



हिमाचल प्रदेश केन्द्रीय विश्वविद्यालय

Central University of Himachal Pradesh

(Established under Central Universities Act 2009)

शैक्षणिक खण्ड, शाहपुर ज़िला काँगड़ा, हिमाचल प्रदेश -176206

Academic Block, Shahpur, Distt. Kangra (HP) – 176206

Website: www.cuhimachal.ac.in

SEMESTER - I

Course Code: ZOO 415

Course Name: Animal Physiology

Credit: 02

Objectives of the Course:

- To enable the students to know about all the physiological processes going on in animal/human body.
- To make the students understand the functions of hormones and their mode of action at molecular level.

Course Learning Outcome: Upon completion of the course, students should be able to:

- Recognize and explain how all physiological systems work in unison to maintain homeostasis in the body; and use of feedback loops to control the same.
- Learn an integrative approach to understand the interactions of various organ systems resulting in the complex overall functioning of the body.

Course contents:

UNIT - I: DIGESTION & RESPIRTION

Digestion: Mechanism of digestion & absorption of Carbohydrates, Proteins, Lipids and Nucleic acids. Composition of bile, Saliva, Pancreatic, gastric and intestinal juices. Respiration: Exchange of gases, Transport of O₂ and CO₂, Oxygen dissociation curve, Chloride shift.

UNIT - II: CIRCULATION AND CARDIAC SYSTEM

Composition of blood, Plasma proteins and their role, blood cells, Haemopoisis, Mechanism of coagulation of blood. Mechanism of working of heart: Cardiac output, Cardiac cycle, origin and conduction of heart beat.

UNIT - III: EXCRETION AND MUSCLE CONTRACTION

Excretion: modes of excretion, Ornithine cycle, Mechanism of urine formation. Structure of Cardiac, Smooth & Skeletal muscles, threshold stimulus, All or None rule, single muscle twitch, muscle tone, isotonic and isometric contraction, Physical, chemical & electrical events of mechanism of muscle contraction.

UNIT – IV: NERVOUS SYSTEM AND NEUROTRANSMITTER



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Neurons, action potential, gross neuroanatomy of the brain and spinal cord, central and peripheral nervous system, neural control of muscle tone and posture. Mechanism of generation and propagation of nerve impulse, structure of synapse, synaptic conduction, saltatory conduction, Neurotransmitters.

UNIT – V: ENDOCRINOLOGY AND REPRODUCTION

Mechanism of hormone action (insulin and steroids) Different Endocrine glands- Hypothalamus, Pituitary, pineal, thymus, thyroid, parathyroid and adrenals, hypo & hyper-secretions. Male and female reproductive system, spermatogenesis and oogenesis.

SUGGESTED BOOKS:

1. Ruegg, J.C., Calcium in muscle activation, Springer Verlag Berlin Heidelberg, New York. 25
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, Berlin Heidelberg, New York.
5. Prosser, C.L. and Brown, F.A. comparative Animal Physiology 2nd Ed. W.B. Saunders, Philadelphia.
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.



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Website: www.cuhimachal.ac.in

Course Code: ZOO 416 Course Name: Structure and Function of Invertebrates

Credit: 02

Objectives:

- To enable the students to develop an appreciation for the biodiversity of invertebrate species.
- To impart knowledge about co-existence of different forms of living organisms ranging from unicellular to multicellular animals.

Course Learning Outcome: Upon completion of the course, students should be able to:

- Learn about the importance of systematics, taxonomy and structural organization of animals. Appreciate the diversity of non-chordates living in varied habit and habitats.
- Critically analyse the organization, complexity and characteristic features of non-chordates making them familiarize with the morphology and anatomy of representatives of various animal phyla.

Course contents

UNIT I: PROTOZOA AND PORIFERA

Protozoa: General organization of Protozoa with special reference to feeding, locomotory organelles and locomotion, reproduction.

Porifera: General organisation of phylum Porifera with special reference to canal system, skeleton and development.

UNIT II: PHYLUM COELENTERATA AND PLATYHELMINTHES

Coelenterata: General organisation of phylum Coelenterata with special reference to polymorphism, corals and coral reefs, development and alternation of generation.

Platyhelminthes: General organisation of phylum Platyhelminthes with special reference to body wall. Digestive system, excretory system and reproductive system. Development and life cycles of *Fasciola* and *Taenia*.

UNIT III: PHYLUM ASCHELMINTHES AND ANNELIDA

Aschelminthes: General organisation of phylum Aschelminthes. Life cycle of *Ascaris lumbricoides*.



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Annelida: General organisation of phylum Annelida with special reference to segmentation, digestive, excretory and reproductive systems.

UNIT IV: PHYLUM ARTHROPODA

Arthropoda: General organisation of Arthropoda. Digestive, Respiratory and Reproductive systems.

UNIT-V: PHYLUM MOLLUSCA AND ECHINODERMATA

Mollusca: General organisation of Mollusca with special reference to feeding, respiration and shell diversity, podium or foot in Mollusca, torsion and detorsion in Gastropoda.

Echinodermata: General organisation of Echinodermata, Comparative account of water vascular system, haemal and perihemal systems, Larval forms in Echinodermata.

SUGGESTED BOOKS:

1. Invertebrate Zoology ----- EL Jordan; P.S. Verma
2. A Text Book of Zoology Vol.I ----- P.S. Dhami; Jk.Dhami.
3. A Text Book of Invertebrate zoology ----- R.L.Kotpal.
4. Biology of Animals --- Cleveland P. Hickman JR Larryds. Roberts.
5. Hyman, L.H. The invertebrates. Vol. I protozoa through Ctenophora, McGraw Hill Co., New York.
6. New York.
7. Barrington, E.J.W. Invertebrate structure and function. Thomoes Nelson and sons Ltd. London.
8. Jagerstein, G. Evolution of Metazoan life cycle, Academic Press, New York & London.
9. Hyman, I. H. the Invertebrates. Vol. 2 Mc Graw Hill. Co., New York.
10. Hyman, L.H. The Invertebrates Vol. 8, McGraw Hall. Co., New York. & London.
11. Barnes, R.D. Invertebrate Zoology, III edition, W.b. Saunders Co., Philadelphia
12. Russel Hunter, W.D.A biology of higher invertebrates, the Macmillan co. Ltd. London.
13. Hyman, L.H. The invertebrate's smaller coelomate groups. Vol. V Mc Graw Hill Co. New York.
14. Parker, T.J. Haswell, W.A. Text book of Zoology, Macmillan co., London.



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Website: www.cuhimachal.ac.in

Course Code: ZOO 417

Course Name: Cell and Molecular Biology

Credit: 02

Course Learning Objective: The objective of the course is to help the students

- To learn and develop an understanding of a cell as a basic unit of life.
- To understand the functions of cellular organelles and how a cell carries out and regulates cellular functions.

Course Learning Outcome: The students will:

- Be able to understand how the cell functions as a unit of life.
- Be able to draw parallels between the physiological processes at the cellular and organismic levels.

Course contents

UNIT- I: CELL STRUCTURE AND FUNCTIONS

Introduction to Cell biology, Basic properties of cells. Structural organization and function of intracellular organelles: Nucleus, Mitochondria, Endoplasmic reticulum, Golgi complex, Lysosomes, Peroxisomes.

UNIT- II: CELLULAR MEMBRANE AND CYTOSKELETON

An overview of membrane functions. Membrane models. Chemical composition of cell membrane. Structure and functions of membrane proteins: Integral protein, peripheral membrane proteins and lipid-anchored membrane proteins. Structure and organization of Microtubules, Intermediate filaments and Microfilaments and their role in cell motility.

UNIT- III CELL SIGNALLING AND CELL TRANSPORT

Different mechanism of cell signalling pathways, Movement of substances across cell membranes: Diffusion, active transport, uniport, symport and antiport.

UNIT- IV: FUNDAMENTAL PROCESSES IN MOLECULAR BIOLOGY

DNA and its organization in cell; structure; A, B, and Z forms. Replication, Transcription, translation, damage and repair. Regulation of gene expression in prokaryotes and eukaryotes

UNIT- V: BASIC TECHNIQUES

Microscopy application and types (TEM and SEM). Centrifugation and Polymerase chain reaction (PCR). Molecular Markers (RFLP, RAPD, SSR's and SNP's), Blotting techniques.

SUGGESTED BOOKS:



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1. Lewin, B. 2000. Genes VIII Oxford University, Press, New York
2. 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.
3. Wolfe, S.L. 1993, Gruissem, W. and Jones, R.L. 2000, Biochemistry and molecular biology of plants, American society of plant physiologists, Maryland, USA
4. Frifelder, D. Molecular Biology. John and Bartlett Publishers, inc., Boston, USA



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Website: www.cuhimachal.ac.in

Course Code: ZOO 418

Course Name: Cell and Molecular Biology & Animal
Physiology Lab

Credit: 02

Objectives of the Course:

- To enable the students to know about all the physiological processes going on in animal/human body.
- Provide knowledge about the complex organization in the eukaryotic cell and the molecular mechanisms of the cellular processes that exist in all cell types.

Course Learning Outcome: Upon completion of the course, students should be able to:

- Learn an integrative approach to understand the interactions of various organ systems resulting in the complex overall functioning of the body.
- Gain knowledge about the techniques and experiments that contributed to the understanding of molecular mechanisms of the cellular processes.

Course contents

1. Study of permanent histological slides of testis and ovaries of insects/ mice/rat.
2. Basis of reaction and demonstration of the sites of proteins, nucleic acids, lipids & carbohydrates in ovaries of insects/rat/mice through slides and photographs.
3. Study of stages of mitosis and meiosis from permanent slides from animal and plant materials through slides/charts/photographs.
4. To demonstrate that the optimum activity of salivary amylase is pH dependent.
5. Demonstration of estimation of Haemoglobin.
6. Demonstration of determination of TLC, DLC, RBC & Count.
7. Demonstration of determination of bleeding and clotting time.
8. Demonstration of determination of blood groups.
9. Demonstration of measurement of blood pressure.
10. Demonstration of estimation of ESR.
11. To study the effect of exercise on cardiovascular and respiratory systems.
12. Demonstration of estimation of the glucose level in blood of mammal, Haematocrit

SUGGESTED BOOKS:

1. Lewin, B. 2000. Genes VIII Oxford University, Press, New York
2. 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.



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3. Wolfe, S.L. 1993, Gruissem, W. and Jones, R.L. 2000, Biochemistry and molecular biology of plants, American society of plant physiologists, Maryland, USA
4. Frifelder, D. Molecular Biology. John and Bartlett Publishers, inc., Boston, USA
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.
8. Prosser, C.L., Comparative Animal Physiology, W.B. Saunders, Toppen Publication.



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Website: www.cuhimachal.ac.in

Course Code: ZOO 419

Course Name: Structure and Function of Invertebrates

Lab

Credit: 02

Objectives:

- To make the students know about the habitat, habits, morphology and economic importance of various types of invertebrates.

Course Learning Outcome: Upon completion of the course, students should be able to:

- Comprehend the economic importance of non-chordates, their interaction with the environment and role in the ecosystem.

Course contents

1. PORIFERA

- a) Specimens: *Scypha*, *Grantia*, *Spongilla*, *Euplectella*, *Hyalonema*, *Euspongia*.
- b) Prepared slides: Spicules, gemmules, *Sycon* (T.S and L.S) gemmules and spicules.

3. COELENTERATA

- a) **Specimens:** *Porpita*, *Physalia*, *Aurelia*, *Metridium*, *Alcyonium*, *Tubipora*, *Madrepora*, *Fungia*, *Gorgonia* and *Pennatula*.
- b) Prepared slides: Hydra (W.M.), T.S. through regions of testis and ovary, *Obelia* (colony, medusa and polyp), *Sertularia*, *Plumularia*, *Tubularia*, *Bougainvillea*, *Aurelia*, *Obelia*, *Sertularia* and *Plumularia*
- c) Preparation of permanent slides.

4. PLATYHELMINTHES

- a) Specimens: *Planaria*, *Dugesia*, *Fasciola*, *Taenia*, and *Echinococcus*.
- b) Slides: *Fasciola* (miracidium, sporocyst, redia and cercaria), scolex and proglottids of *Taenia* (Mature and gravid L.S. & T.S.).
- c) Stained preparation of: Amphistome, proglottid of a cestode.

5. ASCHELMINTHES

- a) Specimens: *Ascaris* (Male and female)
- b) Slides: *Ascaris* (T.S. of male and female gravid).

6. ANNELIDA



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- Demonstration of dissection of Earthworm (digestive, nervous and reproductive systems) through video clippings/models/charts.
- Specimens: *Nereis*, *Heteronereis*, *Polynoe*, *Tubifex*, *Eunice*, *Aphrodite*, *Chaetopterus*, *Arenicola*, *Pontobdella*, *Amphitrite* and *Hirudinaria*.

7. ARTHROPODA

- Specimens: *Peripatus*, *Lepisma*, Cockroach, Grasshopper, Praying mantis, Earwig, Dragonfly, Termite (queen and other castes), Ant, Butterfly, Moth, Beetles, Wasp, Honeybee, Crab, Prawn, *Lepas*, *Balanus*, *Apus*, *Limulus*, Scorpion, Spider, *Millepede* and *Centipede*.

8. MOLLUSCA

- Demonstration of dissection of *Anodonta* (digestive and nervous systems) through video clippings/models/charts.
- Specimens: *Anodonta*, *Mytilus*, *Pholas*, *Pecten*, *Haliotis*, *Aplysia*, *Doris*, *Limax*, *Pila*, *Sepia*, *Octopus*, *Nautilus*, *Chiton* and *Dentalium*.
- Prepared Slides: Glochidium larva, radula of *Pila*, gill lamina of *Anodonta*.

9. Echinodermata

- Specimens: *Asterias*, *Echinus*, *Cucumaria*, *Antedon*, *Ophiothrix*.

SUGGESTED BOOKS:

- Invertebrate Zoology ----- EL Jordan; P.S. Verma
- A Text Book of Zoology Vol.I ----- P.S. Dhami; Jk.Dhami.
- A Text Book of Invertebrate zoology ----- R.L.Kotpal.
- Biology of Animals --- Cleveland P. Hickman JR Larryds. Roberts.
- Hyman, L.H. The invertebrates. Vol. I protozoa through Ctenophora, McGraw Hill Co., New York.
- Barrington, E.J.W. Invertebrate structure and function. Thomoes Nelson and sons Ltd. London.
- Jagerstein, G. Evolution of Metazoan life cycle, Academic Press, New York & London.
- Hyman, I. H. the Invertebrates. Vol. 2 Mc Graw Hill. Co., New York.



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11. Barnes, R.D. Invertebrate Zoology, III edition, W.b. Saunders Co., Philadelphia
12. Russel Hunter, W.D.A biology of higher invertebrates, the Macmillan co. Ltd. London.
13. Hyman, L.H. The invertebrate's smaller coelomate groups. Vol. V Mc Graw Hill Co. New York.
14. Parker, T.J. Haswell, W.A. Text book of Zoology, Macmillan co., London.



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Website: www.cuhimachal.ac.in

Course Code: ZOO 420

Course Name: Entomology

Credit: 02

Objectives of the Course:

- To make the students aware of various pests of food crops and food products and various insect control methods.
- To educate the students about economic importance and techniques of Apiculture and sericulture
- To introduce students to the various orders and some of the most important families of insects so that they can distinguish between harmful and beneficial insects, which form the basis of entomology.

Course Learning Outcomes: After completion of the course, the students will be able to:

- Appreciate the diversity of insects.
- Understand the physiology of Insects which has made them the most successful animals in terms of numbers and variety of species.
- Get a glimpse of the highly organized social life of insects.

Course Contents:

UNIT- I: INTRODUCTION TO CLASS INSECTA

General Introduction of Class Insecta: Characteristic and adaptive features for diversity, Basis of classification and classification up to orders.

General Anatomical description of Insect body: Segmentation and Tagmosis; Integument-structure and function of cuticle, Moulting, Sclerotization and Colouration; Head-Structure of head, Appendages and Antennae, types of antennae; Thorax- Generalized thoracic structure, Appendages of thorax, Types of legs, Development of wings, Types of wing, Flight mechanism, Abdomen- Structure, Appendages; External genitalia.

UNIT-II: DIGESTION, RESPIRATION AND CIRCULATION IN INSECTS

Digestive system: Mouth parts, types and feeding mechanism, Structure of alimentary tract and accessory glands, mechanism of digestion and absorption; Respiratory system: Aerial respiration- spiracles, trachea and tracheoles; Aquatic respiration, mechanism of gas exchange; Circulatory system: organs and mechanism of circulation, haemolymph and haemocytes.

UNIT-III: EXCRETION, REPRODUCTION AND NERVOUS SYSTEM OF INSECTS



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Excretory system: Organs and physiology of excretion, Osmoregulation; Reproductive system: Female & Male reproductive systems; Modes of reproduction; Nervous system- vision (Structure of compound eye, Formation of image) and acoustics (Sound production organs, structure and Mechanism of sound production).

UNIT-IV: SOCIAL, BENEFICIAL AND HARMFUL INSECTS

Social Insects: Evolution of Sociality, Life cycle and Social organization of termites, honeybees and ants.

Beneficial and Harmful Insects: Pollinator and Edible insects, Insect pests of agricultural and medical importance.

UNIT-V: INSECT DEVELOPMENT AND COMMUNICATION

Chemical Communication in Insects: Pheromones and allomones-chemistry and functions; Bioluminescence: Structure of organs and mechanism of light production; Endocrine system: Insect hormones, Metamorphosis; Insect development: Types of larvae and pupae.

SUGGESTED BOOKS:

1. Imms, A. D., A general text book of entomology, Chapman & Hall, UK
2. Borror, D. J., Triplehorn, C. A., and Johnson, Introduction to the study of insects, N. F., M Saunders College Publication, USA
3. Gullan, P. J., and Cranston, P. S., The Insects, An outline of Entomology, Wiley Blackwell, UK
4. Snodgrass, R. E., Principles of Insect Morphology, Cornell Univ. Press, USA
5. Chapman, R. F., The Insects: Structure and function, Cambridge University Press, UK
6. Wilson, E. O., The Insect Societies, Harvard Univ. Press, UK .
7. Wigglesworth, Vincent B, The Principles of Insect Physiology, Chapman & Hall Ltd. USA.
8. Klöden, M. J., Physiological system in Insects, Academic Press, USA



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Website: www.cuhimachal.ac.in

Course Code: ZOO 421

Course Name: Ecology, Environment and Biodiversity

Credit: 02

Objectives of the Course:

- To acquaint the students with the habitat and interactions of diverse animal groups with their environment.
- To educate the students about the basic environmental phenomena like ecosystem, energy flow through the ecosystem and biogeochemical cycles.
- To enable the students to develop an appreciation for the biodiversity of invertebrate and vertebrates.

Course Learning Outcomes:

- Students will be exposed to the fundamental aspects of ecology.
- They will get idea about the impact of anthropogenic activities on the environment.
- Students will get idea about the natural resources and their conservation.
- Apply the basic principles of ecology in wildlife conservation and management.

Course Contents:

UNIT-I: CONCEPT AND STRUCTURE OF ECOSYSTEM

Physical environment; biotic and abiotic factors, Ecosystem and its types, Ecosystem structure, function productivity and energy flow. Habitat, ecological niche, fundamental and realized niche; resource partitioning; character displacement. Ecological succession and its types

UNIT-II: POPULATION ECOLOGY

Characteristics of a population; population growth curves; population regulation; life history strategies (r and K selection), Species Interactions and its types

UNIT-III: BIODIVERSITY AND ITS CONSERVATION

Biological diversity: concepts and levels, role of biodiversity in ecosystem functions and stability, Categories of threat, Terrestrial biodiversity hot spots. Conservation of biodiversity: *In-situ* and *Ex-situ* conservation of biodiversity.

UNIT-IV: BIODIVERSITY MANAGEMENT

Sustainable development, natural resource management in changing environment. Molecular ecology, genetic analysis of single and multiple population, phylogeography, molecular approach to behavioural ecology, conservation genetics.

UNIT-V: ENVIRONMENTAL POLLUTION



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Air pollution, Water pollution, Soil pollution, Noise pollution, Ozone and climate change.

SUGGESTED BOOKS:

1. Charls J. Krebs. 1972. Ecology: The Experimental Analysis of Distribution and Abundance
2. Philipson, J. 1966. Ecological Energetic, Edward Arnold Ltd. London.
3. Odum, E. P. 1970: Ecology, Amerind Publ. Co. New Delhi.
4. Kormondy, E. T. 1971. Concept of Ecology. Prentice Hall of India, New Delhi.
5. Ricklefs, R. E. 1973. Ecology. Thomes Nelson and sons ltd.
6. Colinbaux, P. A. 1985 Introduction to ecology. John Wiley & Sons.
7. Wiegert, R. G. 1976. Ecological Energetic Dowden, Hutchinson & Ross. Inc. Pennsylvania.
8. Scuthwick, C. H. 1976. Ecology and the quality of four environment. D. Van Nestrand
9. Fahey, J. J., and Knapp, A. K. 2007. Principles and Standards for measuring primary production. Oxford Univ. Press. UK.
10. Grant, W. E. and Swanmack, T. M. 2008. Ecological Modeling. Blackwel Publ. Hou
11. 1. Evolution, Barton, N. H., Briggs, D. E. G., Eisen, J. A., Goldstein, A. E., Patel, N. H., Cold Spring Harbor Laboratory Press, New York, USA
12. 2. Evolution, Hall, B. K. and Hallgrimsson, B., Jones and Bartlett Publisher, Sudbury, USA
13. 3. Evolution, Futuyma, D. J., Sinauer Associates, Inc., Sunderland, USA
14. 4. What Evolution Is, Mayr, E., (2001), Basic Books, New York, USA



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Website: www.cuhimachal.ac.in

Course Code: ZOO 422

Course Name: Immunology

Credit: 02

Course Learning Objective:

- To enable understanding the molecular and cellular basis of the development and function of the immune system and identification of its biological, clinical and therapeutic implications.
- To make the student understand the role of immunity in controlling the pathogenic infection.
- To acquaint the students with the defense mechanisms of animals/bodies.

Course Learning Outcome: After completion of the course the students will be able to:

- Define the cellular/molecular pathways of humoral/cell-mediated adaptive responses including the role of Major Histocompatibility Complex
- Integrate knowledge of each subsystem to see their contribution to the functioning of higher-level systems in health and disease including basis of vaccination, autoimmunity, immunodeficiency, hypersensitivity and tolerance.

Course Contents:

UNIT –I: OVERVIEW OF IMMUNE SYSTEM

Components of the immune system, principles of innate and adaptive immunity, antigen and immunogenicity, clonal selection theory; Evolution of immune system.

UNIT –II: PATTERN RECOGNITION AND BCR

Antigen recognition by immune cells: Innate Immunity- Pattern recognition in the innate immune system, TLRs and their role in innate immune response; Adaptive immunity-Antibody structure, antigen recognition by B lymphocytes; molecular mechanism behind BCR formation; B lymphocyte development and survival. Structure and function of MHC complex: antigen processing cells, antigen processing and presentation to T lymphocytes, MHC restriction.

UNIT –III: TCR- STRUCTURE AND FUNCTION

TCR structure and function: T-cell receptor gene rearrangement; T lymphocyte development and survival; Antigen recognition by T-cells, signaling through TCR and T-cell activation, co-receptors and their role in T –cell functioning; co-stimulation.

UNIT –IV: EFFECTOR MECHANISM OF IMMUNE SYSTEM



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Effector mechanisms and regulation of immune responses: Induced innate response to infection, Innate memory, Complement system, NK and NKT cell functions, Humoral immune response, Production of effector T- cells, cytotoxic T- cell effector mechanisms.

UNIT –V: REGULATION OF IMMUNE SYSTEM

Regulation of immune response: Leukocyte activation and migration, Cytokines, innate regulation of the immune response, T-cell mediated immune response, Immunological tolerance. Mucosal immunity. Immunity in health and disease: Allergy and hypersensitivity, Autoimmunity, Immunodeficiency diseases

SUGGESTED BOOKS:

1. Kuby Immunology, Richard, Thomas, Barbara, Janis , W. H. Freeman and Company [Latest edition].
2. Immuno Biology- The immune system in health and disease, Janeway, Travers, Walport and Shlomchik, Garland Science Publishing [Latest edition].
3. Essentials of Immunology, David, Brostoff and Roitt, Mosby & Elsevier Publishing [Latest edition].
4. Fundamentals of Immunology by William E. Paul, Lippincott Williams & Wilkins Publishing [Latest edition].
5. Cellular and Molecular Immunology by Abul K. Abbas, Andrew H. Lichtman, Shiv Pillai, Elsevier Publishing [Latest edition].



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Website: www.cuhimachal.ac.in

Course Code: ZOO 423

Course Name: Advanced Techniques in Biology

Credit: 02

Objectives of the Course: To acquaint the students with various instruments and methodological techniques enable them to peruse scientific research in future

Course Learning Outcome:

To demonstrate proper and safe laboratory practice, proper use of equipment, and the ability to use basic techniques in several areas and advanced techniques.

Course Contents:

UNIT –I: MICROSCOPY AND IMAGE ANALYSIS

Significance of microscopy, stereoscopic zoom microscope, compound microscope, Bright field microscope; fluorescence microscope; confocal microscope,

UNIT –II: ELECTRON MICROSCOPY

Scanning Electron Microscope (SEM) and Transmission Electron Microscope (TEM). Image acquisition and data analysis.

UNIT –III: ANALYTICAL TECHNIQUES AND INSTRUMENTATION

Colorimetry; Spectrophotometry, Atomic Absorption Spectrophotometry (AAS), Basic Lab Instruments Skills using Laminar Air Flow, Incubator, Oven, Autoclave etc. Cell Staining Techniques, Cell Culture of Prokaryote and Eukaryote. Basic Sterilization Techniques in Laboratory. Reagent Preparation in Lab.

UNIT –IV: CHROMATOGRAPHY

Chromatographic Techniques, Thin Layer Chromatography, Paper Chromatography, High Performance Liquid Chromatography, Gas Chromatography, GC Mass Spectroscopy.

UNIT –V: ELECTROPHORESIS AND PCR

Electrophoresis and PCR, Immunological techniques like ELISA and RIA, Chromatography – HPLC/GCMS, ICPMS.

SUGGESTED BOOKS:

1. Principles and Techniques in biochemistry and molecular biology Wilson & Walkes
2. Culture of animal cells Freshuay



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3. Sharma V.K. (1991), Techniques in microscopy and cell Viology, Tata-Mc Craw Hil.
4. Robert Braun Introduction to instrumental analysis Mc.Crew.Hil
5. Bisen & Mathw. Tools and Techniques in Life Sciences,CBS Publishers & distributors.
6. Principles of animal cell culture, Basant Kumar & Rinesh Kumar, Int.Bork 2008, XXII edn.



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Website: www.cuhimachal.ac.in

Course Code: ZOO 424

Course Name: Basics of Wild Life Studies

Credit: 02

Objectives of the Course:

- To educate the students about the basic environmental phenomena like pollution, ecosystem, biogeochemical cycles, etc.
- To educate the students about the importance of wild life conservation.

Course Learning Outcome:

- Identify problems in wildlife and conservation biology
- Know the principles of wildlife and conservation biology and how they are used to manage wildlife and solve environmental problems

Course Contents:

Unit - I: BASIC CONCEPT OF WILDLIFE BIOLOGY

Definition and importance of wildlife and biodiversity; Values of wildlife- positive and negative; Threatened wildlife and IUCN status - Concept of Extinct, Critically Endangered, Endangered, Vulnerable and rare species; Red data book;

Conservation ethics; Importance of conservation; Causes of depletion; World conservation strategies: WCS, CBD, Agenda 21

Unit – II: WILDLIFE SAMPLING

Random sampling, systematic sampling, stratified sampling, cluster sampling (Basics).

Habitat analysis: a) Physical parameters: Topography, Geology, Soil and water; b) Biological Parameters: food, cover, forage, browse and cover estimation; Faecal analysis of ungulates and carnivores: Faecal samples, slide preparation, and Hair identification; Pug marks and Census methods, Standard evaluation procedures: remote sensing and GIS.

Unit – III: WILDLIFE CONSERVATION STRATEGIES AND POLICIES

Estimation of carrying capacity; Human-wildlife conflict; Eco tourism / wild life tourism in forests; Climax communities: characteristics and theories; Ecology of perturbation.

In situ and *Ex situ* conservation- problems and prospects; Sanctuaries, National parks, Community Reserves and Conservation Reserves; Biosphere Reserve, Concept of corridor. Environmental Laws- Environment Protection Act, Air act, Water act, Wildlife protection act, Forest conservation act

Unit – IV: WILDLIFE CONSERVATION IN INDIAN PERSPECTIVE



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Aims & Objectives of wildlife conservation. Wildlife wealth of India; causes for depletion of Indian wildlife; wildlife conservation in India- through age, post-independence initiatives. Different approaches for conservation – *in situ* and *ex situ*.

Unit – V: MANAGEMENT OF IMPORTANT WILD ANIMALS

Conservation status, habit & habitat, behavioural biology, threats and conservation management of the animals-Himalayan salamander/Olive ridley turtles/Great Indian bustard/Himalayan musk deer/Ganges river dolphin.

- Project tiger
- Project elephant
- Project crocodile

SUGGESTED BOOKS:

1. Saha, G.K. and Mazumdar, S. (2017). Wildlife Biology: An Indian Perspective. PHIlearning Pvt. Ltd. ISBN: 8120353137, 978-812035313
2. Sinclair, A.R.E., Fryxell, J.M. and Caughley, G. (2006). Wildlife Ecology, Conservation and Management. Wiley-Blackwell, Oxford, UK.
3. Singh, S.K. (2005). Text Book of Wildlife Management. IBDC, Lucknow.
4. Singh, I.K. and Maurya A.K. (2016) Basics of Environmental Studies, Book Age Publications, ISBN: 9789383281411



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Course Code: ZOO 425

Course Name: Medical Microbiology

Credit: 02

Objectives of the Course :

- The main objective of this course is to provide basic knowledge to students on various microbiological practices in the laboratory.
- To elaborate their knowledge in basic microbiology techniques and performing experiments to identify unknown bacteria by biochemical tests, fungal cultivation and staining, special media.

Course Learning Outcome:

- Understand the methods of cultivation of microorganisms
- To understand and perform various biochemical tests to identify unknown microorganisms, practical exposure to fungus cultivation and staining.
- To understand the use of differential, selective and special media

Course Contents:

Unit I: INTRODUCTION TO MEDICAL MICROBIOLOGY

Principles of classification of microbes; morphological, metabolic and molecular criteria for the classification, A brief introduction to major group of bacteria. Ultra structure of bacteria. Microbial Cultivation, Growth curve and factors influencing growth. Nutritional types requirements of bacteria.

Unit II: STERILIZATION AND STAINING

Disinfection and sterilization: Staining characteristics and techniques. Serological characteristics, Bacterial respiration, Microbial Diversity.

Unit III: FOOD MICROBIOLOGY

Food Microbiology: Microbiology of dairy industry and beverage fermentation. Role of microorganisms in beverages tea and coffee fermentations. Vinegar Fermentation, microbiology of wine industry. Genetically modified foods. Biosensors in food.

Unit IV: ANTIBIOTICS AND THEIR MECHANISM OF ACTION

Antibiotics and their Mechanism of action. Molecular principles of drug targeting. Bacterial resistance to antibiotics. New vaccine technology, DNA vaccines, synthetic peptide vaccines, multivalent subunit vaccines. Vaccine clinical trials.

Unit V: MEDICAL MICROBIOLOGY

Diseases caused by Gram positive bacteria, Diseases caused by Gram



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negative bacteria, Disease caused by toxigenic bacteria, Diseases caused by Gram negative bacteria of family Enterobacteriaceae, sexually transmitted diseases, Overview of medical mycology, Overview of medical parasitology.

SUGGESTED BOOKS:

1. Mackie & McCartney Practical Medical Microbiology 14th edition: Eds: J.G.Colle, A.G. Fraser, B.P. Marmion, A.Simmons- Reprint 2008 Elsevier, New Delhi
2. Jawetz, Melnick & Adelberg's, Medical Microbiology 24th edition: Eds: Brooks and others, McGraw Hill, New York.
3. Koneman's Color Atlas and Text book of Diagnostic Microbiology 6th edn: Eds: Washington winn and others. 2006 Lippincott Williams and Wilkins, Baltimore, USA
4. Ananthanarayan and Paniker's Text book of Microbiology 8th edn. 2009 Universities Press, Hyderabad.
5. Ananthanarayan & Paniker's Textbook of Microbiology, 8th Ed., Orient Longsman, India; 2009.



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Course Code: -----

Course Name: Indian Knowledge system

Credit: 02

Detailed Syllabus will be provided by University level Committee



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SEMESTER - II

Course Code: ZOO 465

Course Name: Cytogenetics

Credit: 02

Course Learning Objective:

- To provide an overview of genetics starting from the work of Mendel to the current understanding of various phenomena like recombination, transposition, sex determination and mutations
- To introduce the basic concepts of inheritance patterns, genetic and genomic basis of traits.
- To inculcate a holistic understanding about the genetic basis of a particular clinical disorder.

Course Learning Outcome: Upon completion of the course, students will be able to:

- Have a deeper understanding of the varied branches of the biological sciences like microbiology, evolutionary biology, genomics and metagenomics.
- Gain knowledge of the basic principles of inheritance.
- Analyse pedigree leading to development of analytical skills and critical thinking enabling the students to present the conclusion of their findings in a scientific manner.

Course Content

UNIT –I CHROMOSOME ORGANISATION

Chromatin structure, Histones, DNA, nucleosome morphology and higher level organization. Functional states of chromatin. Metaphase chromosomes, centromere and kinetochore. Telomere and its maintenance. Holocentric chromosomes, heterochromatin and euchromatin. Giant chromosomes like Polytene and lampbrush chromosomes.

UNIT –II CELL DIVISION

Overview of mitosis and meiosis, sister chromatid cohesion remodeling, regulation of exit from metaphase, chromosome movement at anaphase. Stages in cell cycle.

UNIT –III CYTOPLASMIC INHERITANCE

Extra chromosomal inheritance. Inheritance of mitochondrial and chloroplast genes, maternal inheritance, Role of Mitochondrial inheritance in Evolution.

UNIT –IV DISEASE DUE TO CHROMOSOMAL ABBERATIONS AND CANCER



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Chromosomal anomalies. Structural and numerical alterations of chromosomes, Deletion, duplication, inversion, translocation, ploidy and their genetic implications and common disease due to chromosomal anomalies.

UNIT –V: CANCER GENETICS

Genetics and cancer: oncogenes- tumor inducing retroviruses and viral oncogenes; chromosome rearrangement and cancer; tumor suppressor genes- cellular roles of tumor suppressor genes, pRB, p53, pAPC, genetic pathways to cancer.

SUGGESTED BOOKS:

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.



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Course Code: ZOO 466

Course Name: Comparative anatomy of Vertebrates

Credit: 02

Objectives:

- To enable the students to develop an appreciation for the biodiversity of vertebrates.
- To draw a comparative account of anatomy of vertebrates and hence to understand the evolution of different systems in vertebrates.
- The course furnishes an understanding of evolutionary basis of morphological and anatomical differences as well as similarities that occur among vertebrates.

Course Learning Outcome: Upon completion of the course, students should be able to:

- Explain comparative account of the different vertebrate systems
- Learn the comparative account of integument, skeletal components, their functions and modifications in different vertebrates.
- Understand the evolution of heart, modification in aortic arches, structure of respiratory organs used in aquatic, terrestrial and aerial vertebrates; and digestive system and its anatomical specializations with respect to different diets and feeding habits.

Course Content

UNIT I: INTRODUCTION AND INTEGUMENTARY SYSTEM

Introduction to chordates. Organisation and affinities of *Herdmania* and *Amphioxus*. Comparative account of following systems of the vertebrates with evolutionary trends from Pisces to Mammals. Integumentary system: Integument and its derivatives.

UNIT II: SKELETAL AND DIGESTIVE SYSTEM

Skeletal system: Chondrocranium, Splanchnocranium, Dermatocranium, Jaw suspension. Digestive system: Alimentary canal and associated glands. (Types of teeth, dental formulae and functions, Types of stomach, small and large intestines, Glands : Salivary, gastric, Pancreas and liver).

UNIT III: CIRCULATORY AND RESPIRATORY SYSTEM

Circulatory system: Evolution of heart & aortic arches in different classes of vertebrates. Respiratory system: Respiratory organs. Types of respiratory mechanisms (gills, lungs, skin and accessory respiratory organs).

UNIT IV: URINOGENITAL SYSTEM

Urinogenital system: Succession of kidney (archinephros, pronephros, mesonephros, and metanephros), osmoregulation, evolution of gonads and urinogenital ducts.



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UNIT V: NERVOUS SYSTEM AND SENSE ORGANS

Nervous system: Comparative account and evolution of brain, spinal cord and cranial nerves.

Sense organs: Chemoreceptors, photoreceptors and mechanoreceptors

SUGGESTED BOOKS:

1. A Text Book of Zoology, Vol.II Vertebrates by A.J. Marshall, MacMillan & Co. Ltd., New York (1972).
2. Anatomy of Chordates by C.K. Weichert, McGraw Hill Book Co. Inc. London (1958).
2. Biology of Vertebrates by H.E. Walter and L.P. Sayles, McMillan Co. New York (1949).
3. Comparative Anatomy of Vertebrates by G.C. Kent, Torpen Co.Ltd., Tokyo (1954).
4. Anatomy of Comparative Vertebrates. Hyman, L. H. Satish Serial Pub. House 2004.



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Course Code: ZOO 467

Course Name: Biosystematics and Evolution

Credit: 02

Course Learning Objective: The study of evolutionary biology is essential for anyone who seeks to obtain an understanding of life and natural world. It is a unifying thread which joins all organisms from prokaryotes to highest of eukaryotes. This course emphasizes on the development of evolutionary thought by dealing in general with the process and pattern of biological evolution. On one hand, it offers a chance to students to learn about deciphering evidences ranging from fossil records to molecular data and arranges them to establish phylogenetic relationships of species, while, on the other, it provides a platform to understand various forces which bring about variations among populations of a species and cause them to diversify into new species.

Course Learning Outcome: Upon completion of the course, students should be able to:

- Acquire problem solving and high order analytical skills by attempting numerical problems as well as performing simulation studies of various evolutionary forces in action.
- Apply knowledge gained, on populations in real time, while studying speciation, behaviour and susceptibility to diseases.
- Gain knowledge about the relationship of the evolution of various species and the environment they live in.

Course Content

UNIT – I: DEFINITION AND BASIC CONCEPTS OF BIOSYSTEMATICS

Definitions and perspectives of systematics, classification and taxonomy, goals and importance, Taxa, Taxonomic keys-different kinds, their merits and demerits Polytypic species, race, variety, cline, subspecies, semispecies, super species. Trends in Biosystematics-concepts of different conventional and newer aspects-chemotaxonomy, cytotaxonomy, molecular taxonomy

UNIT – II: TAXONOMIC PROCEDURES

Taxonomic collections, preservation, curation, process of identification Taxonomic keys-different kinds, their merits and demerits, International code of zoological Nomenclature (ICZN)- its operative principles, interpretation and application of important rules, zoological nomenclature; formation of scientific names of various taxa

UNIT –III: INTRODUCTION TO EVOLUTION



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Lamarckism; Darwinism, Evolutionary history, Adaptation, struggle, fitness and natural selection, Types of Natural selection, Stabilizing selection, Sexual Selection, Group Selection, Directional Selection, Disruptive Selection Concepts of Oparin and Haldane, Miller's experiment.

UNIT – IV: ORIGIN AND EVOLUTION OF SPECIES

Speciation, Species concepts - Typological species concept, nominalistic species concept, biological species concept, evolutionary species concept, Difficulties in applying biological species concept.

UNIT – V: EVOLUTION FROM FISH TO MAMMALS

Origin of Vertebrates: Fishes, Amphibians, Reptiles, Aves and Mammals, Evolutionary history of man.

SUGGESTED BOOKS:

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. Elements 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, Molecular Markers, Natural History and Evolution, Chapman & Hall, New York.
9. Dobzhansky, Th. Genetics and Origin of Species. Columbia University Press.
10. Dobzhansky, Th; Ayala, F.J.; Stebbins, G.L. and Valentine, J.M. Evolution, Surjeet Publihsers, Delhi.
11. Futuyama, D.J. Evolutinary Biology, Suinuaer Associations. INC Publishers. Dunderand.
12. King, M. Species, Evolution –The role of chromosomal change. The Cambridge University Press, Cambridge.
13. Merrel, D.J. Evolution and Genetics Holt. Rinchart and Winston, Inc.
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Course Code: ZOO 468

Course Name: Developmental Biology

Credit: 02

Course Learning Objective:

- The course explains the basic principles and concepts underlying the developmental processes at the cellular and molecular level.
- The main objective of Developmental Biology course is to provide four-dimensional thinking of students to truly understand the patterns and process of embryonic development, body plan, fate map, induction, competence, regulative and mosaic development, molecular and genetic approach for the study of developing embryo which is not necessarily shared with any other disciplines in the biological sciences.

Course Learning Outcome: Upon completion of the course, students should be able to:

- Understand the events that lead to formation of a multi cellular organism from a single fertilized egg, the zygote.
- Describe the general patterns and sequential developmental stages during embryogenesis; and understand how the developmental processes lead to establishment of body plan of multi cellular organisms.
- Discuss the general mechanisms involved in morphogenesis and to explain how different cells and tissues interact in a coordinated way to form various tissues and organs.

Course Content:

Unit I: BASIC CONCEPTS OF DEVELOPMENT

Basic concepts of developmental biology- cell division, cell differentiation, signaling, patterning; Model systems: vertebrates model organisms- *Xenopus laevis*, mammals, invertebrate model organism- *Drosophila melanogaster*,

Unit II: GAMETOGENESIS, CLEAVAGE AND GASTRULATION

Embryonic development in vertebrates and invertebrates: Structure of the gametes– the sperm, the egg; Molecular basis of spermatogenesis, Oogenesis. Fertilization, Cleavage types and significance, comparative account of gastrulation, axes and germ layers, Fate maps

Morphogenesis- movement and formation of germ layers;

Gastrulation in amphibian and birds

Unit III: EMBRYONIC DEVELOPMENT OF INVERTEBRATES AND VERTEBRATES

Early embryonic development- of vertebrates and invertebrates- Cleavage and formation of blastula, gastrulation, neural tube formation, cell migration;

General concept of potency, commitment, specification, induction, competence and determination. Late embryonic development- Vulva formation in *Caenorhabditis*, Formation of neural tube in vertebrates



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Unit IV: ORGANOGENESIS

Concept of organogenesis- Development and patterning of vertebrate limb, homeobox genes in patterning, signaling in patterning of the limb. Postembryonic development: growth, cell proliferation, growth hormones; aging- genes and senescence

Hormonal regulation of metamorphosis in insects and amphibians; Regeneration- epimorphic and morphallaxis

Unit V: TERATOGENETICS

Medical implications of developmental biology-Teratogenesis: environmental assaults on development; teratogenic agents; teratological abnormalities.

SUGGESTED BOOKS:

1. Developmental Biology, Scott F Gilbert, 8thed 2006, Sinauers.
2. Essentials of Developmental Biology, JMW Slack 3rd ed, Wiley-Blackwell.
3. Principles of Development, Louis Wolpert, 3rd ed 2007, Oxford.
4. An introduction to Embryology, Balinsky, 5thed 1981, Saunders.
5. Analysis of Biological development, Kalthoff., 1996, McGraw.



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Course Code: ZOO 469

Course Name: Cytogenetics and Developmental Biology Lab

Credit: 02

Course Learning Objective:

- The course explains the basic principles and concepts underlying the developmental processes at the cellular and molecular level.
- To introduce the basic concepts of inheritance patterns, genetic and genomic basis of traits.

Course Learning Outcome: Upon completion of the course, students will be able to:

- Understand the events that lead to formation of a multicellular organism from a single fertilized egg, the zygote.
- Acquire basic knowledge of the cellular processes of development and the molecular mechanisms underlying these.
- Gain knowledge of the basic principles of inheritance.
- Analyse pedigree leading to development of analytical skills and critical thinking enabling the students to present the conclusion of their findings in a scientific manner.

Course Contents:

1. Techniques in the study of chromosomes and their applications: Short term (lymphocyte) and long term (fibroblast) cultures, chromosome preparations, karyotyping, chromosome labeling, in situ hybridization, chromosome painting.
2. Study banding pattern of chromosome.
3. Giant chromosome polytene from *Cheironomous/Drosophila* larva.
4. Preparation of solutions for Molecular Biology experiments.
5. Isolation of chromosomal DNA from bacterial cells.
6. Isolation of Plasmid DNA by alkaline lysis method
7. Agarose gel electrophoresis of genomic DNA & plasmid DNA
8. Evolution study through collection of specimens.
9. Study of morphological characters of local Amphibians and Reptiles.
10. Study of Homologous and Analogous organs from suitable specimens.
11. Study of fossil evidences from plaster cast models and pictures.
12. Visit to Forest/National park/Wild life Sanctuary to study the behaviour of animals.
13. Developmental stages study of *drosophila*



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14. Developmental stages study of amphibian embryo
15. Developmental stages study of Chick embryo
16. Developmental stages study of mammal embryo
17. Experiments of Spemann and Mangold.
18. Vital dyeing, extirpation, isolation, transplantation; Role of nucleus, cytoplasm and yolk;

Suggested Reading

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. Developmental Biology, Scott F Gilbert, 8thed 2006, Sinauers.
6. Essentials of Developmental Biology, JMW Slack 3rd ed, Wiley-Blackwell.
7. Principles of Development, Louis Wolpert, 3rd ed 2007, Oxford.
8. An introduction to Embryology, Balinsky, 5thed 1981, Saunders.
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Course Code: ZOO 470

Course Name: Comparative anatomy of Vertebrates and biosystematics Lab

Credit: 02

1. Classification upto orders, excepting Pisces and Aves, where classification upto subclasses is required, Habits, Habitats, external characters and economic importance (if any) of the following animals:

Chondrichthyes: *Zygaena, Pristis, Trygon, Rhinobatus, Chimaera.*

Actinopterygii: *Polypterus, Acipenser, Muraena, Catla. Hippocampus, Syngnathus, Exocoetus, Anabas, Tetradon, Echeineis and Solea.*

Dipneusti (Dipnoi): *Protopterus (Lung fish)*

Amphibia: *Uraeotyphlus, Necturus, Ambystoma* and its *Axolotl* larva, *Salamandra, Hyla, Rhacophorus.*

2. **Reptilia:** *Hemidactylus, Calotes, Draco, Varanus, Phrynosoma, Chamaeleon. Typhlops, Python, Bungarus, Naja, Hydrus, Vipera, Crocodilus. Gavialis, Chelone and Testudo.*
3. Demonstration of dissection of *Labeo* through video clipping/models/charts: Digestive and reproductive systems, Circulatory system: heart, afferent and efferent branchial arteries, Nervous system: cranial nerves and internal ear.
4. Study of the skeleton of *Labeo, Rana* and *Varanus.*
5. Study of poison apparatus in snakes through charts.
6. **Aves:** *Anas, Milvus, Pavo, Eudynamis, Tyto* and *Alcedo.*
7. **Mammalia:** *Ornithorhynchus, Echidna, Didelphis, Macropus, Loris, Macaca, Manis, Hystrix, Funambulus, Panthera, Canis, Herpestes, Capra, Pteropus.*
8. Demonstration of dissection of Chick and White Rat through video clipping/models/charts. Chick: Digestive, arterial, venous and urinogenital systems. White Rat: Digestive, arterial, venous and urinogenital systems.



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SUGGESTED BOOKS:

1. A Text Book of Zoology, Vol.II Vertebrates by A.J. Marshall, MacMillan & Co. Ltd., New York (1972). 2. Anatomy of Chordates by C.K. Weichert, McGraw Hill Book Co. Inc. London (1958).
2. Biology of Vertebrates by H.E. Walter and L.P. Sayles, McMillan Co. New York (1949).
3. Comparative Anatomy of Vertebrates by G.C. Kent, Torpen Co.Ltd., Tokyo (1954).
4. Anatomy of Comparative Vertebrates. Hyman, L. H. Satish Serial Pub. House 2004.



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Course Code: ZOO 471

Course Name: Endocrinology and Neural Physiology

Credit: 02

Course Learning Objective:

- To provide students with a basic understanding of human endocrine glands, neuro-endocrine glands and their structure, function and signalling pathways.
- To facilitate the understanding of the biosynthesis and biochemistry of hormones.
- To integrate the basic and clinical aspects of endocrinology to enhance the understanding of students about the consequences due to hyposecretion, hypersecretion and absence of hormones leading to various diseases and metabolic disorders.

Course Learning Outcome: After completion of the course the students will be able to:

- Understand endocrine system and the basic properties of hormones.
- Appreciate the importance of endocrine system and the crucial role it plays along with the nervous system in maintenance of homeostasis.
- Gain insight into the molecular mechanism of hormone action and its regulation.
- Identify principles /mechanism underlying various neurological disorders.

Course Content

UNIT –I: INTRODUCTION TO ENDOCRINOLOGY

Introduction to endocrine system and common endocrine organs. Chemical nature of hormones. Hormone Secretions (apocrine, holocrine, and merocrine) Hormone Delivery, Hormonal feedback in homeostasis

UNIT –II: MECHANISM OF HORMONE ACTION

Mechanism of hormone action. Protein Hormones, Membrane receptors, G-proteins and control of adenylate cyclase, Cyclic AMP cascade, Other signal Transduction systems (PLC and PLA pathways). Steroid hormones, Hypothalamo-hypophysial System, General organization, Neurohypophysial octapeptides (Oxytocin and Vasopressin). Hypophysiotropic hormones: Chemistry localization and actions. Adenohypophysial hormones: Chemistry and physiological roles.

UNIT –III: NEURAL CONTROL OF HORMONES

Somatotropin and Prolactin, Glycoprotein hormones (FSH, LH and TSH), Pro-opiomelanocortin (ACTH, MSH, β -LPH & β -endorphin), Neural control of adenohypophysis. Thyroid Gland :



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Biosynthesis of thyroid hormones. Control of secretion and Physiological roles of thyroid hormones.

UNIT –IV: STEROID HORMONES

Steroid hormone biosynthesis and pathways: Testis - Physiological roles of androgens. Ovary - Physiological roles of Estrogen, Progesterone and Relaxin.

UNIT –V: ADRENAL HORMONES

Adrenal Cortex - Control of mineralocorticoid and glucocorticoid secretions. Physiological roles of glucocorticoid and mineralocorticoid, Neural control of endocrine system and sense organ. Adrenal Medulla: Catecholamine biosynthesis, release and its physiological roles of these hormones.

SUGGESTED BOOKS:

1. Hadley: Endocrinology, Prentice hall. International Edition. 2000
2. Norris: Vertebrate Endocrinology (2nd ed). Lea & Febriger. 1997
3. Brooks and Marshall: Essentials of Endocrinology, Blackwell Science. 1995
4. Turner and Bagnara: General Endocrinology, W. B. Saunders Company Philadelphia. 1984
5. Larson: Williams Text Book of Endocrinology, 10th edition. W. B. Saunders Company, Philadelphia. 2002.



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Course Code: ZOO 472

Course Name: Principal of Biochemistry

Credit: 02

Course Learning Objective:

- To comprehend the fundamental principles of chemistry that govern complex biological systems.
- To make the study relevant, interesting, encouraging to the students to join the industry or to prepare them for higher studies including research.

Course Learning Outcome: Upon completion of the course, students should be able to:

- Gain knowledge and skill in the fundamentals of biochemical sciences, interactions and interdependence of physiological and biochemical processes.
- Get exposed to various processes used in industries and gain skills in techniques of chromatography and spectroscopy.
- Demonstrate foundation knowledge in biochemistry; synthesis of proteins, lipids, nucleic acids, and carbohydrates; and their role in metabolic pathways along with their regulation.

Course Content

UNIT- I: INTRODUCTION

Structure of atoms, molecules and chemical bonds, Stabilizing interactions (Van der Waals, electrostatic, hydrogen bonding, hydrophobic interaction) Principles of biophysical chemistry (pH, buffer, reaction kinetics, thermodynamics, colligative properties)

UNIT- II : CARBOHYDRATES: STRUCTURE AND FUNCTION

General structure, classification and chemical properties of carbohydrates.

Isomerism in Glucose (Optical isomerism, Ring structure, Anomers & Epimers, Aldose & Ketose Isomerism) Bioenergetics - glycolysis, TCA cycle and oxidative phosphorylation

UNIT- III: AMINO ACIDS AND PROTEINS

Structure and classification of amino acids, Protein structure and function (Ramachandran plot, secondary structure, domains, motif and folds, Myoglobin, haemoglobin, etc)

Enzymes (Principles of catalysis, kinetic and regulation, isozymes), protein hormones and Conjugated proteins: Lipoproteins, glycoproteins, nucleo proteins.

UNIT- IV: LIPIDS: STRUCTURE & FUNCTION



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Definition and Nomenclature of fatty acids Classification of fatty acids and lipids.

Saturated & Unsaturated fatty acids Simple lipids: Triacylglycerols, waxes

Complex Lipids: Phospholipids, Glycolipids Derived Lipids: Steroids, Lipoprotein, Prostaglandins, Oxidation of fatty acids; biosynthesis of saturated and unsaturated fatty acids.

UNIT- V: NUCLEOTIDES AND NUCLEIC ACIDS

Nucleotides; building blocks of nucleic Acid

Conformation of nucleic acids (DNA, RNA, helix (A, B, Z), t-RNA,)

Proteins-nucleic acid interaction and Post-transcriptional modification, Biosynthesis of purines and pyrimidines.

SUGGESTED BOOKS:

1. Zubay, G. 1988, biochemistry (2nd 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. and 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.



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Course Code: ZOO 473

Course Name: Animal Behaviour

Credit: 02

Course Learning Objective:

- To understand the historical foundations of the field, as well as current theories and evidence for a broad range of behavioral topics.
- Behavioral ecology and the evolution of behaviors as adaptations will be recurring themes interwoven through all topics discussed. The purpose of the Animal Behavior Laboratory is for students to have hands-on experiences designing and implementing experiments that concern a variety of behavior.

Course Learning Outcomes: At the completion of their Animal Behavior course, students will be able to:

- Exhibit critical and integrative thinking skills
- Demonstrate ability to communicate scientific information in both oral and written formats
- Demonstrate knowledge of key concepts in animal behavior
- Exhibit quantitative research skills (or demonstrate ability to perform all parts of the scientific method)

Course Content:

UNIT- I: INTRODUCTION

Introduction -Definition, Ethology, History of the study of animal behavior and contribution of scientists; significance of Animal behaviour, objectives of behaviour; Approaches and methods in study of behaviour.

UNIT- II: PATTERNS OF BEHAVIOUR

Reflexes- reflex action, types of reflexes, reflex arch, characteristics of reflexes; Orientation and Navigation, Migration in fishes and birds; Individual behavioural patterns; Fixed action pattern, Instinct and Learnt Behaviour; Associative learning, classical and operant conditioning, Habituation, Imprinting; Learning and memory.

UNIT- III: ROLE OF BRAIN, HORMONES AND PHEREMONES

Hormones and pheromones in regulation of behaviour; Motivation; Mimicry, mimetic releaser and code breakers; Biological rhythms- Types and characteristics.

UNIT- IV: SOCIAL BEHAVIOR

An over view of Sociality in animal systems, Aggregations- Schooling in fishes, Flocking in birds, Herding in mammals, Social organization in honey bee, Various type of communications



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Altruism: Reciprocal altruism, group selection, kin selection and inclusive fitness, cooperation, alarm call and Parental care.

UNIT- V: ECOLOGICAL ASPECTS OF BEHAVIOUR

Habitat selection, Homing, Territoriality, Dispersal, Foraging; Reproductive behaviour: Asymmetry and Sexual Dimorphism, Mate choice, Sexual selection and sexual conflicts.

SUGGESTED BOOKS:

1. Peter Marler and J. Hamilton, Mechanism of Animal Behaviour, John Wiley & Sons, USA
2. David McFarland, Animal Behaviour, Pitman Publishing Limited, London, UK
3. John Alcock, Animal Behaviour, Sinauer Associate Inc., USA
4. Goodenough, McGuire and Wallace, Perspective on Animal Behaviour, John Wiley & Sons, USA
5. Sherman P. W. and John Alcock, Exploring Animal Behaviour, Sinauer Associate Inc., Massachusetts, USA
6. Manning A. and Dawkins M.S., An Introduction to Animal Behaviour, Cambridge University Press, UK
7. Richard Dawkins, The Selfish Gene, Oxford University Press, 2016.



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Course Code: ZOO 474

Course Name: Applied Zoology

Credit: 02

Objectives of the Course:

- To make the students aware of various pests of food crops and food products and various insect control methods.
- To educate the students about economic importance and techniques of Apiculture and sericulture

Course Learning Outcomes:

- Understand pests of food crops and food products and various insect control methods.
- Understand different honey bee species, bee products, silk worm species and sericulture.
- Understand different species of culturable fishes, ornamental fishes, fish culture practices, management of fish culture, fish processing and preservation.

Course Contents

UNIT – I: SERICULTURE AND PISCICULTURE

Sericulture Silkworm and its strains, rearing of silkworms, sericulture and its components, silk reeling Pests, and diseases of silkmoth. Pisciculture Monoculturer and composite culture Fresh water, & marine fisheries, induced breeding & its technique in pisciculture; Haps & ponds for fish culture and their management. Fish diseases and their control.

UNIT – II: PEST CONTROL AND PEST MANAGEMENT

Pest Control Principles and practices of pest control. Methods of pest control-Chemical Biological, Microbial, Integrated control. organochlorine, Insecticides, Organosphosphorus insecticides, Carbamates, Acaricides, Nematicides, Rodenticides, Molluscicides and Botanical pesticides. Pheromonal and Hormonal control. Chemosterilants and genetic control. Crop Pests and their Management Biology and control of following insect pests of agricultural importance.

UNIT – III: MEDICAL ZOOLOGY

Medical Zoology Systematics, biology and control of following medically important organisms. Trichomonas, Onchocerca, Cyclops, sarcoptes, Dermacentor, Phlebotmus, Glossina. Mode of transmission and of some important diseases. Cholera, Typhus, small pox, plague, Malaria,



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Dengue fever, Filariasis & AIDS. Metabolic and Muscular disorders Metabolic disorder with regard to major food stuffs absorption.

UNIT – IV: VACCINATION

Vaccination: Immunization; different types of vaccines; Current status of malarial vaccine.

UNIT – V: WILDLIFE CONSERVATION

Wild Life conservation and conservation strategies; Extinction of wild species meaning and cause; Wild 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.

SUGGESTED BOOKS:

1. Park, K. (2007). Preventive and Social Medicine. XVI Edition. B.B Publishers.
2. Arora, D. R and Arora, B. (2001). Medical Parasitology. II Edition. CBS Publications and Distributors.
3. Kumar and Corton. Pathological Basis of Diseases.
4. Atwal, A.S. (1986). Agricultural Pests of India and South East Asia, Kalyani Publishers.
5. Dennis, H. (2009). Agricultural Entomology. Timber Press (OR).
6. Hafez, E. S. E. (1962). Reproduction in Farm Animals. Lea & Fabiger Publisher
7. Dunham R.A. (2004). Aquaculture and Fisheries Biotechnology Genetic Approaches.
8. CABI publications, U.K.
9. Pedigo, L.P. (2002). Entomology and Pest Management, Prentice Hall.
10. Text Book of Applied Entomology Vol. I & II by K. P. Srivastava



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Course Code: ZOO 475

Course Name: Histology and Histochemistry

Credit: 02

Objectives of the Course:

- To acquaint the students with various techniques to study histology and histochemistry of various animal tissues and to know about fixation and staining techniques.
- To enable the students understand the molecular basis of cell-cell signalling, cell division and transport of ions across cell membranes.

Course Learning Outcomes:

- To identify the basic structure of cells, tissues and organs and describe their contribution to normal function.
- To interpret light- and electron-microscopic histologic images and identify the tissue source and structures.

Course Content

UNIT –I: TISSUE FIXATION

Fixation and Fixatives, Types of fixatives used in tissue fixation. Chemistry of fixation, Choice of Fixatives in histology

UNIT –II: TISSUE PROCESSING

Tissue processing, Dehydration, Clearing and Embedding, Microtomy of tissue sections. Types of microtomes. Sectioning paraffin blocks. Staining of paraffin sections

UNIT –III: PRINCIPLES AND METHODS OF STAINING

Principle and methods of staining. Histological stains. Haematoxylin and Eosin. Principles and methods of histochemical localization and identification of the following: Carbohydrate moieties, Glycogen and glycoproteins with oxidizable vicinal diols by Periodic acid Schiff method. Glycoproteins with carboxyl groups and/or O-sulphate esters by Alcian blue methods.

UNIT –IV: PROTEIN ANALYSIS

Protein end groups, General proteins by Bromophenol blue method, –NH₂ groups by Nihydrin-Schiff method, -SS groups by Performic acid –Schiff and performic acid- alcian blue methods. Lipid moieties. General lipids by Sudan black B method. Neutral lipids by total Sudan III and Sudan IV methods.



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UNIT –V: NUCLEIC ACIDS ANALYSIS AND IHC

Nucleic acids, Methyl green pyronin for DNA and RNA. Feulgen reaction for DNA. Enzymes: Acid and alkaline phosphatases by Metal precipitation and Azo dye methods. Immunocytochemistry: Basic principles of IHC staining. Fluorescence histochemistry: Basic principles in Fluorescence histochemistry.

SUGGESTED BOOKS:

1. Boyd,W. (1976):A text book of Pathology. Structure and function in disease, 4 th edition. Lea and Fibiger, Philadelphia.
2. Pearse, A.G.E. (1980): Histochemistry, theoretical and Applied ,J & A, Churchill Ltd., London.
3. Rogers, A.W.(1983): Cells and Tissues, An introduction to Histology and Cell Biology, Academic Press, NY.
4. Telford, I.R. and Bridgman,C.F.(1990). Introduction to Functional Histology, Harper and Row, NY.
5. Histochemistry in focus: A source book of techniques and research needs. (2007), K. Shyamasundari and K. Hanumantha Rao. Publisher - M. J. Publishers Chennai, India.
6. Histological and Histochemical methods: Theory and Practice. 4th edition (2008), J. A. Kiernan Publisher – Scion Publishing Ltd. Oxford shire. • Colour Atlas of Histology. 3rd edition (2000). L. P. Gartner and J. L. Hiat Publisher – Lippincott- Williams & Wilkins, Baltimore.
7. Histology: A text book and Atlas. 2nd edition (1989). M. H. Ross, E. J. Reith and L. J. Romrell Publisher - Williams & Wilkins, Baltimore.
8. Bailey’s text book of Histology. 15th edition (1964). W. M. Copenhaver. Publisher – The Williams & Wilkins Company, Baltimore.
9. Histochemistry (Vol I –III). 4th Edition (1991), Stoward, P. J. & Pearse, A. G. E. Publisher – Churchill Livingstone Edinburgh, London.



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Academic Block, Shahpur, Distt. Kangra (HP) – 176206

Website: www.cuhimachal.ac.in

Course Code: ZOO 462

Course Name: Indian Knowledge System

Credit: 02

Objectives of the Course :

- To comprehend the knowledge of traditional indian system.
- To provide knowledge of traditional medicine and intellectual property issues, legal framework of traditional knowledge

Course Learning Outcomes:

- Discuss the concept of traditional knowledge
- Have a deeper understanding of Traditional Knowledge in Medicine
- Gain knowledge of Intellectual Property Issues in traditional knowledge

Course content:

Unit – I: INTRODUCTION TO TRADITIONAL KNOWLEDGE

Define traditional knowledge, nature and characteristics, scope and importance, kinds of traditional knowledge, Indigenous Knowledge (IK), characteristics. Protection of traditional knowledge. Traditional Knowledge in Different Sectors (Overview).

Unit – II: THE MEDICAL TRADITION IN ANCIENT INDIA

Specialization into eight branches, The tradition of surgery, medical genetics in Ayurveda, inoculation for smallpox, microbiology and parasitology, communicable diseases and epidemics.

Unit – III: TRADITIONAL KNOWLEDGE AND INTELLECTUAL PROPERTY

Systems of traditional knowledge protection, Legal concepts for the protection of traditional knowledge, Patents and traditional knowledge, Strategies to increase protection of traditional knowledge.

Unit – IV: LEGAL FRAMEWORK AND TRADITIONAL KNOWLEDGE

The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006, Plant Varieties Protection and Farmer's Rights Act, 2001 (PPVFR Act).

Unit – V: OTHER TECHNOLOGIES

A Survey Harappan Technologies/ Later pottery/ Glass/Water Management/ Textile Technology/ Writing Technologies: A Selection from Primary Texts Gemmology/ Water Management/ Textiles and Garments/ Perfumes and Cosmetics.



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Academic Block, Shahpur, Distt. Kangra (HP) – 176206

Website: www.cuhimachal.ac.in

SUGGESTED BOOKS:

1. Traditional Knowledge System in India, by **Amit Jha, 2009.**
2. Traditional Knowledge System in India by Amit Jha Atlantic publishers, **2002.**
3. "Knowledge Traditions and Practices of India" Kapil Kapoor and Michel Danino.
4. Traditional Knowledge System and Technology in India (English, Hardcover,
5. Basanta Kumar Mohanta, Vipin Kumar Singh) Edition: **2012** Language English



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SEMESTER - III

Course Code: ZOO 515 Course Name: Agricultural Entomology Credit: 02

Course Learning Objective:

- The course describes adverse effects of pesticides and management of crop pests by an Integrated Pest Management (IPM) approach.
- The course offers information on transmission of diseases, methods of surveillance for diseases, effective Integrated Management of Vector control and other methods of prevention of arthropod borne diseases

Course Learning Outcomes:

- The course study makes the students capable to learn ill effects of pesticides and management of crop pests by bio-rational methods in an integrated approach (IPM) and impart concerned knowledge to the farmers and get involved in various pest management organizations.

Course Content:

Unit –I: INTRODUCTION TO PEST AND PEST SURVEILLANCE

Definition of pest, pest status, factors responsible for achieving the status of pest, General equilibrium position (GEP), Economic injury level (EIL), economic threshold level (ETL), action threshold, Damage boundary (DB), pest spectrum, pest complex, carrying capacity, causes of pest outbreak, secondary pest outbreak, pest surveillance and sampling.

Unit-II: INSECT PESTS OF CEREAL CROPS

Systematic position, host plants, seasonal history, nature of damage, life cycle and integrated management of the important insect pests of major cereal crops (Paddy, Wheat, Maize etc.)

Unit-III: INSECT PESTS OF PULSES AND ORNAMENTAL CROPS

Systematic position, host plants, seasonal history, nature of damage, life cycle and integrated management of the important pests of Sugarcane, Pulses and Ornamental crops.

Unit-IV: INSECT PESTS OF FRUITS AND VEGETABLES

Systematic position, host plants, seasonal history, nature of damage, life cycle and integrated management of the important pests of fruits and vegetables.

Unit –V: STORED AND POLYPHAGOUS INSECT PESTS

Systematic position, host plants, seasonal history, nature of damage, life cycle and integrated management of the important stored and polyphagous pests.



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Website: www.cuhimachal.ac.in

Locust, Termites and White grubs- different species and phases, phase transition, periodicity, migration, biology and control measures.

Suggested Books:

1. Matthews, Robert W., **Matthews**, Janice R., Insect Behaviour, Springer, Dordrecht
2. Pedigo, L. P., Entomology & Pest Management, Prentice Hall, New Jersey, USA
3. Norris, Caswell-Chen and Kogan, Concepts of IPM, Prentice-Hall, USA
4. Hill, D. S., Agricultural insects pests of the tropics and their control, Cambridge University Press, UK
5. S. Pradhan, Agriculture Entomology and Pest Control, Indian Council of Agriculture Research.



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Academic Block, Shahpur, Distt. Kangra (HP) – 176206

Website: www.cuhimachal.ac.in

Course Code: ZOO 516 Course Name: Entomology LAB Credit: 02

Course Learning Objective:

- The course describes adverse effects of pesticides and management of crop pests by an Integrated Pest Management (IPM) approach.
- The course offers information on transmission of diseases, methods of surveillance for diseases, effective Integrated Management of Vector control and other methods of prevention of arthropod borne diseases

Course Learning Outcomes:

- The course study makes the students capable to learn ill effects of pesticides and management of crop pests by bio-rational methods in an integrated approach (IPM) and impart concerned knowledge to the farmers and get involved in various pest management organizations.

Course content:

1. Morphology: Study of head and its sclerites.
2. Study of wings and their venation,
3. Study of different types of mouth parts of Insects
4. Study of different types of antennae and legs of insects.
5. Taxonomy: Identification of insects belonging to different groups up to orders and sub orders.
6. Study of various types of social insects and their nests.
7. Dissection/Demonstration of Alimentary canal, Reproductive system, Circulatory system, Excretory system and Nervous system of insects
8. Estimation of LD50 and LC 50 through data provided.
9. Agricultural Entomology: Collection and identification of economically important insects and various stages of their life history.
10. Identification of important insect pests of different crop plants and stored products.
11. Visits to agricultural fields and forests for on spot study of pests and damage caused by them.
12. Study of life history stages of medically important insects.
13. Identification and anatomical studies of major vector species of Anopheles, Culex and Aedes.



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Suggested Books:

1. Pedigo, L. P., Entomology & Pest Management, Prentice Hall, New Jersey, USA
2. Norris, Caswell-Chen and Kogan, Concepts of IPM, Prentice-Hall, USA
3. Hill, D. S., Agricultural insects pests of the tropics and their control, Cambridge University Press, UK
4. S. Pradhan, Agriculture Entomology and Pest Control, Indian Council of Agriculture Research.



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Academic Block, Shahpur, Distt. Kangra (HP) – 176206

Website: www.cuhimachal.ac.in

Course Code: ZOO 517

Course Name: Fisheries and Limnology

Credit: 02

Course learning Objective:

This course has been designed to equip the student with a balanced and complete scientific understanding of fisheries concepts.

Course Learning Outcome:

After completion of the course the students will be able to:

- Acquire knowledge of physiology, reproduction of fishes.
- Analyse different kinds of water and identify/differentiate different kinds of fishes.
- Know about different kinds of fishing methods and fish preservation which can be employed for export and storage of commercial fishes.
- Find the reasons behind the depletion of fisheries resources

Course Content

UNIT- I: INTEGUMENTARY, DIGESTIVE AND RESPIRATORY SYSTEM

Exo Skeleton: Structure and development of Placoid scales Food and feeding habits, Digestive system and its anatomical modifications Respiration: Structure and functions of gills; adaptations for air breathing; role of air bladder. Mechanism of gas exchange Buoyancy mechanisms: Role of fat and swim bladder Applied Ichthyology

UNIT-II: URINOGENITAL SYSTEM

Excretion and Osmoregulation; Glomerular and aglomerular kidneys; Nitrogen (ammonia, urea, TMAO) excretions; Mechanism of water and salt balance in fresh water, marine, estuarine fishes. Role of skin and gills Reproduction: Structure of gonads, spawning, Parental care Fish migration – types and regulation

UNIT-III: NERVOUS AND ENDOCRINE SYSTEM

Brief introduction to Thermoregulation of Fishes, Nervous system and Sense organs: Organization of the central and peripheral nervous systems. Eye, lateral line organs and chemoreceptors, Electric Organ Endocrine organs: Functions of the pituitary, thyroid, inter-renal and chromaffin tissues, ultimobranchial and corpuscles of Stannius

UNIT-IV: FISH PRESERVATION AND PHYSICOCHEMICAL CHARACTERISTICS



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Biochemical Composition, Preservation, Fish spoilage and Rigor mortis, Fish Processing, Principles and processes of: Drying, Salting, Freezing, Refrigeration. Abiotic (Physicochemical Factors in Freshwater Ecosystem): Physical characteristics of water: Temperature, thermal stratification, Light, Density, Water movement and thermal exchange. Chemical characteristics of water: Hydrogen ion concentration (pH), Dissolved oxygen, Free carbon-dioxide, Total dissolved solids (T.D.S), Carbonates and Bicarbonates. Turbidity: Causes and impact on aquatic organisms.

UNIT-V: FISH RESOURCES AND MANAGEMENT

Inland Fisheries Resources: Riverine fisheries- Ganga river system, Brahmaputra river system, East coast river system. Aquatic/Natorial adaptations of freshwater fauna.

Productivity of water bodies – Primary, secondary, Productivity Plankton of freshwater biotopes – Phyto and Zooplankton, Plankton sampling: Methods of collection, preservation and identification.

Principle of composite fish culture, Composite fish culture of endemic and exotic fishes in India. Carp farming, Snow trout farming Construction and Maintenance of Aquaria, ornamental fishes, indigenous and exotic fishes Economic importance of fish and fish products

Reference Books

1. Purdom, Colise. 1993. Genetics and Fish Breeding. Chapman and Hall, London.
2. Greg Lutz, C. 2001. Practical genetics for Aquaculture. Fishing News Books, London.
- Reference Books 1. Larka, W.S. 2000. Fish Genetics and Biotechnology. CIFE. ICAR. Mumbai.
3. Sinnot, E.W., Dunn, L.C. and Dobzhansky, T. 1992. Principles of Genetics, Tata McGraw-Hill Publishing Company Ltd., New Delhi.
4. Tave, D. 1995. Selective breeding Programmes for Medium Sized Fish Farms. FAO Fisheries Technical Papers No. 352, Rome, FAO, 122 P.
5. Pandian, T.J., Strussmann C.A. and Marian, M.P. 2005. Fish genetics and Aquaculture Biotechnology, Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi



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Academic Block, Shahpur, Distt. Kangra (HP) – 176206

Website: www.cuhimachal.ac.in

6. Garg, S.k , Bhatnaga,A, Kalla A and Johal, M.S. Experimental Ichthyology CBS Publisher and Distributors Darya Ganj New Delhi -110002

7. Midlen & Redding TA. 1998. Environmental Management for Aquaculture. Kluwer.

8. Lynwood, S. Smith. Narendra Publ. House, Delhi. 2003. Introduction to the fish physiology.

9. Arvind Kumar and Pushaplata Dubey. Daya Publ. House, Delhi. 2006. Fish Management and Aquatic Environment

10. Lagler, Bardock, Miller & Possino, John Wiley & Sons, N.Y., London: 2012. Ichthyology, 2nd Ed.

11. Halver and Hardy. Acad. Press. 2002: Ash Nutrition. An Imprint

12. Talwar, P.K. and *Jhingran*, A.G. (1991) Inland Fishes of India and Adjacent Countries. Oxford-IBH Publishing Co. Pvt. Ltd., New Delhi, 1158 p.



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Academic Block, Shahpur, Distt. Kangra (HP) – 176206

Website: www.cuhimachal.ac.in

Course Code: ZOO 518 Course Name: Fisheries and Limnology LAB Credit: 02

Course learning Objective:

This course has been designed to equip the student with a balanced and complete scientific understanding of fisheries concepts.

Course Learning Outcome:

After completion of the course the students will be able to:

- Acquire knowledge of physiology, reproduction of fishes.
- Analyse different kinds of water and identify/differentiate different kinds of fishes.
- Know about different kinds of fishing methods and fish preservation which can be employed for export and storage of commercial fishes.
- Find the reasons behind the depletion of fisheries resources

Course Content

1. To estimate the dissolved oxygen in water.
2. To estimate the pH of water.
3. To study the benthic organisms.
4. To study the Exotic culturable fishes.
5. Estimation of total hardness in a given water sample.
6. To study the different common diseases of fishes caused by virus, bacteria, protozoan and helminthes.
7. To study the different types of phytoplankton.
8. To study the different types of zooplankton.
9. Estimation of nitrate in a given water sample.
10. Estimation of total alkalinity in a given water sample.
11. Estimation of total chlorides in a given water sample
12. To estimate the phosphate of water.
13. To determine the BOD of water.
14. To study the different types of fishing gears.

Reference Book

1. Garg, S.k , Bhatnaga,A, Kalla A and Johal, M.S. Experimental Ichthyology CBS
Publisher and Distributors Darya Ganj New Delhi -110002



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Website: www.cuhimachal.ac.in

2. Ward, H. B. & G. Ch. Whipple, edited by W. T. Edmondson: Fresh Water Biology. 2 ed. London & New York: John Wiley & Sons 1957. 1248 p. 276/-s
3. APHA, AWWA, & WEF (2005). Standard methods for the examination of water and waste water (21st ed.). New York, Washington, DC: Jointly prepared and published by the American Public Health Association, American Water Works Association, and Water Environment Federation.
4. FAO. 1999. Aquaculture Production Statistics 1988-'97.
5. Jayaram, K.C. 1999. The Freshwater Fishes of the Indian Region. Narendra Publication, New Delhi
6. Y Sreekrishna; Latha Shenoy; (2001). Indian Council of Agricultural Research. Directorate of Information and Publications on Agriculture



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Website: www.cuhimachal.ac.in

Course Code: ZOO 519

Course Name: Advances in Molecular Biology

Credit: 02

Course Learning Objective: The course aims to provide students with an introduction of the underlying molecular mechanisms of various biological processes in cells and organisms.

- **Course Learning Outcome:**
- Upon completion of the course, students will be able to:
- Describe the basic structure and chemistry of nucleic acids, DNA and RNA;
- Compare and contrast DNA replication machinery and mechanisms in prokaryotes and eukaryotes.
- Elucidate the molecular machinery and mechanism of information transfer processes—transcription and translation—in prokaryotes and eukaryotes

Course Content

Unit-I: MOLECULAR MECHANISM IN CELL DIVISION

Mitosis and meiosis, their regulation, steps in cell cycle, and control of cell cycle. Regulation of Cell cycle progression: Maturation promoting factors (MPF), Cyclins and Cyclins dependent kinases, growth factors and growth inhibitory factors. Cell death and apoptosis.

Unit-II: MECHANISM OF DNA REPLICATION AND REPAIR

DNA replication, repair and recombination (Unit of replication, enzymes involved, replication origin and replication fork, fidelity of replication, extrachromosomal replicons, DNA damage and repair mechanisms, homologous and site-specific recombination).

Unit-III: MECHANISM OF TRANSCRIPTION AND TRANSLATION

RNA synthesis and processing (transcription factors and machinery, formation of initiation complex, transcription activator and repressor, RNA polymerases, capping, elongation, and termination, RNA processing, RNA editing, splicing, and polyadenylation, structure and function of different types of RNA, RNA transport).

Unit-IV: CONTROL OF GENE EXPRESSION IN PROKARYOTES

Constitutive, Inducible and Repressible gene expression, Positive and Negative control of gene expression, Lac, Tryptophan, arabinose operons; lysogenic repression in lambda bacteriophage.

Unit-V: CONTROL OF GENE EXPRESSION IN EUKARYOTES

Eukaryotic genome organization, Proteins involved in the control of transcription, Protein, protein interactions, Post-translational control, DNA methylation, Cell Signaling, Ligand binding to membrane receptors and its role in regulating transcription, phosphorylation cascade and amplification of signal.



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Recommended Books:

1. Freifelder D (2012). Molecular Biology, 5th edition. Narosa Publishing House, India
2. Allison A. Elizabeth (2012) Fundamental Molecular Biology, 2nd Edition. J Willey and Sons, Hoboken, New Jersey.
3. Freifelder D and Malacinski GM (2005) Essentials of Molecular Biology, 4th Edition, John and Bartlett Publishing, UK
4. Raghavarao, D.: Statistical Techniques in Agricultural and Biological research (1983), Oxford and IBH Publishing Co.
5. Karp, G. 2010 Cell and Molecular Biology: Concepts and Experiments. John Wiley & Sons. Inc.
6. Cooper, G.M. and Hausman, R.E. 2009 The Cell: A Molecular Approach. 5th Edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA Ailey & Sons. Inc.
7. Allison A. Elizabeth (2012) Fundamental Molecular Biology, 2nd Edition. J Willey and Sons, Hoboken, New Jersey.
8. De Robertis, E.D.P. and De Robertis, E.M.F. (2006) Cell and Molecular Biology. 8th edition. Lippincott Williams and Wilkins, Philadelphia.
9. Cooper, G.M. and Hausman, R. E. (2009) The Cell: A Molecular Approach. 5th edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.
10. Lodish, H., Berk, A. and 6 more. (2007) Molecular Cell Biology 6th edition. W. H. Freeman.



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Course Code: ZOO 520 Course Name: Advances in Molecular Biology LAB Credit: 02

Course Learning Objective: The course aims to provide students with an introduction of the underlying molecular mechanisms of various biological processes in cells and organisms.

Course Learning Outcome:

Upon completion of the course, students will be able to:

- Describe the basic structure and chemistry of nucleic acids, DNA and RNA;
- Compare and contrast DNA replication machinery and mechanisms in prokaryotes and eukaryotes.
- Elucidate the molecular machinery and mechanism of information transfer processes—transcription and translation-in prokaryotes and eukaryotes

Course Content

1. DNA Isolation Techniques for both Prokaryote and Eukaryote
2. RNA Isolation Techniques for both Prokaryote and Eukaryote
3. Chromosome Isolation Techniques
4. FISH (Fluorescence Insitu Hybridization Technique).
5. DNA and RNA Staining Techniques.
6. Plasmid DNA Isolation and Genomic DNA Isolation.
7. PCR and its application
8. Electrophoresis Techniques in Genetics.
9. Protein Isolation techniques.
10. Cell Culture Techniques.

Recommended Books:

1. Lewin, B. 2000. Genes VIII Oxford University, Press, New York
2. 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.
3. Wolfe, S.L. 1993, Grissem, W. and Jones, R.L. 2000, Biochemistry and molecular biology of plants, American society of plant physiologists, Maryland, USA
4. Frifelder, D. Molecular Biology. John and Bartlett Publishers, inc., Boston, USA



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Website: www.cuhimachal.ac.in

Course Code: ZOO 521

Course Name: Research Methodology

Credit: 02

Objectives of the Course

- To introduce the students to research methods applicable in biological studies.
- To acquaint the students to different types of scientific writing.
- to provide hands-on experience with collection, analysis and interpretation of data and also writing a report/thesis.
- to motivate students to learn scientific investigation to solve problems, test hypothesis, develop or invent new products for the benefit of society.

Course Learning Outcome:

After completing this course, the students should be able to: ·

- Describe basic concepts of research and its methodologies ·
- Identify appropriate research topics and set up hypothesis ·
- Perform literature review using library (print) and internet (online) resources ·
- Design experiments/surveys, collect data and represent data in tables/figures · Analyze data with appropriate software tools, interpret results and draw conclusion

Course content

UNIT I: INTRODUCTION TO RESEARCH METHODOLOGY:

Meaning of Research, Objectives of Research, Motivations in Research, Types of Research, Research Approaches, Significance of Research, Research Methods v/s Methodology, Research and Scientific Methods, Research Process, Criteria of Good Research.

UNIT II: PROBLEM IDENTIFICATION AND FORMULATION:

Identification of Research problem, Research Question – Investigation Question – Measurement Issues – Hypothesis – Qualities of a good Hypothesis –Null Hypothesis & Alternative Hypothesis. Hypothesis Testing – Logic & Importance.

UNIT III: RESEARCH DESIGN:

Meaning, Need, Features of Good Design, Concept and Importance in Research, Exploratory Research Design – concept, types and uses, Descriptive Research Designs – concept, types and uses. Experimental Design: Concept of Independent & Dependent variables.

UNIT IV: SAMPLING

Concepts of Statistical Population, Sample, Sampling Frame, Sampling Error, Sample Size, Non-Response. Characteristics of a good sample. Probability Sample – Simple Random Sample, Systematic Sample, Stratified Random Sample & Multi-stage sampling.

UNIT V: TOOLS OF DATA COLLECTION



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Collections of Primary Data, Collection of Data through questionnaire and Schedules, other Observation Interview Methods, Collection of Secondary Data, Selection of appropriate method for data collection, Case Study, Focus Group Discussion, Techniques of developing research tools, viz. Questionnaire and rating scales etc. Reliability and validity of Research tools.

Suggested Books:

1. Garg, B.L., Karadia, R., Agarwal, F. and Agarwal, U.K., 2002. An introduction to Research Methodology, RBSA Publishers.
2. Kothari, C.R., 1990. Research Methodology: Methods and Techniques. New Age International. 418p.
3. Sinha, S.C. and Dhiman, A.K., 2002. Research Methodology, Ess Ess Publications. 2 volumes.
4. Singh, Y. K. (2006). Fundamental of Research Methodology and Statistics. New Delhi. New International (P) Limited, Publishers.
5. Kumar, R. (2011). Research Methodology: a step-by-step guide for beginners (3rd edition). London, UK: TJ International Ltd, Padstow, Cornwall.



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Website: www.cuhimachal.ac.in

Course Code: ZOO 522 Course Name: Application of computer, GPS, Image Analysis and PAST in Research Credit: 02

Objectives of the Course:

- To introduce students to Fundamentals of Computer - introduction to the internet and the world wide web (WWW) Information technology - an overview of what it is and what are its applications.
- To acquaint the students to Microsoft Word, Excel, Powerpoint, GPS, PAST.

Course Learning Outcomes:

- The course enables the students to understand the IT applications in the area of biology
- Use of GPS, Image analysis and PAST etc.
- On completion of the course, students should have acquired essential knowledge to meet their computational requirements as a life sciences aspirant

Course Content

UNIT I: INTRODUCTION TO MICROSOFT WORD

Typing text in MS Word, manipulating text, formatting the text & using different font sizes, bold, italics. Using bullets and numbering, insertion of pictures, & file insertion, aligning of the text and justify.

UNIT II: MICROSOFT POWERPOINT

Preparing new slides using MS-Power-point, Inserting slides, Slides transition and animation. Using templates, different text and font sizes. Inserting slides with sounds, inserting clip arts, pictures, tables and graphs, Presentation using wizards

UNIT III: SPREADSHEET TOOL

Introduction to spread-sheet applications, features & functions, using formulae & functions, data storing, features for statistical data analysis, generating charts/graphs & other features (Microsoft Excel, Open office and similar or other advanced tools)

UNIT IV: INTRODUCTION TO INTERNET

Definition about the World Wide Web & brief history. Using search engine and beginning Google search- Exploring the next using Internet explorer and Navigator- Uploading and Download of files and images- E-mail ID creation- Sending messages- Attaching files in E-mail.

UNIT V: OTHER SOFTWARES

GPS (applications and example of GPS), Image analysis Software, Use of PAST for scientific data analysis, Use of BLAST in research programmes.



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Suggested Books

1. Jensen, J.R.,. Remote sensing of the environment: An earth resource perspective, Prentice Hall, Upper saddle river, NJ 2000
2. Joseph, George, , Fundamental of Remote Sensing, University Press (India) Pvt. Ltd, Orient Longman Pte. Ltd., Hyderabad, India 2003
3. Lillesand, T.M. and Kieffer, R.W.,. Remote Sensing and Image Interpretation, 5th Edition., Wiley, New York 2003
4. Panda, B. C., 8. Remote Sensing: Principles and Applications, Viva Books Private Limited, India 2008
5. Avery, T.E., and G.L.Berlin, Fundamental of remote sensing and airphoto interpretation, 5th ed, Macmillan, New York, 1992
6. Barrett, E.C., and L.F.Curtis, Introduction to environmental remote sensing, 3rd ed, Chapman and Hall, New York, 1992
7. Barrett, E.C., and L.F.Curtis, Introduction to environmental remote sensing, 3rd ed, Chapman and Hall, New York, 1992



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Website: www.cuhimachal.ac.in

Course Code: ZOO 523 Course Name: Role of Biostatistics in Research Credit: 02

Objectives of the Course:

- To introduce the students to research methods applicable in biological studies.
- To acquaint the students to different types of scientific writing

Course Learning Outcomes: After completing this course, the students should be able to:

- Identify research tools and their use in research
- Formulate and test hypothesis based on the nature of the research problem
- Apply different statistical methods for analysis

Course Content

UNIT I: BIOSTATISTICS

Definition and relevance of Biostatistics in biological research. Descriptive Statistics: Meaning, Objectives, Organization of data, Population, sample, variable, parameter, primary and secondary data, screening and representation of data, frequency distribution, tabulation, bar diagram, histograms, pie diagram, Measures of Central Tendency: Arithmetic Mean, median, mode, quartiles and percentiles, Measures of Dispersion: Range, variance, standard deviation, coefficient of variation; Skewness and Kurtosis.

UNIT II: INFERENCE STATISTICS

Inferential Statistics: Hypothesis testing, Errors in Hypothesis Testing- Null Hypothesis, Alternative Hypothesis, Type I and Type II errors, Confidence Limits. Setting up of level of significance. One tailed and Two- tailed tests.

UNIT III: PROBABILITY AND DISTRIBUTION

Definition of probability (frequency approach), independent events. Addition and multiplication rules, conditional probability, examples- bernoulli, binomial, poisson and normal distributions; bivariate

UNIT IV: CORRELATION AND REGRESSION

Correlation and Regression: Correlation coefficient (r), properties, interpretation of r, partial and multiple correlations, linear regression: Fitting of lines of regression, regression coefficient, Bivariate and Multiple Regression.

UNIT V: PARAMETRIC AND NON-PARAMETRIC STATISTICS



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Parametric and Non-Parametric Statistics: Definition, Advantages, Disadvantages, Assumptions

Parametric Tests: Student's t-test, One Way Analysis of Variance, Two Way Analysis of

Variance Non-Parametric Tests: Chi square test

Suggested Books:

- 1 Biometry. 3rd edition (2001). R. R. Sokal and F. J. Rohlf. W. H. Publisher-Freeman and Company.
- 2 Biostatistical analysis. 5th edition (2008). J. H. Zar. Publisher-Pearson Education Inc. and Dorling Kindersley Publishing Inc.
- 3 Statistical methods. 6th edition (1967). G. W. Snedecor and W. G. Cochran. Publisher-Oxford and IBH Publishing Co.
- 4 Introductory Statistics for Biology. 3rd edition (1979) R. E. Parker, Publisher-Edward Arnold Ltd. • Statistics and Experimental Design 2nd edition (1980). G. M. Clarke. Publisher-Edward Arnold Ltd.
- 5 Elementary Bayesian Biostatistics. (2008) L. E. Moye. Publisher - Chapman and Hall/CRC, Boca Raton
- 6 Statistical Methods in Biology 3rd edition (1994). N.T. J. Bailey. Publisher-Cambridge University Press
- 7 Understanding Medical Statistics. (1983) L. A. Goldstone and William Heinemann. Publisher Medical Books LTD.
- 8 Introduction to Biostatistics. (1973) R. R. Sokal and F. J. Rohlf. Publisher-W. H. Freeman & Company.
- 9 Statistics: Concepts and Applications. (1995), H. Frank and S. C. Althoen. Publisher-Cambridge University Press.
- 10 Biostatistics: A foundation for analysis in Health Sciences. 5th edition (1991). W. W. Daniel. Publisher-John Wiley & Sons



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Website: www.cuhimachal.ac.in

Course Code: ZOO 524 Course Name: Review of Literature Credit: 02

Objectives of the Course:

To acquaint the students to different types of scientific writing.

Course Learning Outcomes:

Through this paper students should be able to write effective research paper, review article, research proposal and thesis.

Course Content

UNIT I: BASIC INTRODUCTION TO LITERATURE REVIEW

Introduction and the role of the literature review in scientific research- Definition, Need and Significance of Literature review in Research.

UNIT II: TYPES OF LITERATURE REVIEW

Types of Literature review- Evaluative, Explorative, Instrumental. Different elements of Literature review.

UNIT III: LITERATURE SEARCH

Literature search for review: Sources of Literature Review-; Primary, Secondary and Tertiary. Use of Search Engines in Literature Review: PubMed, Google Scholar etc.

UNIT IV: STEPS OF LITERATURE REVIEW

Different steps of Literature review: Guidelines to follow during the writing stage of Literature review, Bibliography, Citations, Types of Citation-MLA, APA, Harvard etc.

UNIT –V: WRITING OF LITERATURE REVIEW

Structure of Literature Review- Introduction, Body and Conclusion; Organisation of Literature review; Characteristics of a good literature review,



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Website: www.cuhimachal.ac.in

Course Code: ZOO 525

Course Name: Research Proposal writing skill

Credit: 02

Objectives of the Course:

To acquaint the students to different types of scientific writing.

To help students to understand the methods of citation and referencing styles, check plagiarism and get insight of intellectual property right

Course Learning Outcomes:

Through this course students should be able to:

- Identify ethics of research in writing research proposal, thesis and research paper.
- Represent the research proposal, thesis and research paper effectively.

Course Content

UNIT- I: LITERATURE SURVEY

Literature survey, developing hypothesis, writing research objectives and origin of proposal for particular research problem.

UNIT -II: METHODOLOGY DEVELOPMENT

Methodology development, expected outcomes writing and finding gap in research. Ethics of writing paper, Guidelines for preparation of research proposals, Budget preparation, Style of writing: MLA, APA, SHS, Origin of Research proposals

UNIT-III: STARTING OF PROPOSAL PROCESS

Starting of Proposal Process: Introduction, background and significance, Review of prior studies and literature, aim of research, research design and methods, implication and contribution of knowledge, compliance and ethical principles

UNIT-IV: RESEARCH BUDGET

Writing research budget and its justification. Need of overhead charges for supporting Institute and need of Supplementary document like endorsement letter from institute to funding agency.

UNIT-V: FUNDING IN RESEARCH

Introduction to different National and International funding agency and fellowship support.



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SEMESTER - IV

Course Code: ZOO 565 Course Name: Medical Entomology Credit: 02

Objectives of the Course:

The rate of pathogen transmission by insects is increasing at an alarming rate posing a growing threat to the human population. Disease transmission by these insects can be prevented only by studying their biology, modes of transmission of pathogens by them, evaluation of associated risk factors, devise effective methods to control these insects and resolve the challenges posed.

Course Learning Outcome: Upon completion of the course, the students will be able to:

Describe the host-pathogen relationships and the role of the host reservoir on transmission of parasite

Recognize various possible modern tools and methodologies for laboratory diagnosis, surveillance and treatment of diseases

Explain control methods of insect vector diseases including spreading awareness on public health programs and mitigating insect borne diseases · Employ the use of advanced management strategies in disease control with respect to parasite evolution

Course Contents

UNIT-I: INTRODUCTION AND CLASSIFICATION

Classification of medically important Insects and other arthropods, Characteristic features of insects orders categorised as vectors (*Diptera*, *Siphonaptera*, *Siphunculata*, *Hemiptera*) and their evolutionary, anatomical, physiological, cellular and molecular adaptations as vectors;

UNIT-II: INSECT BORNE DISEASES AND EPIDEMIOLOGY

Medical important insect vectors of order Diptera- their life cycle, epidemiology and management: Mosquitoes, Sand flies, Tsetse flies, Houseflies; Study of Transmission; Epidemiology; Occurrence, Causative agents and Control of: Mosquito borne diseases- Malaria, Dengue, Yellow fever, Chikungunya, Viral encephalitis, Filariasis; Control of mosquitoes; Sand-fly borne diseases- Leishmaniasis, phlebotomus fever; Control of sand flies; Tsetse fly-borne disease-sleeping sickness.

UNIT-III: VECTOR BORNE DISEASES

Vector borne diseases spread through:



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Siphonapterans-Fleas-Host-specificity; Study of flea borne diseases- Plague, typhus fever; Control of sand flies; Siphunculata- Human louse (head, body and pubic louse) as disease vectors; study of louse borne diseases-Typhus fever, relapsing fever, trench fever, vagabond's disease, phthiriasis; Control of human louse; Hemipterans-Bugs as insect vectors; Blood sucking bugs; Chagas disease; Bed bugs as mechanical vectors; Control and prevention methods.

Vectors and diseases spread through class arachnida, crustacean ticks, mites, cyclops, their life cycle and control measures

UNIT-IV: VECTOR MANAGEMENT

Vector management strategies: Chemical and Non-chemical methods of control i.e., quarantine, cultural, mechanical, chemical, biological, behavioural; Integrated Vector Management.

UNIT-V: FORENSIC ENTOMOLOGY

Forensic Entomology: important insects as Forensic tools, role of insects/arthropods in criminal investigation, by predicting time and cause of death.

Suggested Books:

1. Medical and Veterinary Entomology Mullen, G. , Durden, L., Academic Press, USA
2. Medical and Veterinary Entomology, Kettle, D. S., Cabi Press, USA
3. Medical Entomology for students, Service, M. Cambridge University Press, UK
4. The Insects, An outline of Entomology, Gullan, P. J. , and Cranston, P. S., Wiley Blackwell, UK
5. Park K. (2007) Preventive and social medicine XVI edition, B.B. Publisher
6. Arora DR and Arora B (2001). Medical Parasitology, II Edition. CBS Publications and Distributors
7. Imms A.D. (1977) A General Text Book of Entomology. Chapman and Hall UK
8. Roy D.N. and Brown A.W.A. 1970. Entomology (Medical and Veterinary) including insecticides & insects & Rat control; The Bangalore Printing & Publishing Co. Ltd., Bangalore
9. Mullen, G. and Durden L. 2009. Medical and veterinary entomology, Academic press, London



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10. Service M.W. 1996. Medical Entomology for students. Chapman & Hall, London.
11. World Health Organization. 1975. Manual on practical entomology in malaria. Part II. Methods and Techniques., Geneva.
12. Kettle, D.S. 1995. Medical and Veterinary Entomology. 2nd edition. CAB International. New York, NY.
Eldridge, B.F., J. D. Edman, 2004. Medical Entomology. A textbook on public health and veterinary problems caused by arthropods. Ed. B.F.Eldridge, J.D.Edman. Kluwer Academic Publishers. 672 p.



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Website: www.cuhimachal.ac.in

Course Code: ZOO 566

Course Name: Medical Entomology LAB

Credit: 02

Objectives of the Course:

Disease transmission by these insects can be prevented only by studying their biology, modes of transmission of pathogens by them, evaluation of associated risk factors, devise effective methods to control these insects and resolve the challenges posed.

Course Learning Outcome:

Recognize various possible modern tools and methodologies for laboratory diagnosis, surveillance and treatment of diseases

Explain control methods of insect vector diseases including spreading awareness on public health programs and mitigating insect borne diseases · Employ the use of advanced management strategies in disease control with respect to parasite evolution

Course Content

1. Study of mouthparts and their modification in medically important insects
2. Study of life history stages of medically important insect vectors through permanent slides or photographs: *Aedes*, *Culex*, *Anopheles*, lice (head, body, pubic), bed bug, *Phlebotomus* (sand fly), *Musca domestica* (house fly).
3. Study of life stages of medically important ticks and mites.
4. Study of different diseases transmitted by above insect vectors.
5. Field visit/Project report on any one disease transmitted by insect vector/important forensic insects

Suggested Books:

1. Medical and Veterinary Entomology Mullen, G. , Durden, L., Academic Press, USA
2. Medical and Veterinary Entomology, Kettle, D. S., Cabi Press, USA
3. Medical Entomology for students, Service, M. Cambridge University Press, UK
4. The Insects, An outline of Entomology, Gullan, P. J. , and Cranston, P. S., Wiley Blackwell, UK
5. Park K. (2007) Preventive and social medicine XVI edition, B.B. Publisher
6. Arora DR and Arora B (2001). Medical Parasitology, II Edition. CBS Publications and Distributors
7. Imms A.D. (1977) A General Text Book of Entomology. Chapman and Hall UK



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Website: www.cuhimachal.ac.in

Course Code: ZOO 567

Course Name: Advances in Aquaculture and Fishery

Credit: 02

Course Objectives: Culture techniques of aquatic organisms from different aquatic resources (freshwater, estuarine and marine) are included in this course.

Various molecular techniques like transgenic fish production, genetic selection, hybridization, etc. are also included in this paper.

Course Learning Outcomes: The study of culture techniques of various aquatic organisms helps in the production of healthy food for human consumption in a sustainable manner and also in employment generation.

Course Content

Unit I: AQUACULTURE- PRINCIPLES AND PRACTICES

Introduction: Definition, basics, scope and history of aquaculture; Present global and national scenario. Aquaculture systems: Systems of aquaculture: pond culture, pen culture, cage culture, running water culture and zero water exchange system. Extensive, semi intensive, intensive and super-intensive aquaculture in different types of water bodies viz., freshwater, brackish water and marine water. Introduction, scope & status of fishery science. Pisciculture, Advantage of pisciculture, Freshwater water Culturable fishes, Economic importance of fishes.

UNIT-II: EVOLUTION AND PHYLOGENY OF FISHES

Introduction and History of Ichthyology Classification and diagnostic characters (up to orders) of extant Cyclostomata, Chondrichthyes and Osteichthyes (9 major orders of fishes), Extinct fish group Origin, Evolution and Phylogeny of fishes' External morphology, body form, appendages, pigmentation, Principles of morphometry, Locomotion

UNIT-III: ADVANCED TECHNOLOGY IN FISHES

Biofloc technology (BFT): Introduction, principle and design, components of Biofloc technology system. Project preparation for constructing hatchery, use of probiotics and immunostimulants in hatcheries, Induced breeding- Advantages of induced breeding, technique of induced breeding, factors affecting induced breeding. Migration in Fishes.



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UNIT-IV: AQUACULTURE ENGINEERING

Genetic Engineering: Recombinant DNA; Restriction Enzymes and ligases; Gene Cloning and Transgenic Fish. Application of Molecular Biology Techniques: Cell culture and cell lines; Development of vaccines against fish; Hybridoma technology: production of monoclonal antibodies; Diagnostic kits: development of gene probes, PCR techniques.. Probiotics: Growth promoters, Immunomodulators. Bioremediation: Waste water treatment, Biofilters in aquaculture, Biofertilizers, Biosensors, Bioindicators. Bioinformatics: Concept of Bioinformatics - NCBI. Gene bank sequence database - Primary and Secondary database.

UNIT-V: ENVIRONMENT MANAGEMENT FOR AQUACULTURE

Introduction to **recirculating aquaculture system (RAS)**, concept of water reuse and recirculation, principle, advantages and disadvantages, components of RAS- solid removal, biological filtration, aeration and oxygenation, disinfection and sterilization, water quality management, species selection.

Remote sensing: Principles of remote sensing: orbits, electromagnetic radiation, diffraction, electro-optical, and microwave systems. Data Input; Data Management.

Books Recommended :

1. Pillay TVR, 1996. Aquaculture Principles and Practices, Fishing News Books Ltd., London
2. Pillay TVR & M.A.Dill, 1979. Advances in Aquaculture. Fishing News Books Ltd., London
3. Stickney RR 1979. Principles of Warm Water Aquaculture. John Wiley & Sons Inc. 1981
4. Boyd CE 1982. Water Quality Management for Pond Fish Culture. Elsevier Scientific Publishing Bose AN et.al., 1991. Coastal Aquaculture Engineering. Oxford & IBH Publishing Company
5. Ivar LO. 2007. Aquaculture Engineering. Daya Publ. House. 10. Shang, Y.C. 1990. Aquaculture Economic Analysis – An Introduction.
6. Nikolsky GV. 1963. Ecology of Fishes, Academic Press.



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7. Bardach, JE et al. 1972. Aquaculture – The farming and husbandry of freshwater and marine organisms, John Wiley & Sons, New York.
8. Boyd, CE. 1982. Water Quality Management for Pond Fish Culture. Elsevier Sci. Publ. Co.
9. ICAR. 2006. Hand Book of Fisheries and Aquaculture. ICAR.
10. Pillay TVR & Kutty MN. 2005. Aquaculture- Principles and Practices. 2nd Ed. Blackwell
11. Coche, A. G. and J. F. Muir. 1996. Pond Construction and Fresh Water Fish Culture – Pond Farm Structures and Layouts – Simple Methods for Aquaculture. FAO. Daya Publishing House, New Delhi. Upadhyay, A. S. 1995. A Hand Book on Design, Construction and Equipments in Coastal Aquaculture (Shrimp Farming). Daya Publishing House, New Delhi
12. MPEDA 1990. Aquaculture Engineering and Water Quality Management. Cochin, India.
13. Midlen & Redding TA. 1998. Environmental Management for Aquaculture. Kluwer.
14. Lynwood, S. Smith. Narendra Publ. House, Delhi. 2003. Introduction to the fish physiology.
15. Arvind Kumar and Pushaplata Dubey. Daya Publ. House, Delhi. 2006. Fish Management and Aquatic Environment
16. Lagler, Bardock, Miller & Possino, John Wiley & Sons, N.Y., London: 2012. Ichthyology, 2nd Ed.
17. Halver and Hardy. Acad. Press. 2002: Ash Nutrition . An Imprint
18. Talwar, P.K. and *Jhingran*, A.G. (1991) Inland Fishes of India and Adjacent Countries. Oxford-IBH Publishing Co. Pvt. Ltd., New Delhi, 1158 p.



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Website: www.cuhimachal.ac.in

Course Code: ZOO 568

Course Name: Advances in Aquaculture and Fishery LAB

Credit: 02

Course Objectives: Various molecular techniques like transgenic fish production, genetic selection, hybridization, etc. are also included in this paper.

Course Learning Outcomes: The study of culture techniques of various aquatic organisms helps in the production of healthy food for human consumption in a sustainable manner and also in employment generation.

Course Content:

1. To estimate the dissolved oxygen in water.
2. To estimate the pH of water.
3. To study the benthic organisms.
4. To study the Exotic culturable fishes.
5. Estimation of total hardness in a given water sample.
6. To study the different common diseases of fishes caused by virus, bacteria, protozoan and helminthes.
7. To study the different types of phytoplankton.
8. To study the different types of zooplankton.
9. To Estimation of total hardness in a given water sample.
10. To Estimation of total alkalinity in a given water sample.
11. To Estimation of total chlorides in a given water sample
12. To estimate the phosphate of water.
13. To determine the BOD of water.
14. To study the different types of fishing gears.
15. Gamete cryopreservation protocols.
16. Concepts of genebank sequencing.
17. Biosecurity aspects involved in aquaculture.
18. Visit to biosecured aquaculture environment.
19. Isolation of DNA
20. Isolation of RNA



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Suggested Books:

1. Pillay TVR, 1996. Aquaculture Principles and Practices, Fishing News Books Ltd., London
2. Pillay TVR & M.A.Dill, 1979. Advances in Aquaculture. Fishing News BooksLtd., London
3. Stickney RR 1979. Principles of Warm Water Aquaculture. John Wiley & SonsInc. 1981
4. Boyd CE 1982. Water Quality Management for Pond Fish Culture. Elsvier Scientific Publishing Bose AN et.al., 1991. Costal Aquaculture Engineering. Oxford & IBH Publishing Company



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Website: www.cuhimachal.ac.in

Course Code: ZOO 569

Course Name: Molecular Genetics

Credit: 02

Course learning Objective:

The course will help in building sound fundamental knowledge of molecular genetics, to be used as a stepping stone for higher studies and research in this field.

Course Learning Outcome: Upon completion of the course, students will be able to:

- Have a deeper understanding of the varied branches of the biological sciences like microbiology, evolutionary biology, genomics and metagenomics.
- After successful completion of the course the student should be able to design and comprehend experimental strategies for whole genome, transcriptome and proteome analysis.

Course Contents

Unit-I: STRUCTURE AND FUNCTION OF THE GENETIC MATERIAL

The genetic material - Structure of nucleic acids - folding motifs, conformation flexibilities, super-coiling of DNA; Packaging of DNA in the nucleus- structure of chromatin, Function of the genetic material; Evolution of genetic material;

Unit- II: PROKARYOTIC AND EUKARYOTIC DNA

Difference between prokaryotic and eukaryotic DNA replication initiation; Termination of replication; Proof- reading activity; Transcription initiation by RNA polymerases, regulation of transcription-factor activity, elongation and termination of transcription.

Unit- III: VARIATION IN GENETIC MATERIAL

Stability and variation in the genetic material. Mechanism of DNA repair; Genome instability; Homologous and site-specific recombination. Mechanism of homologous recombination in prokaryotes and eukaryotes;

Unit-IV: FATE OF RNA IN TRANSCRIPTION AND TRANSLATION

Fate of RNAs exported from the nucleus- Stability of different types of RNA; Translational machinery and translational control- Energetics of amino acid polymerization, tRNAs and their modifications; Amino-acylt-RNA synthetases; Initiation of translation in prokaryotes and eukaryotes and its regulation; elongation and its control, Termination of translation.

Unit-V: POST TRANSLATIONAL MODIFICATION



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Post-transcriptional gene control mechanism and nuclear transport - Processing of the 5' and 3' ends of eukaryotic mRNA; Types of introns and their splicing, Micro RNA and other noncoding RNAs; Transport across the nuclear envelope- Structure of the nuclear membrane and the nuclear pore complexes.

Suggested Literature:

1. Molecular Biology of the Gene, Watson et al. (7th Ed. 2017), Pearson Education, Delhi, INDIA
2. Lewin's Genes XI (2014), Jones and Bartlett Publishers, Boston, USA
3. Molecular Cell Biology, Lodish et al., W.H. Freeman and Company (8th Ed. 2016)
4. Accuracy in Molecular Processes: Its Control and Relevance to Living System, TBL Kirkwood, RF Rosenberger, and DJ Gala (1989), Chapman and Hall, NY, USA.



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Website: www.cuhimachal.ac.in

Course Code: ZOO 570

Course Name: Molecular Genetics LAB

Credit: 02

Course learning Objective:

The course will help in building sound fundamental knowledge of molecular genetics, to be used as a stepping stone for higher studies and research in this field.

Course Learning Outcome: Upon completion of the course, students will be able to:

- Have a deeper understanding of the varied branches of the biological sciences like microbiology, evolutionary biology, genomics and metagenomics.
- After successful completion of the course the student should be able to design and comprehend experimental strategies for whole genome, transcriptome and proteome analysis.

Course Contents

1. DNA isolation protocol for bacteria and yeast
2. DNA isolation protocol from mammals
3. RNA Isolation Protocol
4. UV Spectrophotometry- best for quantifying oligos, single stranded RNA and DNA.
5. Representative DNA Size Markers for Agarose Gels
6. Ethidium fluorescence- best if you have small quantities and no fluorometer
7. Simplified preparation of DNA from blood
8. Restriction digestion of DNA
9. Determination of cellular DNA and Protein concentrations
10. Role of PCR in DNA amplification
11. Staining method to determine nucleic acid
12. Role of Gel Doc in genetic study.

Suggested Literature:

1. Molecular Biology of the Gene, Watson et al. (7th Ed. 2017), Pearson Education, Delhi, INDIA
2. Lewin's Genes XI (2014), Jones and Bartlett Publishers, Boston, USA
3. Molecular Cell Biology, Lodish et al., W.H. Freeman and Company (8th Ed. 2016)
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Website: www.cuhimachal.ac.in

Course Code: ZOO 571

Course Name: Academic Writing

Credit: 02

Objectives of the Course:

- To acquaint the students to different types of scientific writing.
- To help students to understand the methods of citation and referencing styles, check plagiarism and get insight of intellectual property right

Course Learning Outcomes:

Through this course students should be able to:

- identify ethics of research in writing research proposal, thesis and research paper.
- represent the research proposal, thesis and research paper effectively.

Course content

Unit I: INTRODUCTION OF ACADEMIC RESEARCH WRITING

Introduction of academic and research writing, importance of academic writing and basics of academic writing. English in academic writing and styles of research writing.

Unit II: PLAGIARISM

UGC guidelines on Plagiarism, tools of detection of plagiarism and avoiding plagiarism. Journal metrics, author metrics

Unit III: LITERATURE MANAGEMENT TOOL

Literature review, process of literature review, online literature databases. Literature management tools. Referencing and citation, submission, and post submission.

Unit IV: WRITING RESEARCH ARTICLE AND PROPOSAL

Introduction and tips for writing the Popular article, research proposal, Research article, review articles, book and thesis. Empirical study.

Unit V: ETHICS IN ACADEMIC WRITING

Challenges in Indian research and writing, team management, time management, Open education resources, Ethics in academic writing.



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Suggested Books/Materials:

- Stephen B. Heard. The Scientist's Guide to Writing: How to Write More Easily and Effectively throughout Your Scientific Career, Princeton University Press (2016)
- John M. Swales, Christine B. Feak. Academic Writing for Graduate Students: Essential Tasks and Skills, University of Michigan Press (2012)



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Website: www.cuhimachal.ac.in

Course Code: ZOO 572

Course Name: Paper publication/Seminar, Conferences

presentation at National Level

Credit: 02

Objectives of the Course:

To acquaint the students to different types of scientific writing and presenting their work.

Course Learning Outcomes: Through this course students should be able to

- write effective research paper, research proposal and thesis.
- identify ethics of research in writing research proposal, thesis and research paper.
- represent the research proposal, thesis and research paper effectively.

Course Content:

1. Publish at least one research article in UGC approved research journal/Journal of Himalayan Life Sciences.
2. Publish at least one review article in UGC approved research journal/ Journal of Himalayan Life Sciences.
3. Participate in an oral presentation/ talk in refereed conference/ Seminar. Additionally, student must submit a writeup at CUHP before the end of this course.
4. Participate in poster presentation in a referred conference / Seminar. Additionally, student must submit a writeup at CUHP before the end of this course.
5. Participate in a seminar/ conference/ training event etc and make a detailed report.



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Website: www.cuhimachal.ac.in

Course Code: ZOO 573

Course Name: Role of Artificial Intelligence in Animal Science Research Credit: 02

Objectives of the Course:

This course offers an overview of fundamental concepts of Bioinformatics and Biostatistics. An interdisciplinary program, it emphasizes integration of Computer Science with Biology and introduces the students to various computational methods and software tools for understanding biological databases, gene sequence alignments, gene annotation, protein structure predictions, drug discovery, molecular phylogeny, metagenomics, etc.

Course Learning Outcome: After completion of the course the students will be able to:

- Explain the basic concepts of Bioinformatics and its various applications in different fields of biological sciences
- Describe theoretically sources of biological data, and list various biological databases – nucleic acids, protein sequence, metabolic pathways and small molecule
- Identify various file formats of sequence data and tools for submission of data in databases as well as retrieval of gene and protein data from databases

Course Contents

UNIT–I: Introduction to Bioinformatics

Definition and scope of Computational Biology and Bioinformatics, National Centre for Biotechnology Information (NCBI), Basic Local Alignment Search Tool (BLAST), Flavors of BLAST (BlastP, BlastN, BlastX, tBlastN), Different file formats, Bioinformatics in India-current status and future implications.

UNIT–II: Biological Database: An Introduction

General Introduction of Biological Databases, Primary Biological Databases, Secondary Biological Databases, Specialized Databases, GenBank, DDBJ, EMBL, PDB, Uniprot (SwissProt/TrEMBL), PIR, Pfam, PROSITE, CATH, KEGG, SCOP.

UNIT–III: Sequence Alignments and Phylogenetics

Introduction to Sequences alignments, Local Alignment and Global Alignment, Pairwise Sequence Alignment and Multiple Sequence Alignment, ClustalX, Muscle, T-Coffee, Phylogenetics (Overview), Phylogenetic tree, Bootstrapping, MEGAX.



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UNIT–IV: An Introduction to Artificial Intelligence (AI)

Artificial Intelligence (Basics), Machine Learning (Basics), Neural Networks (Overview), Support Vector Machine (Overview), Hidden Markov Model (Overview)

UNIT–V: Applications of Artificial Intelligence in Animal Husbandry

AI in Automated Milking, Animal Health Monitoring, Precision livestock farming, Optimizing farm animal growth, tackling parasites, improving feed quality, Seminar, Project work.

Suggested Books:

1. Essential Bioinformatics, First Edition. Author: Jin Xiong, Published by Cambridge University Press, United Kingdom, ISBN 13 978-0-511-16815-4.
2. Bioinformatics: Sequence and Genome Analysis, Second Edition. Author: David Mount, Published by Cold Spring Harbor Laboratory Press, United States, ISBN 978-087969712-9.
3. Machine Learning for Dummies, First Edition. Author: John Paul Muller and Luca Massaron, Published by Wiley, ISBN-13: 978-1119245513.
4. Deep Learning for the Life Sciences. Author: Bharath Ramsundar, Peter Eastman, Patrick Walters, Vijay Pande, Publisher(s): O'Reilly Media, Inc. ISBN: 9781492039839.
5. Lednicer, D. “Strategies for Organic Drug Discovery Synthesis and Design”; (1998) Wiley International Publishers.



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Website: www.cuhimachal.ac.in

Course Code: ZOO 574

Course Name: Use of Advanced Software like, Biorender,

GIS, Mendeley and Turnitin etc in Research

Credit: 02

Objectives of the Course:

- To introduce students to Fundamentals of Biorender, GIS, Mendley and Turnitin and its applications in research.

Course Learning Outcome:

- After successful completion of the course the student should be able to use mentioned softwares and apply them in their research process.

Course Contents

UNIT I: BIORENDER

Features of biorender, figure drawing, graphical representation of paper, pre-drawn icons

UNIT II: MENDLEY

References manager, academic social network, storage organization and search all references, Insertion of citation and bibliography into Microsoft word.

UNIT III: GIS

Use of Geographic Information system (GIS) mapping to Capture and analyse geographic data.

UNIT IV: TURNITIN

Use of Turnitin to check plagiarism and create similarity index and originality report.

UNIT V: OTHER SOFTWARES

Other software used in animal sciences according to research need like Latex

Suggested Softwares:

1. Biorender,
2. GIS,
3. Mendeley
4. Turnit
5. Latex



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Website: www.cuhimachal.ac.in

Course Code: ZOO 595

Course Name: Dissertation

Credit: 08

Dissertation (50%):

4 Credits

Presentation and Viva voce (50%): 4 Credits

The course of dissertation is based on their specialization field to get more learning in particular field with Practical knowledge.