M.Sc. Zoology

First Semester

Course No.	**Title of the Course**	**Marks :400**
I	Biosystematics & Taxonomy	60
II	Structure and Functions of Invertebrates	60
III	Insect diversity & Physiology	60
IV	Biology of Parasites	60
Practicals I-IV (20 marks each)		80
Internal Assessment (15 Marks each)		60
Attendance (5 Marks Each)		20
Total		**400 Marks**

Second Semester		**Marks: 400**
V	Cell and Molecular Biology (Common Course)	60
VI	Biostatistics and Computer Applications (common Course)	60
VII	Comparative Anatomy of Vertebrates	60
VIII	Developmental Biology	60
Practical V to VIII (20 marks each)		80
Internal Assessment (15 Marks Each)		60
Attendance (5 Marks Each)		20
Total		**400**

Third Semester		**Marks: 400**
IX	Cytogenetics & Evolution (Common Course)	60
X	Immunology and Biotechnology (Common Course)	60
XI	Applied Zoology	60
XII	General Physiology	60

Practical IX to XII (20 marks each)	80
Internal Assessment (15 Marks Each)	60
Attendance (5 Marks Each)	20
Total	**400**
Fourth Semester	**Marks 300**
XIII Biochemistry (Common Course)	60
XIV Ecology (Common Course)	60
XV Special Paper	60
Practical XIII to XV (20 marks each)	60
Internal Assessment (15 Marks Each)	45
Attendance (5 Marks Each)	15
Total	**300**
Grand Total	**1500**

Special Paper: 1. Molecular and Human Genetics 2. Biochemistry 3. Parasitology 4. Entomology 5. Molecular Physiology (A candidate shall be required to opt one specialization)

M.Sc Zoology

Semester–I

Course-I

Biosystematics and Taxonomy

1. **Definition and basic concepts of Biosystematics and taxonomy**
   - 1.1 Historical resume of systematic
   - 1.2 Stages in taxonomy
   - 1.3 Importance of taxonomy
   - 1.4 Aims and tasks of a taxonomist
2. **Treads in Biosystematics-concepts of different conventional and newer aspects**
   - 2.1 Ecotaxomony
   - 2.2 Behavioural taxonomy
   - 2.3 Cytotaxonomy
   - 2.4 Biochemical taxonomy
   - 2.5 Numerical taxonomy
3. **Dimension of speciation and species concept**
   - 3.1 Typological species concept
   - 3.2 Biological species concept
   - 3.3 Evolutionary species concept
   - 3.4 Polytypic & monotypic species, subspecies, infraspecific groups, super species and other kind of species.
4. **Concept of zoological classification**
   - 4.1 Theories of biological classification
   - 4.2 Kinds & Component of classification
   - 4.3 Phyletic Lineages
   - 4.4 Linnaean hierarchy
5. **Taxonomic collections, methods & data recording**
   - 5.1 Collecting ways and data collection
   - 5.2 Preservation of collected material and curating
   - 5.3 Methods of identification and problems encountered in identification
   - 5.4 Taxonomic characters and taxonomic keys
   - 5.5 Preparation of taxonomic publication and taxonomic paper
6. **Zoological Nomenclature**
   - 6.1 International code of Zoological Nomenclature (ICZN)
   - 6.2 Operative principles and important rules of nomenclature
   - 6.3 Important Latin words & abbreviations and Linnaean Signs
7. **Conservation of diversity- theory, achievement and future directions**

8. **Evaluation of Biodiversity indices with brief reference to Shannon-Weinner index and dominance index.**

Suggested Reading Material:

1. M.Kato.The Biology of Biodiversity. Springer.
2. E.O. Wilson, biodiversity. Academic Press, Washington.
3. G.G. Simpson, Principle of animal taxonomy. Oxford IBH Publishing company.
4. E. Mayer. Eleements of Taxonomy. Oxford IBH Publishing company.
5. E.O. Wilson. The diversity of Life (The College edition W.W. Northem & Co.
6. B.K. Tikadar. Threatened Animal of India, ZSI publication Calcutta
7. V.C. Kapoor. Theory and Practice of Animal Taxonomy. Oxford & IBH Publishing Co.
8. J.c. Avise, Molecuular Markers, Natural History and Evolution, Chapman & Hall, New York.

M.Sc. Zoology

Course-II

Semester-I

Structure and Functions of Invertebrates

1.0 Organisation of Coelom

1.1 Acoelomates
1.2 Pseudocoelomates
1.3 Coelomates; Protostomia and Deuterostoma.

2.0 **Locomotion**

2.1 Flagella and ciliary movement in Protozoa
2.2 Hydrostatic movement in Coelenterata, Annelida and Echinodermata

3.0 Nutrition and Digestion

3.1 Pattens of feeding and digestion in lower matazoa
3.2 Filterfeeding in Polychaeta Mollusca and Echinodermata
4.0 Respiration
4.1 Organs of respiration: Gills, Lungs and trachea
4.2 Respiratory pigmrnts
4.3 Mechanism of respiration

5.0 Excretion

5.1 Organs of excretion: coelom, coelomoducts, Nephridia and Malphigian tubules
5.2 Mechanism of excretion
5.3 Excretion and osmoregulation

6.0 Nervous system

6.1 Primitive nervous system: Coelenterata and Echinodermata
6.2 Advanced nervous system: Annelida, Arthropoda (Crustacea and Insecta) and Mollusca (cephalopoda)
6.3 Trends in neural evolution

7.0 Invertebrates Larvae

7.1 Larval forms of fee living invertebrates
7.2 Larval forms of parasites

7.3 Strategies and Evolutionary significance of Larval forms

8.0 Minor Phyla

8.1 Concept and significance

8.2 Organization and general characters

Suggested Books

1. Hyman, L.H. The ivertebrates. Vol. I protozoa through Ctenophora, McGraw Hill Co., New York.
2. Barrington, E.J.W. Invertebrate structure and function. Thomoes Nelson and sons Ltd. London.
3. Jagerstein, G. Evolution of Metazoan life cycle, Academic Press, New York & London.
4. Hyman, I. H. the Invertebrates. Vol. 2 Mc Graw Hill. Co., New York.
5. Hyman, L.H. The Invertebrates Vol. 8, McGraw Hall. Co., New York. & London.
6. Barnes, R.D. Invertebrate Zoology, III edition, W.b. Saunsders Co., Philadelphia
7. Russel Hunter, W.D.A biology of higher invertebrates, the Macmillan co. Ltd. London.
8. Hyman, L.H. The invertebrates smaller coelomate groups. Vol. V Mc Graw Hill Co. New York.
9. Read, C.P. Animal Parasitism. Prentice Hall Inc., New Jersey.
10. Sedddgwick, A. a. Student text book of Zoology. Vol. I, II, and III Central book Depot, Allahabad.
11. Parker, T.J. Haswell, W.A. Text book of Zoology, Macmillan co., London.

M.Sc. Zoology
Semester-I

Course-III

Insect Diversity and Physiology

1. **Insect Diversity:** An introduction to Insect classification including historical development, Basis of Insect classification; Classification of insects upto orders with focus on local examples; Newer trends in Insect taxonomy.
2. **Insect Morpohology:** Comparative morphology of head thorax, abdomen and their appendages; functional morphology of mouth parts and genitalia
3. **Anatomy and Physiology:** Anatomy and elementary physiology of the following systems of a typical Insect:
   (i) Integumentaryy system
   (ii) Digestive System
   (iii) Exeretory System
   (iv) Respiratory System
   (v) Nervous System
   (vi) Reproductive System
4. Receptors and Stridulatory organs
5. Insects growth and metamorphosis
6. Insect pheromones and Diapause
7. Insects as vectors of human diseases
8. Insects of commercial Importance and their culture; honeybees, Silkworm and Lac Insect
9. Brief idea about chemical and biological control of insect pests
10. Insects in the service of Forensic Science

Suggested Readings:

1. Chapman, R.F. 1998. The insects structure and Function. Cambridge Univ. Press, Cambridge.
2. Daly, H.V. Doyen, J.T. an Ehrlich, P.R. 1988. Introduction to insect Biology and Diversity. McGraw Hill Ltd. London.
3. Imms, A.D. 1992. A. General Text book of entomology. Chapman & Hall, London.
4. Snodgrass. R.E. 1989 Principles of Insect Morphology. Mc Graw Hill, New York.
5. Blum, M.S. 1996. Fundamentals of Insect Physiology John Willey & Sons. New York.
6. Tembhare, D.B. 1997. Modern Entomology. Himalaya Publishing House, Mumbai.
7. Mani, M.S. 1997. General Entomology Oxford & IBH Publishing Co., New Delhi
8. Srivastva, K. P. 1998. A Text Book of Applied Entomology (Vol. I & II) Kalyani Publihshers, New Delhi.

9. Nayar, K. R. Anantha krishnan, T.N. and David, B.V. 1998 General and Applied Entomoloty. Tata McGraw Hill Publishing Co. Ltd., New Delhi.
10. Wigglesworth, V.B. 1992. Principles of Insect Physiology ELBS edition.

M.Sc. Zoology

Semester-I

Course-IV

Biology of Parasites (General Course)

- Introduction Origin and Evolution of Parasitism
- Morphology, Life cycle, pathogenicity and prophylaxis of Letshmania sp; Trypanosoma sp; Plasmodium sp; Balantidium sp; Eimeria sp.
- Merphology, life cycle, pathogenicity and prophylaxis of Trematode parasites;
- Fasciola sp.; Fasciolopsis sp; Dicrocoelium sp.; Paragonimus sp.;
- Schistomoma spp.; Fasciolopsis sp; Clonorchis sp; Dicrocoelium sp.; Paragonimus sp.; Schistosoma spp.; Polystoma sp.
- Mcrphology, life cycle, pathogenicity & prophylaxis of cestode parasites; Diphyllobothrium sp; Echinococcus sp; Hymenolepls sp; Dipylidium sp.
- Morphology, life cycle, pathgenicity and prophylaxis of Nematode parasites;
- Ascaris sp.; Trichinella sp.; Enterobius sp.; Stronglyoides sp.; Necator sp.;
- Ancylostomia sp.; Wuchereria sp.
- Morphology and life cycle of Acanthocephalan parasite; Macracanthorhynchus sp.

Suggested Reading

1. Cheng, T.C. General parasitology Academic Press, Inc. (1986)
2. Noble, E.R. and Noble, G.A: Parasitology, The biology of Animal parasites Lea and Fabiger
3. Andeson, D.R.: Comparative Protozoology, Cambridge Uni. Press.
4. Chandler, A.C. and Read, C.P.; Introduction of Parasitology, Willy Eastern,
5. Belding, D.A. A text book of Prasitology, Meredith pub. Co.
6. Baker, J.R. Parasitic Protozoa, Academic Press
7. Grell, K.G. Protozoology, Springer Verlag

Semester-II

Course-V

Cell and Molecular Biology (Common Course)

1. **Structural organization of Plant and animal Cell:**

(i) Cell wall: structure, function and biogenesis

(ii) Plasma membrane; structure, models, functions, sites for ATPases,ion carriers, channels and pumps

(iii) Plasmodesmata: structure, role in movement of molecules, camparison with gap junctions.

(iv) Plant vacuole: Tonoplast membrance, ATPases as storgaeg, organelle

(v) Structure and fuctions of microbodies: Golgi apparatus, lysosomes, endoplasmic reticul lum

2. Chloroplast and mitochondria: Structure, genome organization, gene expression, nucleochloroplastic interactions, biogenesis of mitochondria
3. Nucleus: structure, nuclear pores, nucleosome organization, nucleolus
4. The cytoskeleton: Organization and role of microtubules and microfilaments, motor movements implications in flagellar and other movements.
5. Cell cyle and apoptosis: Control mechanisms, role of cyclins, cyclin-dependent kinases, cytokinesis and cell plate formation, mechanisms of programmed cell death
6. Gene expression:

(i) DNA structure; A, B, and Z forms; replication, damage and repair

(ii) Transcription, promoters and transcription factors, splicing, mRNA transport, rRNA biosynthesis, differences in propkaryotes and eukaryotes

(iii) Translation; structure of ribosome, mechanism of translation initation, elongation and termination, structure and role of tRNA

7. Regulation of gene expression in prokaryotes and eukaryotes
8. Protein sorting: Targeting of proteins to organelles

Suggested Readings:

Lewin, B. 2000. Genes VII Oxford University, Press, New York

Alberts, B. Bray, D., Lewis, J. Raff, M., Roberts, K. and Watson, J.D. 1999, Molecular biology of the cell. Garland Publishing, Inc. New York.

Wolfe, S.L. 1993, Gruissem, W. and Jones, R.L. 2000, Biochemistry and molecular biology of plants, American society of plant physiologists, Maryland, USA

Frifelder, D. Molecular Biology. John and Bartlett Publishers, inc., Boston, USA

Course VI: Biostatistics and Computer Applications: (Common Course)

1. Brief description and tabulation of data and its graphical representation.
2. Measures of central tendency and dispersion: mean, median, range, standard deviation and variance. Correlation and simple linear regression.
3. Sampling: Sampling Techniques, sampling errors, framing Hypothesis, level of significance, tests of significance (F & t test), chi-square test
4. Introduction of digital computers: Organization; law-level and high –level languages, binary number system.
5. Flow charts and programming techniques.
6. Introduction to programming in Q basic.
7. Introduction to data structures and database concepts; introduction to internet and its applications.
8. Introduction to MS OFFICE software, covering word processing, spreadsheets and presentation software
9. Computer Oriented statistical techniques.
10. Frequency table of single discrete variable, computation of mean, variance and standard deviation, t-test correlation coefficient.
11. Bio-informatics.

M.Sc. Zoology

SEMESTER-II

Course-VII

Comparative Anatomy of Vertebrates

1.0 Origin of Chordata and Vertebrate Morphology

1.1 Concept of Protochordata

1.2 Definition, scope and relations to other discipline

1.3 Importance of the study of vertebrate morphology

2.0 Origin and Classification of Vertebrates

3.0 Vertebrate Integument and its Derivatives

3.1 Development, general structure and functions of skin and its derivatives

3.2 Glangs scales, horns, claws, nails, hoofs, feathers and hairs

4.0 Digestive System

4.1 General structure & Functions of Digestive System

4.2 Comparative anatomy of alimentary canal in vertebrates

5.0 Circulatory System

5.1 Blood

5.2 Evolution of heart

5.3 Evolution of aortic arches

6.0 Respiratory System

6.1 Characters of respiratory tissue

6.2 Internal and external respiratory tissue

6.3 Comparative account of respiratory organs

7.0 Skeletal System

7.1 Form function, body size and skeletal elements of the body

7.2 Comparative account of jaw suspesnsorium & vertebral column

7.3 Limbs and girdles

8.0 Evolution of Urinogemital system in vertebrate series

9.0 Sense organs

9.1 Simple receptors

9.2 Organs of olfaction and taste

9.3 Lateral line system

9.4 Elecroception

10.0 Nervous system:

10.1 Comparative anatomy of the brain in relation to its functions

10.2 Comparative anatomy of spinal cord

10.3 Nerves-Cranial, Peripheral and autonomous nervous systems

11.0 **General Topics**

11.1 Origin of birds

11.2 Migration of birds and fishes

11.3 Extinct reptiles

11.4 Evolutionary Histories, of Horse, Camel, elephant and man.

Suggested books:

1. Alexandar, P.M. The ctorol ddata Cambridge University Press London
2. Bamington, E.J.W. The biology of Hemichordata and Protochordata. Oliver and Boyd, Edinbourgh.
3. Boume, G.H. The structure and functiosn of nervous tissue. Academic Press, New York and London.
4. Center, G.S. Structuer and habit in vertebrate evolution-Sedgwick and Jackson, London.
5. Kent, G.c. Compatative anatomy of vertibrates
6. Monielli, A.r. the chordates. Casmbridge university Press, London.
7. Smith, H.S. Evolution of chordate structure. Hold Rinehart and Winstoin Inc. New York.
8. Waters, H.E. and Sayles, L.D. biology of vertebrates. Mac Millan & Co., New York.
9. Weichert, C.K. and Preesch, W. Elements of chordate anatomy, 4th Edn. Mc. Graw Hall Book Co., New York.
10. Montagna, W. Comparative anatomy, Jophn Wiley and Sons Inc.

M.Sc Zoology

Semester –II

Course: VIII

Developmental Biology

1. Introduction development Biology

1.1.`Scope, Science of developmental biology and its applications

1.2. Developmental patterns in metazoan.

2.0 Germ Cell

2.1 Germ cell migration in amphibian, birds and mammals.

2.2 Differentiation of germ cells into sperm or egg.

3.0 Spermatogensis

3.1 A detailed study of the process in mammal, Gene expression during sperm development.

4.0 Oogenesls

4.1 Oogenic meiosis

4.2 Maturation of oocyte in amphibian

4.3 Role of progesterone in oogenesis

4.4. Gene transcription in oocye

4.5 Vitellogenesis

5.0 Fertilization

5.1 Contact recognition between sperm and egg

5.2 Acrosomal reaction

5.3 Gemeta bindings and fusion (roleof egg membranes)

5.4 Activatinof egg.

6.0 Creation of Multicellularity

6.1 Cleavage characteristics

6.2 Patterns of cleavage (Radial holoblastic, bilateral holoblastic, spiral holoblasric, Rotational holoblastic and meroblastic)

6.3 Casulation in amphibian (Frog and chick)

6.4 Concept of fate maps (Chick, frog)

7.0 Organizers and induction

7.1 Primary embryonic induction

7.2 Regional specificity of induction

7.3 Molecular mechanism of primary embryonic induction

7.4 Molecular nature of organizers (I to VI)

8.0 Early vertebrate development

8.1 Neuralation and development of ectoderm

8.2 Organization of mesoderm and endoderm

9.0 Differentition

9.1 Cell commitment and differentiation

9.2 Chemical basis of differentiation

10.0 Organogenesis

10.1 Development of redumentary organs in amphibian and mammal

10.2 Cellular interactions during the development of limb, brain, eye, heart and liver

11.0 Placenta

11.1 Development of placenta, different types

11.2. Placental normones and their functions/ importance

12.0 Multiple ovulation and Embryo transfer technology

12.1 Supovulation

In-vitro fertilization

12.3. In Vitro oocyte maturation

12.4 Cryopreservation

12.5 Embryo transfer technology

Books Recommended:

1. Reproduction I animals by Austen and short
2. Molecular Biology of Development by Scott. F. Gilbert
3. Human Reproduction by R. G. Edwards
4. Introduction to Embryology by Balisnsky
5. Molecular Biology of Fertilization byy Schatten and Schatten.

M.Sc Botany/Zoology

Semester-III

Course-IX

Cytogenetics & Evolution (Common Course)

1. Chromosome Organization:

1.1.Structuer of chromosomes, DNA packaging and DNA replication

1.2. Metaphase chromosomes, centromere, kinetochore, telomere and its importance

1.3.Heterochromatin and euchromatin

1.4.Chromosome banding

1.5.Polytene and lampbgrush chromosomes

2. Sex chromosomes, sex determination and dosage compensation in Drosophila and human
3. Mendelian and non-Mendelian Inheritance:
   - 3.1 Mendelian inheritance and its modification
   - 3.2 Maternal effect
   - 3.3 Epigenetic inheritance
   - 3.4 Extranuclear inheritance
4. Veriationin cbromosome structure and number
5. Brief description of gene expression:

5.1 Genetic code

5.2 Transcription and translation

5.3 Regulation of gene expression

6. Gene mutation and DNA repair:

6.1 Consequences of mutations

6.2 Occurrence and causes of gene mutation

6.3 DNA repair

7. Quantitative genetics:

7.1 Quantitative traits

7.2 Polygenic inheritance

7.3 Heritability

8. Population genetics and evolution

8.1 Genes in populations

8.2 The Hardy-Weinberg Equilibrium

8.3 Factors that change allele frequencies in populations :a) Mutations, b) Migration, c) Natural selection, d) Random genetic draft and e) Genetic load.

9. Origin and evolution of species

9.1 Biological species concept

9.2 Anagenesis and cladogensis

9.3 Allopatric, parapatric and sympatric speciation

9.4 Gradualism and pubctuated equilibrium
9.5 Neo-Darwinism
9.6 The shifting-balance Theory of Evolution
10. Molecular evolution:
10.1 Experimental approaches used to compare species at molecular leave
10.2 Phylogenetic trees
10.3 Molecular drive-a cohesivie mode of species evolution
10.4 Neutral theory of molecular evolution

Suggested Readings:

1. Gardner, E.J.; Simmon, M.J. and Snustad, D.P. Principles of Genetics, John wiley & Sons, inc. NY
2. Weaver, R.F. and Hedrick, P.W. Genetics. Wm C. Brown Publishers.
3. Brown, T.a. Genetics- A Molecular, Approach, Chapman & Hall.
4. Mitra, S. Genetics-A Blueprint of life, Tata McGraw Hill
5. Dobzhansky, Th. Genetics and Origin of Species. Columbia University Press.
6. Dobzhansky, Th; Ayala, F.J.; Stebbins, G.L. and Valentine, J.M. Evolution, Surjeet Publihsers, Delhi.
7. Futuyama, D.J. Evolutinary Biology, Suinuaer Associations. INC Publishers. Dunderand.
8. King, M. Species, Evolution –The role of chromosomal change. The Cambridge University Press, Cambridge.
9. Merrel, D.J. Evolution and Genetics Holt. Rinchart and Winston, Inc.
10. Strikberger, M.W. Evolution Jones and Barlett Publishers. Boston London.

Semester-III

Course-X: Immunology and Biotechnology: (Common Course) Immunology:

Introduction to immunology

Innate and acquired immunity, characteristics of immune response, humoral and cellular immunity benefits and damaging effects of immunology.

Cell and tissues of immune system:

Cells of immune system, primary and secondary loymphoid organs.

Antigens:

Immunogenes, major cleasses of antigens, physical and chemical properties of antigens.

Immunoglobulins:

Structure and functions of immunoglobulins, classes and subclasses of human immunoglobulins, polymorphism, primary and secondary immune response.

Complement system:

Complement proteins, pathways of complement activation

Antien-antibody reactions:

Precipitation, agglntination immune fluorescence, radio immunoassay

ELIS A, immunobleting.

Monogleral antibodies:

Hybridoma, isolation and characterization of monoclonal antibodies

Hypersensitivity

Anaphylaxis, antibody-mediated cytotoxic and immune complex reactions, delayed-type hypersensitivity

Biotechnology:

Biotechnology: scope significance, nicrobes and microbial systems and their improvement for biotechnological use.

Principles and techniques of plant and animal cell culture.

Principles and applicatiosn of DNA recombinant technology to agricultural and human diseases. Aims, strategies for development of transgenics (with suitable examples), intellectual property rights, possible econolgical risks and ethical concerns. Construction of genomic/c DNA libraries, PCR and DNA finger printing.

Fermentation technology, design, process , scale up and down stream processing, production of antibiotics, boverages, enzymes, Ethanol and methane from biomass; bioremediantion, biopesticides and biosensors, single cell protein.

Suggested Reading:

1. Immunology by Janis Kuby
2. Immunology by J.P. Bellanti.
3. Fundamentals of Immunology by W.E. Paul
4. Essential Immunology by J.M. Roitt
5. Immunology by E.S. Golub
6. Immunology by E. Benjamini, R. Coico and G. Sunshine
7. Walker, J.M. and Gungold, E.B. (eds) Molecular biology and Biotechnology, Royal Society of Chemistry, Cambridge, 1990.
8. Maniaties. T.N. Fritsch, E.F. and Sembroook, t. Molecular Cloning. A Laboratory Mannual, cold spring Herber, New York. 1990
9. Domain, A.L. and Solomon, N.A. (eds), Mannual of Industrial , Microbiology and Biotechnology, American society of microbiology Washington, 1986.
10. Prtimrose, S.B. Molecular Biotechnology (second Edition), Blackwell Scientific Publications, Oxford, 1991.
11. Kumar H.D. A text book on Biotechnology, affiliated East West Press Pvt. Ltd., New Delhi, 1993.

Semester –III

Course-XI

Applied Zoology

1. **Sericulture**

Silkworm and its strains, rearing of silkworms, sericulture and its components, silk reeling Pests, and diseases of silkmoth. Byproducts of sericulture, Non-mulberry sericulture-Tassar, Muga and Ericulture: Sericulture industry in India.

2. **Apiculture:**

The honeybees; Apicultural practices: Have products, Bee pasturage, apiculture and crop pollination; Beekeeping and pesticides; Enemies and diseases of honeybees.Beekeeping industry in India and its future.

3. **Pest Control**

Principles and practices of pest control. Methods of pest control-Chemical Biological, Microbial, Integrated control. Corganochlorine, Insecticides, Organisphosophorus insecticides, Carbamates, Acaricides, Nematicides, Rodenticides, Molluscicides and Botanical pesticides. Pheromonal and Hormonal control. Chemosterilants and genetic control.

4. **Crop Pests and their Management**

Biology and control of following insect pests of agricultural importance: Termites, Rice weevils, castor hairy caterpillar, codling moth, mango mealy bug, Cotton white fly, citrus psylla and cabbage Caterpillar. Biology and control of some important Phytoparastic nematodes: Anguina, Xiphinema sp Meloidogyne sp & Heterodera sp.

5. **Medical Zoology**

Systematics, biology and control of following medically important organisms. Trichomonas, Trichuris, Onchocerca, Cyclops, sarcoptes, Dermacentor, Phlebotmus, Glossina, Blowfly, Gadfly.

Mode of transmissionand brief epidemonolgy of some important diseases. Cholera, Typhus, small pox, plague, Malaria, Dengue fever, Filariasis & AIDS

6. **Vaccination: Immunization; different types of vaccines; Current status of malarial vaccine.**
7. **Wild Life Management**

Objective of wild life conservation and conservation strategies; Extinction of wild species meaning and cause; Wile life protection in India and classification of threatened species, protected wild animals, protected areas and their management in India Endangered fauna and special projects for endangered species.

8. Pisciculture

Monocultuer and composite culture Fresh water, & marine fisheries, induced breeding & its technique in pisciculture; Haps & ponds for fish culture and their management; Fish enemies and their control; fish diseases and their control; Importance of fish culture and fishing gears

9. Metabolic and Muscular disorders

Metabolic disorder with regard to major food stuffs absorption

Types of myopathies (congenital, metabolic, endocrine, toxic and inflammatory) Painful muscle syndromes (mechanical, chemical syndromes, ischaemia, focal muscle pain, diffuse Shulam's synorme cramps, contracture, myotonia). Principle of management and drug treatment.

Suggested Books

1. Jhingran, V.G. 1995. Fish and Fisheries of India, Hindustan Publ. Corp., New Delhi.
2. Lagler, K.F. Bardach, J.E. Miller, R.R. and Pasina, D.R. M. 1987. Inohthology John Wiley and Sons, New York.
3. Deshmann, R. F. 1992. Wild life biology. Wiley Eastern Publisher, New Delhi.
4. Sharia, V.B. 1995. Wildlife in India. Natral Publisher, Dehradun.
5. Verman, L.R. 19990 Beekeeping in integrated mountain development. Oxford & IBH Publ. Co., New Delhi.
6. Stine, K.E and Brown, T. M. 1996. Principles of Toxicology. Lewis Publishers London.
7. Atwal, A. S. 2000, Essentials. Of beekeeping & Pollination. Kalyani Publ. New Delhi.
8. Hassal, A.K. 1990. The Biochemistry and uses of Pesticides EELBS Editions
9. Atwal, A.S. and Dhaliwal G.S. 1997. Agriculture pests of South Asia and their management. Kalyani Publishers New Delhi.
10. Aruga, H. 1998. Principles of S ericulture. Oxford & IBH Publishing Co. New Delhi.
11. Harper, Physiological Chemistry
12. Karpati, G. Jones. D.H. and Griggs, R. c. Disorders of voluntary muscle, 7th edition. Cambridge Univ. Press.

Semester-III

Course-XII

General Physiology

1. Nutrition and digestion

1.1. Digestion and absorption of proteins, fats and carbohydrates

1.2.Vitamins, minerals and their role

1.3.Coordination and control of digestion

2. Body fluids

2.1 Structure and functions of bloods vessels

2.2 Pressure, blood flow, resistance and interrelationship

2.3 Vascular distensibility and vascular compliance

2.4 Different types of body fluids, their importance and regulation

3. Respiration

3.1 Transport of O2 and CO2

3.2 Distribution and physiology of respiratory pigments

3.3. Carbon monoxide poisoning

3.4 Buffer systems (Bicarbonate buffer system, phosphate buffer system, Protein buffer system

3.5 Respiratory regulation of acid base balance

3.6 Respiratory Quotient

4. 0 Recreation

4.1 Functional anatomy of mammalian kidney and its renal unit

4.2. Ultrafilteration, absorptionand secretion mechanisms in urine formation

4.3 Role of antidiuretic hormone and aldosterone

4.4. Kidney in acid base balance

5.0 Muscle System

5.1 Ultrastructure of a skeletal muscle

5.2 Differences between skeletal, cardiao and smooth muscle

5.3 Mechanism of contraction of skeletal muscle

5.4 Biochemistry of actomyosin ATPase reaction

6. Endocrine System

6.1 Structural and functional organization of pituitary gland

6.2 Hormones secreted by thyroid, parathyroid, adrenal gland, pancreas and their functions.

6.3 Feedback inhibition

6.4 Hormonal regulation of mineral and electrolye concentration

6.5 Hormones and metabolism

7.0 Reproductive physiology

7.1 Histophysiology of mammalian gonads (Testis, Ovary)

7.2 Hormones secreted by gonads

8. Receptor Physiology

8.1 Mechanoreception

8.2 Photoreception

8.3 Phonoreception

8.4 Chemoreception

8.5 Equilibrium reception

9. Environmental Physiology

9.1 Basic concept of stress and strain

9.2 Adaptation, acclimation and acclimatization

9.3 Physiological adaptation to osmotic and ionic stress

9.4 Adaptation to high altitude and deep diving

Suggested Books

1. Ruegg, J.C., Calcium in muscle activation, Springer Verlag Berlin Heidelberg, New York.

2. Hoar, W.S. General and comparative physiology, Prentice, Hall Inc./England Wood cliffs, New Jersey.
3. Guyton, A.C. and Hall, J.E.; Text book of medical physiology, 10th Ed, Saunders, Harcourt, India.
4. Heilmeyer, L.M.G. Cellular regulation of protein phosphorylation, springer-verlag, Berlian Heidelberg, New York.
5. Prosser, C.L. and Brown, F.A. comparative Animal Physiology 2nd Ed. W.B. Sunders, Philadelplina.
6. Karpati, G., Jones, D.H. and Griggs. R.C. Disorders of Voluntary Muscle, 7th Edn, Cambridge University Press.
7. Turner, C.D. General Endocrinology, 4th Ed. W.B. Saunders, Philadelphia London.
8. Prosser, C.L., Comparative Animal Physiology, W.B. Saunders, Toppen Publication.

IV Semester

Course XIII

Biochemistry (Common Course)

1. A review of laws of thermodynamics, redox potentials
2. Carbohydrate-classification, occurrence, structure and function of monosaccharides, oligosachharides.
3. Lipids-classification, occurrence structure and importance of acyl lipids and phosphates, biosynthesis of fatty acids, B-oxidation and role of polyunsaturated fatty acids.
4. Outlines of Nitrogen fixation, symbiotic and non-symbiotic
5. Amino acids, peptides and proteins. Occurrence, structure and function of amino acids, stereoisomers synthesis of amino acids by reductive amination, GS-GOGAT system transmination classification of proteins according to solubility, structure and function of proteins. Conjugate proteins, lectins and their importance, protein synthesis, transcription, translation degradation and protein folding.
6. Protein-ligand, protein protein, nucleic acid protein and nucleic acid-ligand interactions, Enzymes-classification, mode of action . Enzyme kineties ()Michaelis Menten Constant), Enzyme inhibition. Coenzymes, cofactors, Ribozymes.
7. Nucleic acid bases-their structure structure, and function of DNA, genetic code, different kinds of RNA and their origin. Role in protein, synthesis and in revers transcription DNA polymorphism
8. Biosyt nthesis and functions of secondary metabolites phenolics, flabonids, terpenoids.
9. Alkalods and steroids, suberins
10. Importance of Acetyl Co. A and Shikimic acid in intermediary metabolism
11. Chemical foundations of biology e.g. pH acids, bases, fubbbers, weak bonds, free energy, resonance, isomerisation etc.

Suggested Readings:

1. Zubay, G. 1988, biochemistry (2^{nd} ed), Macmillan Publ. House N.Y.
2. Mahler, H.R. and codes F.H. 1971. Biological chemistry, Harper International.
3. Lehinger. A.L. 1978, Biochemistry Kalyani Publishers, Ludhiana
4. Goodwin T.W.a dn Meriar L.E.I. 1989 Introductory plant Biochemistry pergamon Press VY.
5. Conn, E.E. and Shimpap, P.K. 1976. Outlines of Biochemistry Wiley Eastern
6. Styer, Biochemistry.
7. Freifelder Molecular Biochemistry.

M.Sc. Botany/Zoology

Semester-IV

Course-XIV

Ecology (Common Course)

1. Climate, Soil and Vegetation patterns and organization: Life zones, major biomes, vegetation, soil types, concepts of community, ecological succession.
2. Ecosystem organization: Structure and Functions, primary production, energy dynamics, litter fall and decomposition, global biogeochemical cycles, mineral cycles in terrestrial and aquatic ecosystems.
3. Population growth and dynamics: Models of population growth (Stochastic and time lag), Reproduction strategies, mating preference spacing systems r and k selection, case studies in population dynamics.
4. Predation: Predator-Prey interaction, Host parasite interaction, Role of predation in nature.
5. Competition and Mutualism: Types and theories of competition, commensalism and mutualism, Plant-Pollinator and animal-animal interactions, Niche theory.
6. Biological diversity: concepts and levels, role of biodiversity in ecosystem functions and stability, speciation and ----- categories of threat, distribution and global patterns, Terrestial biodiversity hot spots.
7. Environmental pollution: types, Sources effects on plant and animal ecosystems Greenhouse gases, Ozone layer and ozone hole, consequences of climatic changes.
8. Ecological management: concepts, sustainable development, sustainability indicators, degraded ecosystems and their regeneration with special reference to waste lands, forests and aquatic ecosystems.

Suggested Reading

1. Begon and Mortimer: Population Ecology
2. Horace and Quick: Population Ecology
3. Elseth, G.D.: Population Biology
4. Thomas C.E. Population Biology
5. Krebs C.J.: Ecological Methodology
6. Slanden & Bang: Biology of Populations
7. Hillary S.E. Ecology 2000
8. Merrit Emlern J. An evolutioinary approach Brewer Principles of Ecollgy Price P.W: Slobodchikoff and Gand W.S.: A new Ecology Odum: Fundamentals of Ecology H.D. Kumar –General Ecology 1997, J.Merritt Emlen: Ecology -1973.

M.Sc. Zoology (IV Semester)

Molecular and Human Genetics

Course-XV)

Special Paper

Molecular Genetics

1. Basic of genetic analysis:

1.1 Terminology
1.2 Mutants and revertants
1.3 Uses of mutants
1.4 Genetic analysis of mutants
1.5 Site directed mutagenesis

2. Genome analysis:

2.1 Cytogenetic mapping
2.2 Genetic linkage mapping using molecular markers
2.3 Physical mapping

3. Recombination and transposition at molecular level:

3.1 Sister chromatid exchanges and homologous recombination
3.2 Site specific recombination
3.3 Transposition

4. Computer analysis of genetic sequences:

4.1 General concepts in sequence analysis
4.2 Identification of functional sequences
4.3 Homology
4.4 Structure prediction

5. Recombination DNA and genetic engineering:

5.1 Gene cloning
5.2 Detection of genes and gene products
5.3 Analysis of alteration of DNA sequences
5.4 Uses of microganisms in biotochology
5.5 New methods for genetically manipulating plants and animals
5.6 Applications of transgenic plants and animals
5.7 Gene therapy
5.8 DNA fingerprinting

HUMAN GENETICS

6. Human population genetics:

6.1 Polymorphic nature of human proteins

6.2 Biology of human races
6.3 Mutation and human diversity
6.4 Determination of mutation rates
7. Prenatal diagnosis and genetic counseling:
7.1 Prenatal diagnosis of birth defects
7.2 Uses of amniocentesis
7.3 Ultrasonography
7.4 Prenatal diagnosis by DNA analysis
7.5 Chorion-villi sampling
7.6 Genetic counseling
8. Human immunogenetics:
8.1 Immunological reactions
8.2 Immunoglobin genes and structure of immunoglobins
8.3 Generation of antibody diversity
8.4 Human leucocyte antigens
8.5 Treatment of autoimmune diseases
8.6 Allergy and applied immunology
8.7 Blood and antigens
8.8 Transplantation antigens
9. Genetic basis of cancer:
9.1 Transformed cells
9.2 Oncogenes
9.3 Carcinogens
9.4 Teratoma and teratocarcinomas
9.5 Cancer therapy

Suggested Reading:

1. Atherly, A.G. Girton, J.R. and Mc Donald, J.F., The Science of Genetics. College, Publishing, Harcourt Brace College, Publishers. NY.
2. Watson, J.D.; Hopkins; N.H.; Roberts, J.W.; Steitz, J.A. and Weiner, A.M. Biology of Genes, The Benjamin/Cummings Publishing Company Inc. Tokya
3. Griffiths, A.J.F., Gelbart, W.M.; Miller, J.H.; Lewontin, R.C. and Modern Genetic Analysis. W.H. Freeman and Company, New York.
4. Brooker, R.J. Genetics: Analysis and Principles. Benjamin/Cumming, Longman Inc.
5. Manage, E.J. and manage, A.P. Basic Human Genetics. Sinauer, Associates, Inc.
6. Hartl, Daniel L. Human genetics. Harper and Row
7. Rothwell, N.V. Human Genetics. Prentice-Hall.
8. Winchester, A.M. heredity, Evolution and Humankind. West Publishing Company.

M.Sc Zoology

Course-XV

Semester-IV

Biochemistry (Special Paper)

THERMODYNAMICS

1.1 Application of the first and second law of thermodynamics in understanding energies in the living cells.

CARBOHYDRATES

2.1 Chemistry of animon sugars and sialic acids. Structure and function of glycoprotein, Proteoglycans, mucopolysaccharides, bacterial cell sugar compounds and storage polysaccharides.

2.2. Intermediatiary metabolism, multiple enzyme systems and experimental approaches to the study of metabolism.

2.3 Glycolysis Kerb cycle, anaplerotic and amphibolic nature of Kreb cyle, Regulation of Glyoxalate pathway.

2.4 Glycolysis, Gycogenolysis and their regulation

2.5 Pentose phosphate pathway and its regulation.

2.6. Gluconeogenesis, Gucogenesis, Glycogenesis, and synthesis of oligosaccharides, and Mucopolysaccharides.

LIPIDS:

3.1 General structure and functions of acylglycerols, phosphoglycerides, Sphingolipides, waxes. steroids and prostaglandin

3.2 Lipid micelles structure of vitamins ADK, steroids and their derivatives

3.3 Formaiotn of Ketone bodies and their regulation

3.4 Biosynthesis of triacylglycerols, Phosphoglycerides, sphingomyelin, prostaglandin's glycolipids and steroids

PROTEINS

4.1 Regulation of amino acid biosynthesis

4.2 Protein splicing and folding

4.3 Post-transnational modification and protein targeting

ENZYMES

5.1 Nomenclature of enzymes

5.2 Assay of enzymes, various methods employed in enzyme assays, enzyme activity specific activity and turn over number for enzymes

5.3 Enzyme catalytic efficiency

5.4 Graphical methods for determination of Km. and Vmax. Types of enzyme inhibition.

NUCLEIC ACIDS

6.1 Degradation and synthesis of purine and pyrimidine nucleotides and their regulation

6.2 Salvage pathway for purine

6.3 Proteins-nucleic acid interaction

6.4 Post-transcriptional modification

6.5 Onogenes

NUTRITION

7.1 Scope and methodology of nutrition as science, energy metabolism
7.2 Food energy carbohydrates, fat proteins, individual nutrients, vitamins and minerals with special reference to:
7.2.1 Distribution in body and biochemical role
7.2.2 Amount in ordinary food
7.2.3 Digestion, absorption, storage and utilization
7.2.4 Requirements and recommended allowances
7.2.5 Effect of deficiency and excess
7.3 Formulation of balanced diet and nutritional adaptation

Suggested Books

1. Zubay, G. 1988. Biochemistry, Macmillion publication
2. Strayer, L, Biochemistry (Freeman)
3. Molecular Biology of the Cell, B. Alberts, D. Bray, J. Lewis, M.Raff et.al. (Garland publication New York).
4. T.E. Creighton. Peroteins: Structure and molecular properties. W.H. Freeman, New York.

5. Davidson, S. et.al. 1975. Human Nutrition and Dietetius.

M.Sc Zoology

Course-XV

Semester-IV

PARASITOLOGY (Special Course)

1. **Parasitic Protozoa**
   - i) Locomotion
   - ii) Nutrition
   - iii) Economic importance of Parasitic Protozoa
2. Trematodes
   - i) Ultrastructure of Tegument
   - ii) Cercaria of Digenea
   - iii) Life Cycles in Digenea
3. Cestodes
   - i) Ultrastructure of Tegumnt
   - ii) Adhesive organs
   - iii) Larval forms and variations in life cycles
4. Nematodes
   - i) Ultrastructure of Tegument
   - ii) Comparative anatomy of Digestive systems
   - iii) Protein, Lipid and Carbohydrate metabolism in Nematodes
   - iv) Infective stages and variations in life cycles
5. Parasite Transmission
   - i) Mechanism for location, Circadian rhythm, penetration into host
   - ii) Chemotherapy of commonly used anthelminthic
   - iii) Nutrition in helminthes, uptake and digestion

Suggested Reading

1. Cheng, T.C. General Parasitology Academic Press, Inc. (1986)
2. Noble E.R. and Noble, G.A. Parasitology, The biology of Animal parasites Lea and Fabigor.
3. Arderson D.R. comparative Protozology, Cambridge Uni. Press.
4. Chandler. A.C. and Read, C.P: Introduction of Parasitological, Willy, Eastern.
5. Belding, D.A. A text book of Parasitological, Meredith Publ. Co.

6. Bager, J.R. Parasitic Protozoa, Academic Press.
7. Grell. K.G. Protozoology, Springer Verlag.
8. Maggenti A:" General Nematology, Springer Verlag.
9. Erasumus D.A: The biology of Treamatodes, Edward Arnold (Publc) Ltd.
10. Dawes Ben: The Trematodes, Cambridge University Press
11. Wardle R.A. & Mc Leod J.A: The Zoology of Tapeworms, Hafner Publs. Co.,
12. Cox F" E.G. Moder Parasitology- A Text book of Parasitology, Blackwell Scientific Publ.
13. Chappel L.H.: Physiology of Parasites, Blakie
14. Croll N.A. & Mathews B.F: Biology of Nematodes, Blakie
15. Lee D. C. 7 Atkinson J.J: Physiology of Nematodes, The Macmillan Press Ltd.
16. Smyth J.D. & Mcmannus D.P: The Physiology and Biochemistry of Cestodes.

M.Sc. Zoology

Semester-IV

Course –XV

Entomology (Special Paper)

1. **Agricultural Entomology**

Biology and control of following insect pests of Agricultural importance: Sanjose scale, Woolly apple aphid, Rice stem borer, Maize, borer, Diamond back moth, Mustard aphid, Mango-hoppers, Melon fruit fly, Potato cutworm, Potato, tubermoth, Sugarcan borers, Pink boll worm fo cotton, Cotton Jassid, Citrus caterpillar, rice weevil, Khapra beetls, Lesser grain borer, Angoumois grain moth, Locusts.

2. **Insect Control and Toxicology**

Basic principles and types of insect control: cultural ,physical, mechanical, biological and chemical control. Mode of action of insecticides: inorganic insecticides; botanical pesticides and synthetic orgainic insecticides. Physiology of insecticidal resistance. Insecticides and environmental pollution.

Newer methods of insect control including genetic methods. Uses of chemosterilants, radiations, hormones and pheromones in insect control. Principles and practices of integrated pest management Microbial control.

3. **Medical Entomology**

Insects as vectors of human diseases. Mode of transmission and epidemiology of major vector borne diseases-malaria, yellow fever, encephalitis, kalazar, plague, typhus, leishmaniasis, filiariasis. Control of vectors.

4. **Isnect Sociobiology**

Basic atrtributes of social life, social organization in honeybee, wasp, termite and ant. Kinds of societies among bees; social significance of the nest; caste determination in bees; Foraging and orientation; Defense mechanisms in bees

Species of honeybees, their general characteristics and economic importance; Honey plant resources; Bee Genetics, Dances and languages of honeybees Foraging behavior of bees in relation to pollination, Honeybee pests and diseases. Bee products: their composition and uses.

5. **Insect Ecology**

Abiotic and biotic factors of environment concerning distribution and abundance of insects. Current theories to explain insect number. Ecology of pest control. Insect mimicry. Entomophagous insects.

Suggested Readings:

1. Atwal, A.S. and Dhaliwal, G.S. 1997. Agriculture pests of South Asia and their management Kalyani Publishers, New Delhi.
2. Pedigo, L.P. 1996. Entomology and Pest Management. Prentice Hall of India, New Delhi.
3. Clarke, L.R. Geier, P.U, Hughes, R.D. and Morris, S.R.F. 1982 The Ecology of Insect population-in theory and practice. ELBS edition
4. Michener, C.D. 1981. The social behavior of the bees. The Belknap Press of Harvard Univ. Cambrige.
5. Verma, , L.R. 1990. Beekeeping in integrated mountain development Oxford & IBH Publ. Co., New Delhi.
6. Wilson, E.O. 1981. The Insect Societies. Harvard Univ. Press, Cambridge.
7. Hassall, A.K. 1990. The biochemistry and uses of pesticides ELBS edition
8. Hill, D.S. 1993. Agricultural insect pests of tropics and their control. Cambridge uni. Press. Cambridge.
9. Stine K.E and Brown. T.M. 1996. Principles of Toxicology, Lewis Publishers, London.
10. Atwal, A.S. 2000, Essentials of beekeeping & Pollination Kalyani Publ. New Delhi.

M.Sc. Zoology

Semester-IV

Course-XV

Molecular Physiology (Special Paper)

1. Digestive System

1.1. Metabolism of carbohydrates, lipids and proteins

1.2. Nutritional disorders

1.3. Neural and hormonal control of Gastrointestinal movements.

2.0 Respiratory system

2.1 Neural regulation of respiration

2.2 Humeral regulation of respiration

3.0 Blood Vascular System

3.1 Intrinsic, nervous and humeral regulation of circulation

3.3. Cardicac cycle

3.4 Conduction system in heart

3.5 Control of excitation and conduction in heart

4.0 Excrction:

4.1 Conter-current mechanism (Formation of concentrated and dilute urine)

4.2 Secretion, Reaborption of different electrolytes, ions, molecules

4.3 Renin-Angiotensin system

5.0 Muscular System

5.1 Ultrastr5ucture of smooth muscle cell

5.2 Mechanism and regulation of vascular, smooth muscle contraction

5.3 An introductory idea of “latch” and “Catch”

5.4. Diversity of slow and fast muscles

6. Nervous System:

6.1 Reflex mechanism

6.2 Types of reflexes

6.3 Functional compartmentalization of brain and hierarchy of control

7.0 Endocrine System

7.1 Hormones, their nature and mechanism of action

7.2 Hormone receptors and signal transduction

7.3 Biosynthesis of adrenal and thyroid hormones

8.0 Reproductive Physiology

8.1 Hormonal regulation of spermatogenesis, and oogenesis

8.2 Mammalian reproductive cycles

8.3 Implantation

8.4 Partuirition

8.5 Lactation

9.0 High Altitude and deep sea Physiology:

9.1 Effect of low O2 at high altitude

9.2 Acclimatization to low O2

9.3 Angular acceleratory forces and their effects

9.4 Artificial climate, and weightlessness

9.5 Nitrogen narcosis and oxygen toxicity.

Suggested Books

1. Guegg, J.C.: Calcium in muscle activation, Springer Verlag Berlin Heidelberg, New York.
2. Hoar, W.S.: General and comparative physiology, Prentice, Hall, Inc./England Wood cliffs, New Jersey.
3. Guyton, A.C. and Hall, J.E.: Text book of medical physiology, 10^{th} Ed., Saunders, Harcourt, India.
4. Heilmeyer, L.M.G. Cellular regulation of protein phosphorylation, Springer-Verlag, Berlin Heidelberg, New York.

5. Prosser, C.L. and Brown, F.A.: Comparative Animal Physiology, 2nd Ed. W.B. Saunders, Philadelplina.
6. Karpati, G., Jones, D.H. and Griggs, R.C.: Disorders of Voluntary Muscle, 7th Edn, Cambridge University Press.
7. Turner, C.D.: General Endocrinology, 4th Ed. W.B. Saunders, Philadelphia London.