evolutionary Principles
(example: Darwin's Finches) Mass extinction (Causes, Names of five major
extinctions), Role of extinction in evolution

Books Recommended:

1.Ashok Verma - Animal Taxonomy
2.Ernst Mayr- Principal sof Systematics
3.Simpson- Principals and Practices of Animal Taxonomy
4.V. C. Kapoor- Principals and Practices of Animal Taxonomy
5.Strickberger: Evolution, CBS Publ. 1994
6.Ridley, M. (2004). *Evolution*. III Edition. Blackwell Publishing
Barton, N. H., Briggs, D. E. G., Eisen, J. A., Goldstein, D. B. and Patel, N. H. (2007). *Evolution*. Cold Spring, Harbour Laboratory Press.
7.Hall, B. K. and Hallgrimsson, B. (2008). *Evolution*. IV Edition. Jones and Bartlett Publishers
8.Campbell, N. A. and Reece J. B. (2011). *Biology*. IX Edition, Pearson, Benjamin, Cummings.
9.Douglas, J. Futuyma (1997). *Evolutionary Biology*. Sinauer Associates.
10.Minkoff, E. (1983). *Evolutionary Biology*. Addison-Wesley.

B.Sc. 2nd Year (Zoology)- 3rd Semester

Paper-5 Animal Physiology and Endocrinology

No. of Lectures (45 min. each)

UNIT- I

Respiration: Types of respiration (cutaneous, branchial, tracheal and pulmonary) 9.0
Respiratory pigments (Haemoglobin, myoglobin, haemoerythrin, haemocyanin and chlorocruorin).
Dissociation of oxyhaemoglobin, factors affecting oxyhaemoglobin dissociation (carbon dioxide, pH and temperature)
Nutrition: Food constituents; Intracellular and Extracellular digestion.
Digestion and absorption of Carbohydrates, Lipids and Proteins.

UNIT- II

Circulation: Composition of blood and functions of blood corpuscles; 9.0
Haemopoesis; Blood coagulation; Blood groups; Types of heart (tubular, pulsative, ampullar and chambered);
Physiology of heart beat.
Excretion: Excretion of nitrogenous wastes (Ammonotelic, Uricotelic, Ureotelic and Guanotelic animals);
Structure of nephron; Physiology of urine formation.

UNIT- III

Nervous system: Types of neurons; Myelinated and non-myelinated nerve fibres. 9.0
Initiation and conduction of nerve impulse; Resting and action potential; Synapse and chemical transmission; Reflex action. Muscles: Types of muscles; Ultrastructure of skeletal muscles; Muscle proteins; Mechanism of muscle contraction;
Elementary knowledge of muscle twitch, tetanus and fatigue

UNIT – IV

Basic idea of endocrine, paracrine & autocrine secretion; Endocrine system as a 9.0
regulatory device; Role in homeostasis. Nature of hormones, transport and salient features of action (amplification, specificity, diversity,. Hormonal interactions, feedback).
Peripheral endocrine glands: Morphology of the endocrine glands (Thyroid, Parathyroid, Adrenal cortex, Adrenal Medulla, Islets of Langerhans, Testis & ovary). Chemical structure, biological actions and control of secretion of their hormones. Menstrual cycle.

Books recommended:

1. Prosser and Brown: Comparative Animal Physiology, Wiley.
2. Nielson: Animal Physiology, Cambridge.
1. Brook, C.G.D., & Marshall, N.J.: Essential Endocrinology, IV ed. Blackwell Publishing.
2. Ho'Riordan, J.L., Malan, P.G. and Gould, R.P.: Essentials of Endocrinology. Blackwell Scientific Publications
3. Laycock, J.F. and Wise, P.H.: Essential Endocrinology. Oxford University Press.
4. Hadley, M.E.: Endocrinology. Pearson Education Pvt. Ltd. Singapore.

B.Sc. 2nd Year (Zoology)- 3rd Semester
Paper-6 Biochemistry and Developmental biology

	No. of Lectures (45 min each)
UNIT- I	
Properties of water, water as biological solvent; Chemical bonds; Noncovalent bonds; Concept of free energy; Acid and Bases, pH and buffers. Carbohydrates: Biological significance, structure and classification. Lipids: Biological significance, structure and classification.	9.0
UNIT- II	
Amino acids: Significance, structure and classification. Proteins: Function and diversity; Overview of structure and conformation. Basic knowledge of metabolism of carbohydrates, lipids and proteins. Enzymes: Definition, characteristics, classification including ribozymes and Abyzymes; Mechanism of enzyme Action; Michaelis Menten Constent (Km) and V-max; Co-enzymes; Vitamins.	9.0
UNIT-III	
Gametogenesis: Events in spermatogenesis. Morphology of mature mammalian spermatozoon. Events in Oogenesis. Fertilization: Mechanism of fertilization; Molecular events. Fate Map. Elementary idea of parthenogenesis.	9.0
Types of eggs and cleavage. Role of yolk during cleavage. Products of cleavage (Morula and Blastula). Comparison of gastrulation in sea urchin, frog and chick up to the formation of three germ layers. Fate of germ layers.	9.0
UNIT-IV	
Extra Embryonic Foetal Membrane (Chick). Elementary concept of primary organizer; Induction, nature and mechanism of action. Totipotency. Teratogenesis Development of chick embryo up to 72 hours. Defferentiation and organogenesis of vertebrate eye.	9.0

Books recommended:

1. Conn and Stumpf: Outlines of Biochemistry. John Wiley.
2. Grant: Biology of Development System. Holt, Reinehart & Wilson, 1978.
3. Gilbert, Developmental Biology. 3rd ed. Sinauer, 1991.
4. Berril: Developmental Biology. McGraw-Hill. Indian ed. 1974.

B.Sc. 2nd Year (Zoology)- 4th Semester

Paper 7: Ecology and Toxicology

No. of Lectures (45 min. each)

UNIT-I

General Concepts: Definition of ecology, history and its relation to humanity. 9.0
The environment: Abiotic, biotic & edaphic factors.
Introduction to laws of limiting factors; Homeostasis & feedback.
Concept of ecosystem; Component & types (Grassland, Forest, Pond, River).
Food chain: Grazing and detritus; Food web.
Energy flow in ecosystem. Primary and secondary productivity.

UNIT-II

Biogeochemical cycles: Water, Carbon, Nitrogen and Phosphorus 9.0
Population: Definition; Biotic potential; Density, Natality, Mortality and growth curves;
Global human population growth;
Dispersion, Aggregation, Isolation and Territoriality.
Intra and inter-specific relationships.
Community: Definition & concept. Stratification; Dominance; Diversity.
Concept of habitat & niche; Ecological Succession.

UNIT-III

Pollution: Definition, Types, Sources & effect (Air, Water, Noise & Radioactive pollution). 9.0
Solid waste management; Effect of deforestation.
Environmental Laws & Acts in India.

Concept of Toxicology: Definition, purpose and scope of study. Major source of toxicants: Sewage, Industries & Agriculture field. General classification of toxicants: Industrial chemicals, carcinogenic substances, Domestic Wastes, Pesticides, Fungicides, Herbicides, etc.

UNIT-IV

Measurement of toxicity: Bioassays, LC 50 or LD 50. Determination of safe concentration, Lethal concentration. Acute vs chronic toxicity. 9.0
Dose-Response Curve: Response of test organism (fish, insects, rat, etc.) to the different doses of DDT, Detergents (soaps) & Dieldrin.
Bioaccumulation & Biomagnification of hydrocarbons, pesticides and heavy metals in animals.
Excretion of toxic substances from animal body.

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.
5. Francis, B.M.: Toxic Substances in the Environment. Somerset, NJ, Wiley & Sons1994.
6. Passivirta, J.: Chemical Ecotoxicology. Boca Raton, F.L., Lewis Publishers, 1991.
7. Hathway, D.E.; Molecular Aspects of the Toxicology. The Royal Society of Chemistry. Burlington House, London.
8. Omkar: Concept of Toxicology. Sobhan Lal Nagin Chnad & Co., Delhi

B.Sc. 2nd Year (Zoology)- 4th Semester
Paper 8: Conservation Biology and Animal Behaviour

No. of Lectures

UNIT I:

Wild life - Values of wild life - positive and negative; Our conservation ethics; Importance of conservation; Causes of depletion; World conservation strategies; Habitat analysis, Evaluation and management of wild life - Physical parameters: Topography,Geology, Soil and water. Biological Parameters: food, cover, forage, browse and cover estimation. 9.0

UNIT II:

Management of habitats - Setting back succession; Grazing logging; Mechanical treatment; Advancing the successional process; Cover construction; Preservation of general genetic diversity; National Organizations involved in wild life conservation; Wild life Legislation – Wild life Protection act - 1972, its amendments and implementation; Management planning of wild life in protected areas; 9.0

UNIT III

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. 9.0

UNIT IV

Biological rhythms. The Biological Clock. Circadian rhythms and their Synchronization seasonal rhythms. Photoperiodism. Communication: Visual, olfactory, accoustic.Chemoreception: Chemicals (pheromones) as signals in insects, fish and mammals. Hormonal Control of behaviour. Cooperation and conflict. Evolution of altruism. 9.0

Recommended Books:

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

B.Sc. 3nd Year (Zoology)- 5th Semester
Paper-9: Molecular Biology and Biotechnology

No. of Lectures
(45 min. each)

UNIT I

DNA as genetic material, Structure of DNA, Types of DNA, Replication of DNA in prokaryotes and eukaryotes: Semiconservative nature of DNA replication, Bi-directional replication, DNA polymerases, The replication complex: primosome, replisome, Rolling circle replication, Unique aspects of eukaryotic chromosome replication. 9.0

UNIT II

DNA damage and repair: causes and types of DNA damage, mechanism of DNA repair: Photoreactivation, base excision repair, nucleotide excision repair, mismatch repair, recombinational repair, nonhomologous end joining. Homologous recombination: models and mechanism. 9.0

UNIT III

RNA structure and types of RNA, Transcription in prokaryotes: Prokaryotic RNA polymerase, role of sigma factor, promoter, Initiation, elongation and termination of RNA chains Transcription in eukaryotes: Eukaryotic RNA polymerases, transcription factors, promoters, enhancers, mechanism of transcription initiation, promoter clearance and elongation RNA splicing and processing: processing of pre-mRNA: 5' cap formation, polyadenylation, splicing,rRNA and tRNA splicing. 9.0

UNIT IV

Biotechnology: Definition and scopes; Biotechnological innovations in the area of medical, agriculture, industrial and forensic sciences.
Biotechnology in India: Government organizations and human resource development. 9.0

Books recommended:

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

B.Sc. 3rd Year (Zoology)- 5th Semester

Paper-10: Microbiology and Immunology

UNIT – I

General account of different groups: Cyanobacteria, fungi, yeast, viruses. 9.0
Bacteria: Structure, classification, nutrition and reproduction.

UNIT-II

Microbiology Techniques: Media preparation, sterilization, pure culture and staining techniques. 9.0
General structure and multiplication of Viruses; General characteristics of bacteriophages.

UNIT-III

Overview of the immune system- Introduction to basic concepts in immunology, components of immune system, principles of innate and adaptive immune system; 9.0
Cells and organs of the immune system- Haematopoeisis, primary and secondary lymphoid organs.

UNIT-IV

Antigens- Basic properties of antigens, B and T cell epitopes, haptens and adjuvants; Antibodies- Structure, classes and function of antibodies, monoclonal antibodies, Structure and functions of MHC, exogenous and endogenous pathways of antigen presentation and processing; cytokines, types and functions of complement system 9.0

SUGGESTED READINGS

1. Kindt, T. J., Goldsby, R. A., Osborne, B. A., Kuby, J. (2006). VI Edition. Immunology. W.H. Freeman and Company.
2. Delves, P. J., Martin, S. J., Burton, D. R., Roitt, I.M. (2006). XI Edition. Roitt's Essential Immunology, Blackwell Publishing.
3. G. J. Tortora- Microbiology: and Introduction
4. S. C. Parija- Text book of Microbiology

B.Sc. 3rd Year (Zoology)- 6th Semester

Paper 11: Economic Zoology

	No. of Lectures (45 min. each)
UNIT I	
Elementary knowledge of sericulture, apiculture & lac culture. Integrated Pest Management (IPM).	9.0
UNIT II	
Transmission, Prevention and control of diseases: Tuberculosis, swine flu, typhoid Brief account of *Rickettsia prowazekii*, Life history and pathogenicity of *Entamoeba histolytica, Plasmodium vivax* and *rypanosoma gambiense* Life history and pathogenicity of *Schistosoma, Ancylostoma* and *Wuchereria bancrofti*	9.0
UNIT III	
Biology, Control and damage caused by *Helicoverpa armigera, Pyrilla perpusilla* and *Papilio demoleus* and *Tribolium castaneum*; Safe storage of stored grains. Life cycle, medical importance and control of *Pediculus humanus corporis, Anopheles, Culex, Aedes, Xenopsylla cheopis, Phlebotomus argentipes*	9.0
UNIT IV	
Preservation and artificial insemination in cattle;synchronization of estrus in cattle. Principles of poultry breeding, Management of breeding stock and broilers, Processing and preservation of eggs Genetic improvements in aquaculture industry; Induced breeding and transportation of fish Seed.	9.0

Books Recommended:

1. Jabde, P.V.: Text Book of Applied Zoology: Vermiculture, Apiculture, Sericulture. Lac Culture. Agricutural Pests and their Control. Discovery Publishing House.
2. Ravindranathan, K.R.: Economic Zoology. Dominant, New Delhi 2003. Vedant eBook (P) Ltd. New Delhi.
3. Shukla, G.S. & Upadhyay, V.B.: Economic Zoology. 4th Ed. 2005-06. Rastogi Publ., Meerut.
4. Sobti, R.C.: Medical Zoology. Sobhan Lal Nagin Chand & Co. Jallendhar.
5 Park, K. (2007). *Preventive and Social Medicine*. XVI Edition. B.B Publishers.
6 Arora, D. R and Arora, B. (2001). *Medical Parasitology*. II Edition. CBS Publications and Distributors.
7 Kumar and Corton. *Pathological Basis of Diseases*.
8 Atwal, A.S (1986). *Agricultural Pests of India and South East Asia*, Kalyani Publishers
9 Dennis, H. (2009). *Agricultural Entomology*. Timber Press (OR).
10 Hafez, E. S. E. (1962). *Reproduction in Farm Animals*. Lea & Fabiger Publisher
11 Dunham R.A. (2004). *Aquaculture and Fisheries Biotechnology Genetic Approaches*.CABI publications, U.K.
12 Pedigo, L.P. (2002). *Entomology and Pest Management*, Prentice Hall.

B.Sc. 3rd Year (Zoology)- 6th Semester
Paper 12: Biostatistics & Computer

UNIT-I

Biostatistics as a tool in research. 9.0
Data collection: Random & non-random sampling.
Data tabulation;
Data presentation (Graph, Frequency Polygon, Histogram, Bar diagram, 9.0
Scatter diagram).

UNIT-II

Measures of central tendency- Calculation of Mean, Mode, Median, Geometric mean, 9.0
Harmonic mean

UNIT-III

Measure of dispersion- Variability and statistics of dispersion, Range, Mean deviation, 9.0
Standerd deviation. Coefficient of variation. Standard error of means.

UNIT-IV

Capabilities and limitations of computers; Components 9.0
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 Recomanded:

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

PRACTICAL Syllabus
1ST 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: Taenia solium and Study of its life history stages
Phylum Nemathelminthes: Male and female Ascaris lumbricoides
Phylum Annelida: Aphrodite, Nereis, Pheretima, Hirudinaria
Phylum Arthropoda: Palaemon,Cancer Limulus, Palamnaeus, Scolopendra, Julus, Periplaneta, Apis
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. Different taxa/ topics may be given to different sets of students for this purpose.

B. Cell Biology and GENETICS:

1. Cell Structure and Cell Division- Prepared slides
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
Total	**50**

PRACTICAL SYLLABUS of B.Sc. 2nd SEMESTER (Zoology)

A. Chordata:

Protochordata: Balanoglossus, Herdmania, Branchiostoma, Agnatha: Petromyzon
Pisces: Sphyrna, Pristis, Torpedo, Labeo, Exocoetus, Anguilla,
Amphibia: Ichthyophis/Ureotyphlus, Salamandra, Bufo, Hyla
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. different taxa/ topics may be given to different sets of students for this purpose.

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 (chordate material)	05
4.	Record and Collection	05
5.	Viva Voice	05
6.	Sessional Marks	10
	Total	**50**

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

A. Physiology and Endocrinology

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.
5. Examination of histological section of Pituitary, Thyroid, Parathyroid, Pancreas, Adrenal, Testes, Ovary.

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

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.

Distribution of marks: Duration 4 hrs.

1.	Spotting (10) (Histology, Endocrine glands and Embryology)	20
2.	Exercise on Physiology	05
3.	Exercise on Biochemistry	05
4.	Record and Collection	05
5.	Viva Voice	05
6.	Sessional Marks	10
	Total	**50**

PRACTICAL SYLLABUS of B.Sc. 4th SEMESTER (Zoology)

A. Ecology, Toxicology and Animal Behavior

1. Models Based on different aspects of animal behavior and ecology.
2. Population study of available terrestrial and aquatic animals
3. Physico-chemical study of soil and water (pH, DO, Free CO_2, Turbidity etc)
4. Study of an ecosystem, its biotic components and food chains

B. Conservation Biology

1. Identification of flora, mammalian fauna, avian fauna, herpeto-fauna
2. Demonstration of basic equipment needed in wildlife studies use, care and maintenance
3. (Compass, Binoculars, Spotting scope, Range Finders, Global Positioning System, Various types of Cameras and lenses)
4. Familiarization and study of animal evidences in the field; Identification of animalsthrough pug marks, hoof marks, scats, pellet groups, nest, antlers etc.
5. Demonstration of different field techniques for flora and fauna
6. Parker's 2 Step and other methods for ground cover assessment, Tree canopy cover assessment, Shrub cover assessment.

Distribution of marks: Duration 4 hrs.

1.	Spotting (05) (Ecological adaptation, Wildlife, Animal behaviour)	15
2.	Exercise on Ecology/ Conservation Biology	10
3.	Exercise on Animal Behaviour	05
4.	Record and Collection	05
5.	Viva Voice	05
6.	Sessional Marks	10
	Total	**50**

PRACTICAL SYLLABUS of B.Sc. 5th SEMESTER (Zoology)

A. Molecular biology and Biotechnology:

1. Preparation of chemicals for Molecular Biology experiments.
2. Isolation of chromosomal DNA from bacterial cells.
3. Isolation of Plasmid DNA by alkaline lysis method
4. Agarose gel electrophoresis of genomic DNA & plasmid DNA
5. Preparation of restriction enzyme digests of DNA samples

B. Immunology:

1. Study of lymphoid organs (by slides or photo micrographs)
2. Different classes of antibodies
3. ABO blood group determination
4. Ouchterlony's double diffusion assay
5. Enzyme linked immunosorbent assay (DOT-ELISA)
6. Demonstration of immunoelectrophoresis

C. Microbiology:

1. Media preparation and sterilization,
2. Inoculation
3. Gram's staining.

Distribution of marks: Duration 4 hrs

1.	Exercise on Molecular Biology/Biotechnology	10
2.	Exercise on Immunology	10
3.	Exercise on Microbiology	10
4.	Record and Collection	05
5.	Viva Voice	05
6.	Sessional Marks	10
	Total	**50**

PRACTICAL SYLLABUS of B.Sc. 6th 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* and *Xenopsylla*.
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* and *Tribolium castaneum*
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**