SEMESTER 1ST
MAJOR/MINOR
COURSE

ZOL122J/N: ZOOLOGY (INTRODUCTION TO SYSTEMATICS & NON-CHORDATES)

Credits: Theory=4, Practical=2

Course objective: This course is desired to give a learner the fundamental understanding of relevance of taxonomy and the diversity of non-chordate phyla with emphasis on key characteristics and classification so as to lay a strong foundation in understanding diversity of animal life. It will enlightens how each group of organisms establish themselves in the environment with their special characteristics.

Learning outcome: At the completion of this course, a student will be able to:

- Learn basic taxonomy skills and demonstrate classification and identification abilities of non-chordates;
- Comprehend and explain evolutionary relationship among the various non-chordate groups;
- Get sensitized with the relevance of animal diversity in understanding life from a broader perspective;
- The learner will utilize the knowledge gained from these creatures for the economy and
- human welfare.

Theory: (4 Credits)

Unit I: Animal Taxonomy

1.1 Introduction to systematics: terms & definitions
1.2 Utility and strategy of systematics with emphasis on α, β & ɤ taxonomy
1.3 Taxonomic characters : introduction & types
1.4 Outline classification of kingdom animalia

Unit II: Protozoa, Porifera and Coelentrata

2.1 General characters and classification of protozoa, porifera & coelentrata upto class level
2.2 Locomotion & nutrition in protozoa
2.3 Canal system & skeletal elements in porifera
2.4 Polymorphism in coelenterates

Unit III: Platyhelminthes, Nematoda & Annelida

3.1 General characters and classification of platyhelminthes, nematoda & annelida upto class level
3.2 Morphology, life cycle and pathogenicity of *Taenia solium*
3.3 Morphology, life cycle & pathogenicty of *Ascaris lumbricoides*
3.4 Filter feeding in polychaetes

Unit IV: Arthropoda, Mollusca & Echinodermata

4.1 General Characters and classification of arthropoda, mollusca & echinodermata upto class level
4.2 Mouth parts in insects & insect metamorphosis
4.3 Modification of foot in molluscs & torsion in gastropods
4.4 Water Vascular system & larval forms in echinodermata

Practical's: (2 Credits)

Section I:

1.1 Slide study of protozoa: paramecium, euglena, amoeba, entamoeba, trypanosoma , leishmania & plasmodium

1.2 Museum study of porifera: sycon, spongilla euplectella, hyalonema, euspongi; coelenterate: obelia, hydra, & physalia

1.3 Museum study of helminths: taenia, fasciola, ascaris, trichuris ; annelida: pheritema & hirudinea

1.4 Dissection of earthworm/ neries to expose its nerve ring

Section II:

2.1 Museum study of arthropoda: palaemon, julus, scolopendra, apis , wasp; mollusca: octopus, chiton, pila, unio, Aplysia & echinodermata : starfish, echinus, antedon & holothuria

2.2 Preparation of temporary mount of insect mouth parts & sting apparatus of honey bee

2.3 Dissection of sepia/ loligo to expose its nervous system

2.4 Dissection of starfish to expose its water vascular system

Suggested books:

1. Invertebrate Structure and function by E.J.W Barrington Nelson, London Publishers.
2. Invertebrate Zoology by P.S Dhami and J.K Dhami. R-Chand & Company
3. Invertebrate Zoology by Ruppert and Barnes. Holt Saunders Publishers
4. Modern Texbook of Zoology: Invertebrates by R.L Kotpal. Rastogi Publishers
5. Invertebrate Zoology by E.L Jordan and P.S Verma. S. Chand Publishers

SEMESTER 2nd
MAJOR/MINOR
COURSE

ZOL222J/N: ZOOLOGY (INTRODUCTION TO CHORDATES)

CREDITS: THEORY: 4; PRACTICAL: 2

Course objective: *This course is designed to give a learner the fundamental understanding of the diversity of the phylum chordata with emphasis on their origin, key characteristics, classification, distribution and functioning.*

Learning outcome: *After the completion of this course, a student will be able to*

- *Demonstrate the identification and classification of chordates*
- *Comprehend and explain evolutionary relationship among the various chordate groups*
- *Understand the ecological distribution and evolutionary divergence of chordates*

Theory: (4 Credits)

Unit I: Origin, Classification and Distribution of Chordates

1.1 Origin & evolution of chordates
1.2 General characters of chordates
1.3. Outline classification of the phylum Chordata
1.4 Distribution of vertebrates in different Zoogeographical realms

Unit II: Protochordates and Pisces

2.1 General characters and classification of protochordates up to order level
2.2 Retrogressive metamorphosis in urochordates
2.3 General characters and classification of Pisces up to order level
2.4 Migration and osmoregulation in fishes

Unit III: Amphibians and Reptiles

3.1 General characters and classification of amphibians up to order level
3.2 Parental care in amphibians
3.3 General characters and classification of reptiles up to order level
3.4 General features of poisonous and non- poisonous snakes

Unit IV: Aves and Mammals

4.1 General characters and classification of aves up to order level
4.2 Flight adaptations in birds
4.3 General characters and classification of mammals up to order level
4.4 Adaptive radiation in mammals with reference to locomotory organs.

Practicals: (2 Credits)

Section I:

Classification and diagnostic features of museum specimens / slides belonging to following groups available in respective museums:

Protochordata-Balanoglossus, Herdmania, Branchiostoma
Pisces- Scoliodon, Labeo, Cyprinus , Shizothorax, Salmon
Amphibia- Ichthyophis, Necturus, Bufo, Hyla, Alytes, Salamandra
Reptilia- Uromastix, Vipera, Naja,
Aves – common birds from different orders
Mammalia- Bat, Funambulus, Loris, Herpestes

Section II:

Dissections: alimentary canal, cranial nerves of carp / Scoliodon, Identification of poisonous and non-poisonous snakes. Mount preparation of weberian ossicles of carp, Study of different zoogeographical realms through chart & short films. Field visits for observation and understanding of local fauna

SUGGESTED BOOKS:

1. Chordate Zoology E. L.Jordan P. S. Verm. S.Chand and company, New Delhi
2. Life of Vertebrates J. Z. Young New York Oxford University Press.
3. Text Book of Zoology Vol-11 Porker and Haswel AZTBS Publishers New Delhi
4. The Vertebrate Body Romer and Parso Saunderes Company
5. Chordate Zoology P S Dhami J K OHowu/Pradeep Publications, Jalandhar
6. Comparative Animal Physiology C.L. Proper Satish Book Enterprise Agra
7. General and Comparative Physiology Koor Prentice Hall of India Pvt. Ltd.
8. Modern Text Book of Zoology (Vertebrates) R L Kotpal Rastogi Publications
9. Animal Physiology. Mohan P Arora Himalaya Publishing House, New Delhi
10. Manual of practical Zoology Chordates P S Verma S. Chand and Company Ltd.
11. Animal Physiology Nilsen Cambridge University Press
12. Comparative Anatomy of Vertebrates K.K.Saxena and Saxena Viva Books Pvt.Ltd.
13. *Practical Zoology: Vertebrate (English, Rastogi Publications, S.S.Lal) A Manual of Practical Zoology by P. S. Verma*

Bachelors with Zoology as
Major/Minor 3rd Semester

ZOL322J/N: Zoology: Comparative Anatomy of Vertebrates

Total Credits: 4 Theory, Practicals-2

Course objective: This course is designed to give a learner the fundamental understanding of the structureof organ systems of vertebrates so as to lay a strong foundation in understanding their life processes **Learning outcome:** After the completion of course, a student should be able to understand the structure of different organ systems in vertebrates and shall become a subject expert in animal anatomy

Theory: (4 Credits)

Unit I: Integument & its Derivatives

General structure of skin; comparative structure of integument in vertebrates
Derivatives of integument: scales, beaks, horns, digital tips- claws, hoofs & nails
Feathers- structure & types; hair- structure & development
Epidermal glands: mucous, preening, sweat, sebaceous & mammary glands

Unit II: Digestive & Excretory system

Digestive system: structural organization of gastrointestinal tract and its associated glands
Teeth: development, structure & types; dental formula in Mammals
Excretory system: kidneys-structure & position; urinary ducts, bladders; structure of nephrons
Evolution of kidney

Unit III: Circulatory & Respiratory system

Circulator system- nature & types; heart -structure & types; blood vessels- structure& development
Formation & composition of blood & lymph
Respiratory system: structure of gills, lungs & air sacs; accessory respiratory organs
Origin and phylogeny of lungs

Unit IV: Life controlling &coordinating systems

Nervous system: CNS & PNS; sense organs- eye & ear
Endocrine system: endocrine glands-structural organization & histology
Skeletal and muscular system
Male & female reproductive systems

Practicals: (2 Credits)

Section I:

1. Preparation of temporary mounts or slide study of placoid, cycloid and ctenoid scales
2. Demonstration of feathers, claws, hooves etc., & their types
3. Slide study of sections of different organs: oesophagus, stomach, duodenum, ileum, liver, lung, kidney etc., as per availability
4. Slide study of sections of skin, mammary glands, pituitary, pancreas, testis, ovary, adrenal, thyroid and parathyroid glands as per availability

Section II:

1. Dissections: alimentary canal & cranial nerves of scoliodon / fish / fowl, as per availability
2. Study of various organ systems in fish / fowl / rat
3. Dissection of eye and brain of sheep to show their different parts
4. Study of kidney, heart, brain through charts / models

Suggested books:

1. Chordate Zoology by E. L.Jordan P. S. Verm. S.Chand and company, New Delhi
2. Life of Vertebrates by J. Z. Young New York Oxford University Press.
3. Text Book of Zoology Vol-11 Porker and Haswel AZTBS Publishers New Delhi
4. The Vertebrate Body by Romer and Parso Saunderes Company
5. Chordate Zoology by P S Dhami J K O Howu / Pradeep Publications, Jalandhar
6. Modern Text Book of Zoology (Vertebrates) R L KotpalRastogi Publications
7. Comparative Anatomy of Vertebrates K.K.Saxena and Saxena Viva Books Pvt. Ltd.
8. Introduction to the Comparative Anatomy of Vertebrates M. L.Sirivatava
9. Comparative Anatomy of Vertebrates G.C. Kent and R.K. Carr
10. Manual of practical Zoology Chordates P S Verma S. Chand and Company Ltd.

BACHELORS WITH ZOOLOGY AS MAJOR/MINOR
4th Semester
ZOL422J1/N: ZOOLOGY: COMPARATIVE PHYSIOLOGY OF VERTEBRATES

Credits: Theory=3, Practical=1

Course objective: This course is designed to give a learner, knowledge about the functions of different organ systems so as to lay a strong foundation in understanding their life-process

Learning outcome: After the completion of this course, a student will be able to: understand the working of different organ systems and their defects / disorders

Theory: (3 Credits)

Unit I: Physiology of Digestion & Excretion

1.1. Physiology of gastrointestinal tract and its associated glands; mechanical & chemical digestion

1.2. Absorptions of food; neuro-endocrine control on digestion

1.3. Nature of excretory wastes; osmoregulation

1.4. Mechanism of urine formation and its regulation; urea cycle

Unit II: Physiology of Circulation & Respiration

2.1. Physiology of blood circulation; cardiac cycle; heart rate, cardiac output and its regulation

2.2. Physiology of blood and lymph; coagulation of blood;

2.3. Mechanism of respiration; respiratory volumes and capacities; respiratory pigments

2.4. Transport of respiratory gases, oxygen dissociation curve; regulation of respiration

Unit III: Physiology of life Controlling & Coordinating Systems

3.1. Conduction of nerve impulse; reflex action & its types; physiology of vision & hearing

3.2. Hormones- nature, functions, mode of action & regulation; hormonal disorders

3.3. Physiology of muscle contraction

3.4. Physiology of male & female reproduction; reproductive cycle in female primates with regulation

Practical's: (1Credit)

List of Practical's:

1. Demonstration of enzyme action on starch
2. Preparation of blood smears
3. Determination of TLC & DLC, Total Erythrocyte Count (TEC) & ESR of human blood
4. Estimation of haemoglobin, Blood bleeding & clotting time; measurement of blood pressure
5. Preparation of temporary mounts: squamous epithelium and nerve cells

Suggested books:

1. Chordate Zoology E. L. Jordan P. S. Verm. S. Chand and company, New Delhi
2. Life of Vertebrates J. Z. Young New York Oxford University Press.
3. Text Book of Zoology Vol-11 Porker and Haswel AZTBS Publishers New Delhi
4. The Vertebrate Body Romer and Parso-Saunderes Company
5. Chordate Zoology P S Dhami J K OHowu / Pradeep Publications, Jalandhar
6. Modern Text Book of Zoology (Vertebrates) R L Kotpal Rastogi Publications
7. Text Book of medical physiology by A.C. Guyton (2001)
8. Tortora, G.J. & Grabowski, S. (2006). Principles of Anatomy & Physiology, Wiley& sons
9. Practical Zoology: Vertebrate (English, Rastogi Publications, S. S. Lal)
10. Manual of practical Zoology Chordates P S Verma S. Chand and Company Ltd.

BACHELORS WITH ZOOLOGY AS MAJOR
4th Semester
ZOL422J2: ZOOLOGY: FUNDAMENTALS OF IMMUNOLOGY

Credits: Theory=4, Practical=2

Learning objective: To acquire knowledge about immunity, innate & acquired, complement system; understand the concept of immune deficiencies, hypersensitivity, autoimmunity and transplantation immunology

Learning Outcome: understand the defense mechanism against pathogens and utilize the knowledge for human welfare; gain knowledge on undesirable immunological reactions and their complications in health management

Theory (4 Credits)

Unit I: Overview of Immune System

1.1. Historical background & scope of immunology

1.2. Cells, tissues and organs of the immune system

1.3. Innate immunity and acquired immunity

1.4. Vaccines and their types

Unit II: Molecules of Immune system

2.1. Antigens: nature & types, antigen processing & presentation; MHC: functions & types

2.2. Antibodies: structure, types & functions; theories of antibody formation; monoclonal antibodies

2.3. Cytokines: types, properties and functions.

2.4. Complement system: components & pathways of its activation

Unit III: Immunodeficiency and Tumor Immunology

3.1. Immune deficiencies: primary &secondary; stem cell, T & B-cell & compliment deficiencies

3.2. Acquired immunodeficiency syndrome

3.3. Tumor immunology: immune surveillance, tumor associated antigens & tumor escape mechanisms

3.4. Tumor immunotherapy: antigen non-specific & antigen specific

Unit IV: Damaging and Defective Immune Response

4.1. Concept & classification of hypersensitivity reactions with brief descriptions

4.2. Mechanism of type I and type II hypersensitivity reactions

4.3. Introduction to autoimmune (AI) diseases with emphasis on AI anaemia's & rheumatoid arthritis

4.4. Transplantation immunology: types of grafts; mechanism of homograft rejection

Practical's (2 Credits)

List of Practical's:

1. Demonstration of lymphoid organs
2. Identification of various immune cells by morphology – Leishman staining, Giemsa staining
3. Total leukocyte counts (TLC)
4. Differential leukocyte counts (DLC)
5. Demonstration of phagocytosis in vivo
6. Agglutination reactions- latex agglutination reactions
7. Heam-agglutination reactions- blood grouping, Rh Typing
8. Serum electrophoresis
9. Visit to SKIMS, SKUAST-K and Kashmir University laboratories for demonstration of immunological techniques

Suggested Books / Reading Material

1. Basic Immunology by Sharon, J. William and Wilkins
2. Immunology by F. M. Burnet
3. Immunology by Kuby, Goldsby, R., Kindt, T.J. and Osbourne, B.A., W.H. Freeman
4. Immunology by P. M. Lydyard, A. Whelan And M. W. Fanger
5. Immunology by Roitt, I.M., Brostoff, J. and Male, D. Mosby
6. Immunology: An Introduction by Ian R Tizard
7. Medical Immunology for Students by Playfair, J.H.L. and Lydyard, P.M. Churchill

BACHELORS WITH ZOOLOGY AS MAJOR
4th Semester
ZOL422J3: ZOOLOGY: FUNDAMENTALS OF PARASITOLOGY

Credits: Theory=4, Practical=2

Learning objective: To understand the nature of the parasites and parasitism. To acquaint the students about the knowledge of parasites of medical, veterinary & agricultural importance

Learning outcome: The learner becomes aware about the parasitic diseases & the consequences thereof; understand their mode of transmission, pathogenicity and control and management

(Theory: 4 Credits)

Unit 1: Introduction to Parasitology

1.1. Animal associations with special emphasis on parasitism; terms & definitions in parasitology

1.2. Origin, evolution and distribution of parasites in animal kingdom; parasitic adaptations

1.3. Host parasite relationships

1.4. Zoonosis: definitions & types

Unit II: Medical Parasitology

2.1. Protozoan parasites of man with emphasis on *Entamoeba* & *Plasmodium*

2.2. Trematode parasites of man with emphasis on *Schistosoma* & *Paragonimus*

2.3. Cestode parasites of man with emphasis on *Taenia* & *Diphyllobothrium*

2.4. Nematode parasites of man with emphasis on *Ascaris* & *Ancylostoma*

Unit III: Veterinary Parasitology

3.1. Protozoan parasites of poultry & cattle (*Babesia*)

3.2. Trematode parasites of fish (*Diplozoon*) & ruminants (*Fasciola*)

3.3. Cestode parasites of fish (*Adenoscolex*) & ruminants (*Moneizia*)

3.4. Nematode parasites of fish aves (*Heterakis*) & ruminants (*Haemonchus*)

Unit IV: Agricultural Nematology & Acanthocephalans

4.1. Introduction to phytonematodes with emphasis on their ecology & biology

4.2. Morphology, Life-cycle, pathogenicity and management of *Meloidogyne*

4.3. General account and distinguished features of acanthocephalans

4.4. Acanthocephalan parasites of fish (*Pomphorhynchus)*

Practical's (2 Credits)

List of Practical's:

1. Study of protozoan parasites of man & ruminants through slides available in museum
2. Preparation of permanent mounts of parasitic protozoans
3. Study of trematode parasites of man & ruminants available in museum
4. Study of cestode parasites of man & ruminants available in museum
5. Study of nematode parasites of man & ruminants available in museum
6. Methods of collection, fixation & preservation of parasites from different hosts viz., fish, fowl, sheep and cattle as per feasibility
7. Methods of temporary / permanent mount preparation of ecto and endo helminth parasites
8. Faecal, blood and urine examinations for diagnosis of parasitic diseases
9. Methods of extraction of nematodes from soil

Suggested Books / Reading Material

1. Animal Parasitology by J. D. Smyth
2. Foundations of Parasitology by Gerald D. Schmidt and Larry S. Roberts
3. Foundations of Parasitology by Larry S. Roberts, John Janovy& Steve Nadler
4. General parasitology by Thomas C. Cheng
5. Georgis' Parasitology for Veterinarians 10th Edition Evolve Elsevier.
6. Helminthes Arthropods and Protozoa of Domesticated Animals by EJL Soulsby
7. Introduction to Parasitology by ASA C. Chandler & Clark P. Read
9. Parasitology (Protozoology & Helminthology) K.D. Chatterjee
10. Parasitology by Elmer R. Nobel and Glenn A. Noble
11. Plant Nematology by N.G. Ravichandra
12. Plant Nematology 2nd Edition by Roland N. Perry & Maurice Moens
13. Textbook of introductory plant nematology (revised 2nd edition). Raman K. WaliaHarish K. Bajaj
14. Manual of Practical Microbiology and Parasitology by Pal Chakraborty
15. Parasitology Easy to Learn by Chandra T Jaya, Jaypee Brothers Medical Publishers
16. Practical Exercises in Parasitology by D. W. Halton
17. Practical Guide to Diagnostic Parasitology by Lynne S. Garcia

BACHELORS WITH ZOOLOGY AS MAJOR/MINOR
(CT – I) 5th SEMESTER

ZOL522J1/N ZOOLOGY _ ANIMAL ECOLOGY

CREDITS: THEORY: 03; PRACTICAL: 01

COURSE OBJECTIVE:
The course is designed to aware the students about the structure & function of different ecosystems.

LEARNING OUTCOME:
The learner will understand structure & function of different ecosystems & will utilize the knowledge in conservation & sustainable development of ecosystems.

THEORY: (3 CREDITS)

UNIT I: ECOSYSTEM ECOLOGY

1.1 Ecosystem components: biotic & abiotic
1.2 Ecosystems types: terrestrial & aquatic
1.3 Energy flow and mineral cycling (CNP)
1.4 Ecological laws (Shelford's & Liebig' laws); food chain, food web, & ecological pyramids

UNIT II: POPULATION ECOLOGY

2.1 Attributes of population: natality, mortality, immigration, emigration, life tables & survivorship curves.
2.2 Population growth– exponential and logistic growth patterns; growth models
2.3 Life history strategies: r and k selection, clutch size and sex ratio
2.4 Population regulation– extrinsic and intrinsic factors

UNIT III: COMMUNITY ECOLOGY

3.1 Community characteristics: dominance, diversity, species richness, abundance, stratification.
3.2 Biotic interactions: intra-specific & inter-specific
3.3 Ecological succession: types & mechanisms: concept of climax community
3.4 Ecology niche: concept, types and examples

PRACTICALS (1CREDIT)

1. Study of an aquatic ecosystem: Temperature, turbidity/ penetration of light, determination of pH, total alkalinity and dissolved oxygen content, chemical oxygen demand and free CO_2
2. Determination of population density in a natural/hypothetical community by quadrat method and calculation of Shannon-Weiner diversity index for the same community.
3. Study of life tables and plotting of survivorship curves of different types from hypothetical/real data provided.
4. Report on a visit to National Park/Biodiversity Park/Wildlife sanctuary

SUGGESTED BOOKS / READING MATERIAL

1. Animal Ecology and Environmental Biology by PD Sharma
2. Animal Ecology by Peter Sterling
3. Ecology & Environmental Science by H. R. Singh & Neeraj Kumar
4. Ecology by Chapman and Reiss
5. An Advanced textbook on Biodiversity by Krishnamurthy
6. Colin Vaux, P. A. (1993). Ecology. II Edition. Wiley, John and Sons, Inc.
7. Krebs, C. J. (2001). Ecology. VI Edition. Benjamin Cummings.
8. Odum, E.P., (2008). Fundamentals of Ecology. Indian Edition. Brooks/Cole
9. Robert Leo Smith Ecology and field biology Harper and Row publisher
10. Ricklefs, R.E., (2000). Ecology. V Edition. Chiron Pre

BACHELORS WITH ZOOLOGY AS MAJOR (CT – II)

5th SEMESTER

ZOL522J2 ZOOLOGY _ CELL & MOLECULAR BIOLOGY

CREDITS: THEORY: 04; INTERNSHIP / PRACTICAL: 02

COURSE OBJECTIVE:

The learner will get the knowledge of cell structure and function, besides understanding the principles of molecular biology.

LEARNING OUTCOME*:*

The learner will develop a deeper understanding of cell structure and functions. Further, learner will get acquainted with how cells operate, communicate and die

THEORY (4 CREDITS)

UNIT I: CELL STRUCTURE & DIVISION

1.1 Cell structure: structural features of prokaryotic & eukaryotic cells
1.2 Cell m
1.3 Membranes: structure (models) & functions- active & passive transport
1.4 Eukaryotic cell organization: brief idea of structure and function of main cell organelles
1.5 Cell division & Cell cycle: mitosis and meiosis, their regulation & control

UNIT II: CELL SIGNALING AND TRANSDUCTION

2.1 Cell-cell interactions and modes of cell signaling
2.2 Signaling receptors & Cellular response
2.3 Signal transduction pathways: MAP kinase and JAK/STAT pathways
2.4 Cancer biology: cancer and its classes, Apoptosis

UNIT III: BIOMOLECULES OF LIFE

3.1 Carbohydrates: structure, types & functions
3.2 Lipids: structure, types & functions
3.3 Proteins: basic structure and functions
3.4 Nucleic acids: composition, types & functions

UNIT IV: MOLECULAR BIOLOGY

4.1 Replication in prokaryotes and eukaryotes
4.2 DNA damage & repair
4.3 Transcription & its regulation in prokaryotes and eukaryotes
4.4 Translation and post translational modifications in eukaryotes.

INTERNSHIP OR PRACTICALS (2 CREDITS)

1. Study of cell & cell organelles through slides/charts/models
2. Preparation of temporary stained mount of the onion root for various mitotic stages
3. Preparation of temporary stained mount of the grasshopper testis for various meiotic stages
4. Slide study of various stages of mitotic and meiotic divisions
4. Qualitative tests for reducing sugar, non-reducing sugar, polysaccharide, lipid
5. Quantitative estimation of glucose
6. Estimation of amino acid by formol titration

SUGGESTED BOOKS / READING MATERIAL

1. Cell Biology by C. B. Powar
2. Molecular Cell Biology by Lodish
3. Biochemistry by Voet & Voet
4. Principles of Biochemistry by Lehninger
5. Biochemistry by U. Satyanarayana
6. Science of Genetics by Atherlay
7. Molecular Biology of Gene by Watson et al. Pearson Education, Delhi, India
8. Molecular Biology of the Cell by Alberts et al. Garland Science
9. The Cell: A Molecular Approach by Cooper & Hausman, Sunderland publishers, USA
10. Manual of Practical Zoology by P. S. Verma
11. Biotechniques : Theory and Practice by S. V. S. Rana, Rastogi publishers
12. Principles and techniques of Biochemistry and Molecular Biology by Wilson and Walker

BACHELORS WITH ZOOLOGY AS MAJOR (CT – III)
5th SEMESTER

ZOL522J3 ZOOLOGY _ FUNDAMENTALS OF ENTOMOLOGY

CREDITS: THEORY: 04; PRACTICAL: 02

COURSE OBJECTIVE:
To impart knowledge about morphology, classification, structure & function of insects
Learning outcome*:*
The learner will get insights about the fundamentals of insect science and will utilize the knowledge for identification of insects & understanding the functioning of different organ systems.

Theory (4 Credits)

UNIT 1: MORPHOLOGY AND CLASSIFICATION OF INSECTS

1.1 Structure and composition of integument
1.2 Structure of head, thorax and abdomen
1.3 General features and outline classification of Apterygota up to order and sub-order level
1.4 General features and outline classification of Pterygota up to order level

UNIT II: INSECT ANATOMY-I

2.1 Digestive system
2.2 Excretory system
2.3 Respiratory system
2.4 Circulatory system

UNIT III: INSECT ANATOMY-II

3.1 Nervous system
3.2 Sense organs: simple & compound eyes
3.3 Endocrine system
3.4 Reproductive system

UNIT III: INSECT PHYSIOLOGY

4.1 Physiology of digestion and assimilation
4.2 Physiology of respiration
4.3 Physiology and biochemistry of haemolymph, haemocytes and their functions
4.4 Physiology of excretion and formation of uric acid

PRACTICALS (2 CREDITS)

1. Specimen study of some insect orders
2. Permanent mount preparation of thrips, aphids, sucking lice, mosquitoes
3. Minor dissection/temporary mount preparation of head, antennae, wings, and legs of grasshopper/cockroach/housefly
4. Collection, preservation and identification of different types of insects and their larvae
5. Dissection of digestive system in insects (Grasshopper/Cockroach)
6. Dissection of male and female reproductive systems in insects (Grasshopper/Cockroach)

SUGGESTED BOOKS / READING MATERIAL

1. Entomology by Cedric Gillott Plenum Press, New York
2. Fundamentals of Entomology by Richard J. Elizinga
3. Imm's General Text Book of Entomology vol. I & II by Richards and R. G. Davis
4. Introduction to Entomology by Comstock
5. Modern Entomology by D. B. Tembhare, Himalaya Publishing House
6. Introduction to Entomology by Comstock
7. Structure and Function of Insects by R. F. Chapman

BACHELORS WITH ZOOLOGY AS MAJOR/MINOR
(CT – I) 6th SEMESTER

ZOL622J1/N ZOOLOGY _ ANIMAL BEHAVIOUR

CREDITS: THEORY: 03; PRACTICAL: 01

COURSE OBJECTIVE:
To develop a deeper understanding of how animals interact with each other and their environment
LEARNING OUTCOME:
The learner will understand the behaviour of different animal groups, their communication pattern and their social structure. The knowledge will be utilized to promote animal conservation and improve their well-being.

THEORY (03 CREDITS)

UNIT I: BEHAVIOUR DEVELOPMENT

1.1 Home range, territoriality, dispersal & habitat selection
1.2 Food selection and optimal foraging theory
1.3 Genetic and environmental components in the development of behaviour
1.4 Neural basis of behaviour: stimulus filtering & biological rhythms

UNIT II: SOCIAL AND PARENTAL BEHAVIOUR

2.1 Social organization in insects
2.2 Social behaviour in primates
2.3 Parental care in vertebrates
2.4 Communication in animals: auditory, visual, chemical and tactile.

UNIT III: REPRODUCTIVE AND LEARNING BEHAVIOUR

3.1 Courtship and mating systems
3.2 Learning behaviour in vertebrates
3.3 Migration in fishes
3.4 Migration in birds

PRACTICALS/ FIELD SURVEYS: (1 CREDIT)

1. Study of various types of bird nests
2. Investigation of hydrotaxis, chemotaxis and phototaxis in earthworm
3. Conducting the field surveys for studying various types of behaviours in animals
4. Study of social organisation in bees/ants
5. Collection and identification of various social insects
6. Study of parental care & social behaviour through audio-visual aids

SUGGESTED BOOKS / READING MATERIAL

1. An introduction to Animal Behaviour by Manning and Dawkins, Cambridge University Press
2. Animal Behaviour- an evolutionary Approach by John Alcock Sinauer Associates, Inc Publishers Sunderland, Massachusetts
3. Animal Behaviour by Anbery
4. Animal Behaviour by Reena Mathur
5. Animal Behaviour by M.P. Arora Himalaya Publishing House
6. Essential Animal Behavior by Graham Scott
7. Mechanism of Animal Behaviour by Peter Marker and J. Hamilton, Jhon Wiley & Sons USA
8. Principles and Animal Development by S.C. Goel

BACHELORS WITH ZOOLOGY AS MAJOR (CT – II)

6th SEMESTER

ZOL622J2 ZOOLOGY _ PRINCIPLES OF ANIMAL GENETICS

CREDITS: THEORY: 04; PRACTICAL: 02

COURSE OBJECTIVE:

The learner will understand the principles of genetics.

Learning Outcome*:*

The learner will get the knowledge of genomics, inheritance, mapping, genetic diseases & human genome project and will utilize the knowledge to elucidate disease mechanisms, gene cloning and the pedigree analysis.

THEORY (4 CREDITS)

UNIT I: INHERITANCE BIOLOGY

1.1 Mendelian and non-Mendelian inheritance
1.2 Concept of gene: allele, multiple alleles, pseudoalleles & lethal alleles
1.3 Sex determination and sex-linked characteristics; dosage compensation in mammals
1.4 Gene interactions: complementary and supplementary genes; Pleiotropy

UNIT II: GENOMICS AND MAPPING

2.1 Concept of genomics and human genomeproject
2.2 Genetic mutations: gene & chromosomal
2.3 Genetic disorders and pedigree analysis
2.4 Linkage & Linkage maps

UNIT III: POPULATION GENETICS

3.1 Ecological genetics & polymorphism - phenotypic & genotypic polymorphisms
3.2 Genetic drift & genetic equilibrium
3.3 Hardy-Weinberg law& its applications
3.4 Inbreeding & outbreeding; causes & reasons of inbreeding: heterosis

UNIT IV: MOLECULAR GENETICS

4.1 Gene cloning: an overview
4.2 Restriction endonucleases: types & end modification enzymes
4.3 Extraction and purification of nucleic acids; PCR & gel electrophoresis
4.4 Vectors: plasmid & cosmid; gene library

PRACTICALS (2 CREDITS)

1. Study of Human Karyotypes (Normal/abnormal)
2. Study of Barr body through stained slides of squamous epithelial / neutrophil cells
3. Rearing of fruit fly and study of red and white character after crossing
4. Study of polytene chromosomes from chironomus larvae
5. Gel Electrophoresis
6. Demonstration of PCR via virtual mode
7. Demonstration of chromatography via virtual mode

SUGGESTED BOOKS / READING MATERIAL

1. Genes IX by Benjamin Lewin Jones and Bartlett Publishers
2. Genomes by Brown, T.A Garland Science Publishing, London, UK
3. Molecular Biology of Gene by Watson et al. Pearson Education, Delhi, India
4. Principle of Genome Analysis & Genomics by Primrose and Twyman R.M. Blackwell Publishing
5. Principles of Genetics by Gardner et al John Wiley
6. Science of Genetics by Atherlay
7. Fundamentals of Genetics by B. D. Singh
8. Biotechniques: Theory and Practice by S. V. S. Rana, Rastogi Publishers
9. Principles and techniques of Biochemistry and Molecular Biology by Wilson and Walker

BACHELORS WITH ZOOLOGY AS MAJOR (CT – III)
6th SEMESTER
ZOL622J3 ZOOLOGY _ FUNDAMENTALS OF ICHTHYOLOGY
CREDITS: THEORY: 04; PRACTICAL: 02

COURSE OBJECTIVE:

To impart knowledge about the classification and evolution of fishes, modification of various body structures, knowledge about the structure and function of various organs.

LEARNING OUTCOME:

Students will benefit from the course's in-depth coverage of the taxonomy of the major fish groups, as well as their evolutionary history, morphology, physiology and anatomy. In particular, the students will learn about the taxonomy and identification of fish, with a focus on local freshwater fish. They will also gain knowledge about the anatomy and physiology of fish.

THEORY (4 CREDITS)

UNIT 1: SYSTEMATICS AND MORPHOLOGY

1.1 Outline classification of fishes with distinguishing characters upto orders
1.2 Adaptive radiation in Elasmobranchii and Actinopterygii
1.3 Structure, types and modification of scales and fins
1.4 Colouration in fishes

UNIT II: FISH ANATOMY AND PHYSIOLOGY-I

2.1 Digestive system and physiology of digestion
2.2 Structure and function of gills; Accessory respiratory organs; Swim bladder
2.3 Structure and function of heart and blood vessels
2.4 Structure and function of kidneys (Excretion and Osmoregulation)

UNIT III: FISH ANATOMY AND PHYSIOLOGY-II

3.1 Reproductive organs in fishes (Teleost)
3.2 Structure and function of the nervous system (Teleost)
3.3 Sense organs and their function
3.4 Structure and function of endocrine organs

UNIT IV: SKELETON AND MOVEMENT

4.1 Endoskeleton in fishes: Axial Skelton (Typical trunk vertebrae and caudal vertebrae); Appendicular skeleton (girdles)
4.2 Structure and significance of Weberian ossicles
4.3 Musculature in fishes
4.4 Locomotion in fishes

PRACTICALS (2 CREDITS)

1. A general survey of Elasmobranchii, Holocephali, Dipnoi and Teleostei
2. Identification and classification of fish fauna of Jammu & Kashmir
3. Morphometric and meristic characters of fishes
4. To study the general anatomy of fish (alimentary canal, gills, gonads, etc.)
5. Study of feeding habits of herbivorous, carnivorous, and omnivorous fish by gut content analysis of fishes: *Schizothorax*, Trout, and Carp
6. Histological study of different organ systems of fish from prepared slides
7. Study of scales and age determination of fishes using scales (Carp, *Schizothorax*, and *Scoliodon*)
8. Dissection of the nervous system of fish.

SUGGESTED BOOKS / READING MATERIAL

1. Fish and Fisheries of India by V. G. Jhingran (Hindustan Publishing Corporation)
2. A Text Book of Fish Biology & Fisheries by S.S Khanna and H.R Singh (Narendra Publishing House)
3. Biology of Fishes by Q. Bone and R. Moore (Taylor & Francis)
4. The Physiology of Fishes byD.H. Evans, J.B. Claiborne and S. Currie(CRC Press)
5. Fishes: An Introduction to Ichthyology by Peter B. Moyleand Joseph J. Cech Jr.(Prentice Hall India Learning Private Limited)
6. An Introduction to Fishesby H.S. Bhamrah and Kavita Juneja (Anmol Publications Pvt Ltd)
7. An Introduction to Fishes by G.S. Sandhu(Campus Books International)
8. Fish and Fisheries by B.N. Yadav (Daya Publishing House)
9. A History of Fishes by J.R. Norman and P.H. Greenwood (Ernest Benn Limited)
10. Ichthyology: The study of Fishes by K.F. Lagler, J.E. Bardach, and R.R. Miller (John Wiley & Sons)
11. Anatomy of Fishes Part Iby Wilhelm Harder (Schweizerbart'sche Publishing House)
12. Fish and Fisheries by K.Pandey and J.P. Shukla (Rastogi Publication)

BACHELORS WITH ZOOLOGY AS MAJOR/MINOR

7th SEMESTER (CT1)

ZOL722J1/N ZOOLOGY _ ANIMAL DEVELOPMENT

CREDITS: THEORY: 3; PRACTICAL: 1

COURSE OBJECTIVE:

The course is designed to provide a comprehensive understanding of the concepts of embryonic development in animals

LEARNING OUTCOME*:*

On completion of this course, the students should be able to describe the cellular events that regulate the development of specialised cells, tissues and organs during embryonic development

THEORY: (3 CREDITS)

UNIT I: EARLY EMBRYONIC DEVELOPMENT

- Gametogenesis: spermatogenesis, oogenesis; types of eggs & egg membranes
- Fertilization: monospermy, polyspermy and parthenogenesis
- Cleavage: Planes and patterns of cleavage
- Vitellogenesis

UNIT II: LATE EMBRYONIC DEVELOPMENT

- Process of blastulation and gastrulation
- Introduction to extra embryonic membrane in birds
- Implantation of blastocyst and formation of foetal membranes in humans
- Placenta: structure, types and functions

UNIT III: POST EMBRYONIC DEVELOPMENT

- Metamorphosis: changes & hormonal regulation in amphibians
- Regeneration: modes of regeneration and factors affecting regeneration
- Role of hormones in pregnancy and parturition
- Ageing: concepts and theories

PRACTICALS: (1 CREDIT)

List of Practicals:

- Study of gametogenesis through prepared slides/charts
- Study of whole mounts of developmental stages of chick / frog through permanent slides
- Study of different types of Placenta
- Project report on chick embryo development by raising chick embryo in the laboratory

SUGGESTED BOOKS / READING MATERIAL

- Gilbert, S. F. (2010). Developmental Biology, IX Edition, Sinauer Associates, Inc., Publishers, Sunderland, Massachusetts, USA.
- Balinsky B. I. and Fabian B. C. (1981). An Introduction to Embryology, V Edition, International Thompson Computer Press.
- Kalthoff (2008). Analysis of Biological Development, II Edition, McGraw-Hill Publishers.
- Lewis Wolpert (2002). Principles of Development. II Edition, Oxford University Press
- Carlson, Bruce M (1996). Patten's Foundations of Embryology, McGraw Hill, Publishers.
- A Text Book of Animal Distribution & Developmental Biology by Veer Bala Rastogi
- 7. Developmental Biology By Dr Reddy/ Nirmala Jyothi of SBW Publishers
- Developmental Biology By M.A. Subramanian MJP Publishers

BACHELORS WITH ZOOLOGY AS MAJOR (CT – II)
7th SEMESTER
ZOL722J2 ZOOLOGY _ BIO-TECHNIQUES & BIOSTATISTICS

CREDITS: THEORY: 4; PRACTICAL: 2

LEARNING OBJECTIVE:
To understand the role of biological techniques and statistical methods in research studies.

LEARNING OUTCOME:
The knowledge can be utilized in experimentation and research data analysis by using appropriate statistical software.

THEORY (4 CREDITS)

UNIT I: BIOTECHNIQUE I
- Microscopy – principle & types (simple, light, phase contrast & electron)
- Centrifuge – principle & types
- Electrophoresis-principle, types (AGE & PAGE) and applications
- Histological techniques

UNIT II: BIOTECHNIQUE II
- Microbiological technique: media preparation & sterilization; inoculation & growth monitoring
- Cell culture techniques: cell viability testing; culture media preparation & cell harvesting methods.
- Principle and applications of PH meter and spectrophotometer
- PCR-variants & applications; RFLP, RAPD AFLP techniques

UNIT III: RESEARCH PROCESSES & COMPUTATIONAL STATISTICS
- Hypothesis; preparing the research design; sample design – deliberate, random, systematic
- Data collection – observation, interview, questionnaires, schedules
- Computer aided techniques for data presentation & data analyses
- Introduction to statistical package (MS-Excel &SPSS)

UNIT IV: BIOSTATISTICS
- Variability and its measures: mean, mode and median, standard deviation & coefficient of variation
- Probability distribution: binomial, Poisson and normal
- Hypothesis testing: tests of significance based on T, Z and F tests and Chi-square & Anova test
- Correlation and regression analysis

PRACTICALS (2 CREDITS)

List of Practicals:
- Structure and working of different microscopes
- Sub-cellular fractionation by centrifugation
- Gel Electrophoresis
- Histological techniques
- Preparation of buffers
- Demonstration of PH meter & spectrophotometer
- Representation of collected/hypothetical data through: a. Histogram b. Bar chart c. Pie charts
- Statistical analysis of hypothetical data: chi square analysis, student t test & ANOVA
- Visit to a research institute within Kashmir valley for demonstration of advanced equipment's

SUGGESTED BOOKS / READING MATERIAL

- Walliman, N. (2011). Research Methods-The Basics. Taylor and Francis, London and New York.
- Kothari, C. R. Research Methodologies-Methods and Techniques. New Age Publishers.
- Dawson, C. (2002). Practical Research Methods. UBS Publishers, New Delhi
- Booth, W.C., Colomb, G.G. & Williams, J. (2003). The Craft of Research, II Edition, University of Chicago
- Monamy, V. (2009). Animal Experimentation-A Guide to the Issues, II edition. Cambridge University Press.
- Biotechniques: Theory and Practice by S. V. S. Rana, Rastogi Publishers
- Principles and techniques of Biochemistry and Molecular Biology by Wilson and Walker
- An Introduction to Biostatistics by N. Gurumani
- Biotechniques Theory and Practice by S. V. S. Rana, Rastogi publishers
- Fundamentals of Biostatistics by Khan and Khanum, Ukaaz Publications

BACHELORS WITH ZOOLOGY AS MAJOR (CT – III)

7th SEMESTER

ZOL722J3 ZOOLOGY _ FUNDAMENTALS OF WILDLIFE

CREDITS: THEORY: 4; PRACTICAL: 2

LEARNING OBJECTIVE:

To understand various aspects of wildlife conservation & management and application of various techniques in wildlife study

LEARNING OUTCOME*:*

The students can utilize the knowledge in pursuing research and can work in wildlife-oriented research projects funded by Govt. sector and NGOs

THEORY: (04 CREDITS)

UNIT I: INTRODUCTION TO WILDLIFE

- Wildlife: concept, definitions and importance
- Wildlife habitat types (an overview); important bird areas and Ramsar sites in J&K
- IUCN red list categories and criteria; regional red list assessments
- Brief introduction to conventions and conservation bodies: CITES, CBD, CMS, IUCN, WWF, BNHS, NCF

UNIT II: WILDLIFE CONSERVATION

- In situ and Ex situ conservation strategies for wildlife in India
- Concepts of keystone, flagship and umbrella species in conservation
- Conservation projects: Tiger, Hangul, and Snow leopard
- Conservation issues of wildlife in India

UNIT III: MANAGEMENT AND LEGISLATION

- Protected area network in India with special focus on Jammu & Kashmir
- Human- wildlife conflict: causes, consequences and management
- Common diseases of wild animals and control measures
- Wildlife (Protection) Act 1972: brief structure and recent amendments

UNIT IV: TECHNIQUES IN WILDLIFE CONSERVATION

- Remote sensing and GIS: concept and applications in wildlife
- Wildlife census methods (birds & mammals)
- Capture of wildlife: live trapping, mist netting, chemical captures
- Bird ringing and banding, use of radio transmitters in wildlife study

PRACTICALS (2 CREDITS)

List of Practicals:

- Identification of mammals, birds, reptiles and amphibians available in the museum and local vicinity
- Demonstration of basic equipment needed in wildlife studies (Compass, Binoculars, Spotting scope, Range Finders, Global Positioning System, Various types of cameras)
- Demonstration of census methods in the field
- Study of animal evidences in the field through hairs, pug marks, hoof marks, scats, pellets etc.
- Examination of faecal matter of wild animals for parasitic infections
- Preservation of stuffed animals and birds
- Visit and study of important wildlife habitats of J & K

SUGGESTED BOOKS / READING MATERIAL

- Conservation Biology. Richard B. Primack (2017). Sinauer Associates, Inc., Publishers, Sunderland, Massachusetts, U.S.A
- Managing our Wildlife Resources by S. A. Anderson
- Manual of Wildlife Techniques of India, Sale & Ber muller. Wildlife Institute of India, Dehradun.
- Remote Sensing and Image Interpretations, Lillesand, T.M.; Kiefer, R.W.; Chipman, J.W. (2004) John Wiley and Sons, Inc
- Wildlife Biology by Raymond F. Dasmann1.
- Basics of Wildlife Health Care and Management, Rajesh Jani (2012) Narendra Publishing House
- Wildlife Ecology and Management by Bolen and Robinson Printice Hall International (UK)
- Animal Ecology and Distribution of Animals by Rastogi and Jayaraj
- Managing our Wildlife Resources by S. A. Anderson
- Fundamentals of Wildlife Management by Rajesh Gopal Natraj Publishers, Dehradun India

BACHELORS WITH ZOOLOGY AS MAJOR/MINOR
(CT – I) 8th SEMESTER

ZOL822J1/N ZOOLOGY _ EVOLUTIONARY BIOLOGY

CREDITS: THEORY: 3; PRACTICAL: 1

LEARNING OBJECTIVE:

To develop a deeper understanding of the concepts & mechanisms of evolution including natural selection, population bottlenecks & genetic drift.

LEARNING OUTCOME:

Be able to clearly understand the link between environment and evolution. Be familiar with the different agents of evolution.

THEORY (03 CREDITS)

UNIT I: CONCEPT AND THEORIES OF EVOLUTION

- Concept of evolution, historical review of evolutionary concept
- Lamarckism
- Darwinism
- Neo-Darwinism

UNIT II: EVIDENCES OF EVOLUTION

- Analogy and homology
- Embryological & molecular evidences
- Paleontological evidences; Fossils, types and dating
- Phylogeny of horse

UNIT III: EVOLUTIONARY CHANGES & PRINCIPLES OF POPULATION GENETICS

- Variations and mutations
- Natural selection and its types
- Concept of gene pool, gene frequencies – equilibrium frequency (Hardy-Weinberg equilibrium),
- Genetic drift and gene flow

PRACTICALS: (1 CREDIT)

List of Practicals:

- Study of fossil evidences from plaster cast models and pictures
- Study of homology and analogy from suitable specimens/ pictures
- Demonstration of changing allele frequencies with and without selection
- Construction of cladogram based on morphological characteristics
- Charts:
  - Phylogeny of horse with diagrams
  - Darwin's finches with diagrams/ cut outs of beaks of different species

SUGGESTED BOOKS / READING MATERIAL

- Ridley, M. (2004). Evolution. III Edition. Blackwell Publishing
- Hall, B. K. and Hallgrimsson, B. (2008). Evolution. IV Edition. Jones and Bartlett Publishers
- Campbell, N. A. and Reece J. B. (2011). Biology. IX Edition, Pearson, Benjamin, Cummings.
- Douglas, J. Futuyma (1997). Evolutionary Biology. Sinauer Associates.
- Minkoff, E. (1983). Evolutionary Biology. Addison-Wesley
- Mathur, Tomar, Singh. Evolution and Behaviour. Rastogi Publication, Meerut
- Mohan P. Arora. Evolutionary Biology, Himalaya Publishing House, Bombay.

BACHELORS WITH ZOOLOGY AS MINOR (CT – I)

8th SEMESTER

ZOL822N ZOOLOGY _ EVOLUTIONARY BIOLOGY

CREDITS: THEORY: 3; PRACTICAL: 1

LEARNING OBJECTIVE:

To develop a deeper understanding of the concepts & mechanisms of evolution including natural selection, population bottlenecks & genetic drift.

LEARNING OUTCOME:

Be able to clearly understand the link between environment and evolution. Be familiar with the different agents of evolution.

THEORY (03 CREDITS)

UNIT I: CONCEPT AND THEORIES OF EVOLUTION

- Concept of evolution, historical review of evolutionary concept
- Lamarckism
- Darwinism
- Neo-Darwinism

UNIT II: EVIDENCES OF EVOLUTION

- Analogy and homology
- Embryological & molecular evidences
- Paleontological evidences; Fossils, types and dating
- Phylogeny of horse

UNIT III: EVOLUTIONARY CHANGES & PRINCIPLES OF POPULATION GENETICS

- Variations and mutations
- Natural selection and its types
- Concept of gene pool, gene frequencies – equilibrium frequency (Hardy-Weinberg equilibrium),
- Genetic drift and gene flow

PRACTICALS: (1 CREDIT)

List of Practicals:

- Study of fossil evidences from plaster cast models and pictures
- Study of homology and analogy from suitable specimens/ pictures
- Demonstration of changing allele frequencies with and without selection
- Construction of cladogram based on morphological characteristics
- Charts:
  - Phylogeny of horse with diagrams
  - Darwin's finches with diagrams/ cut outs of beaks of different species

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- Campbell, N. A. and Reece J. B. (2011). Biology. IX Edition, Pearson, Benjamin, Cummings.
- Douglas, J. Futuyma (1997). Evolutionary Biology. Sinauer Associates.
- Minkoff, E. (1983). Evolutionary Biology. Addison-Wesley
- Mathur, Tomar, Singh. Evolution and Behaviour. Rastogi Publication, Meerut
- Mohan P. Arora. Evolutionary Biology, Himalaya Publishing House, Bombay.

BACHELORS WITH ZOOLOGY AS MAJOR (CT – III)
8th SEMESTER

ZOL822J3 ZOOLOGY _ APPLIED ZOOLOGY

CREDITS: THEORY: 4; PRACTICAL: 2

LEARNING OBJECTIVE:
The learner will understand application of technology in zoology and human welfare thereof and to train them for their livelihood.

LEARNING OUTCOME:
The knowledge can be utilized to generate self-employment opportunity

THEORY (4 CREDITS)

UNIT I: APPLIED ENTOMOLOGY
- Insects as food & medicine
- Insects as biological control agents
- Role of insects in forensic sciences
- Role of beneficial insects in agriculture

UNIT II: ANIMAL BREEDING AND ANIMAL PRODUCTS
- Inbreeding and outbreeding; modern methods of breeding for improvement of sheep and cattle
- Types, action and uses of different animal venoms with reference to snakes
- Classification, action and uses of animal poisons
- Vermiculture and vermicompost

UNIT III: AQUACULTURE AND CULTURE TECHNIQUES
- Aquaculture: status and prospects; application of biotechnology in aquaculture; induced breeding
- Trout and carp culture
- Prawn culture & pearl culture techniques
- Composite fish culture and integrated fish farming

UNIT IV: ANIMAL BIOTECHNOLOGY
- Concept and scope of biotechnology
- Gene manipulation
- Genetically modified organisms: production of cloned and transgenic animals & their importance
- Recombinant DNA technology and its applications for production of useful molecules

PRACTICAL (FIELD VISITS) (2 CREDITS)
- Field visit to any dairy farm/poultry farm
- Filed trip to any fish farm/hatchery/aquarium
- Field trips to any apiculture/sericulture station
- Submission of report on field visits mentioned above

SUGGESTED BOOKS / READING MATERIAL

- Dennis, H. (2009). Agricultural Entomology. Timber Press
- Sericulture, FAO Manual of Sericulture.
- Hafez, E. S. E. (1962). Reproduction in Farm Animals, Lea and Fabiger Publishers.
- Srivastava, C. B. L. (1999). Fishery Science and Indian Fisheries. Kitab Mahal publications, India.
- Sardar Singh, Beekeeping in India, Indian council of Agricultural Research, New
- Principles and Applications of Recombinant DNA, ASM press, Washington, USA.
- Hafez, E. S. E. (1962). Reproduction in Farm Animals. Lea & Fabiger Publisher
- Dunham R.A. (2004). Aquaculture and Fisheries Biotechnology. CABI publications, U.K.
- An Introduction to Fishes by H.S. Bhamrah, Kavita Juneja Anmol Publications Pvt Ltd
- Text Book of Applied Zoology by P.V. Jabde, Discovery Publishing House