

New Course
added

HCT-1.1: ANIMAL SYSTEMATICS

48 hrs

Objective: Systematic Zoology endeavours to order this diversity of the animal world and to develop methods and principles to make this task possible.

Learning Outcomes: Systematics today is an exciting and active branch of biology and it is to be greatly wished that more students of life sciences take up systematics as their research field. In its broader sense, it is nothing less than a thorough and complete study of the diversity of living forms, and its domain thus encompasses ecology, evolutionary biology and biodiversity studies, in addition to the norms and principles of classification. Systematics has great relevance to the biological control of pests which is itself a very important aspect of applied biology. Providing catalogues, revisions, hand-books, keys, etc.

Unit 1:

Introduction: Science of taxonomy, History and stages of taxonomy, Importance of taxonomy, Problems of taxonomists, Aim and tasks of taxonomists, Taxonomy as profession. 04

Unit 2:

New trends and approaches in taxonomy: Morphological, Embryological, Ecological, Behavioral, Cytogetic, Molecular, Biochemical and Numerical Approaches 04

Unit 3:

Zoological classification: Kinds of classification, Phylogenetic lineages, Components of classification, Linnaean hierarchy, Methods of phylogenetic analysis (phenetic and cladistic methods) 05

Unit 4:

Species Concepts: Historical perspectives of species concepts (Typological, Nominalistic, Evolutionary, Biological, Phylogenetic); other kinds of species; Subspecies; Intraspecific groups (Deme, Form/Morphotype, cline, Variety); Models and mechanism of speciation. 05

Unit 5:

a. Taxonomic collection: Collection of animals, preservation, curating, storage, cataloguing of specimens, Taxidermi, Deterioration of museum specimens, Taxonomic publications, 08
b. Zoological Nomenclature: Origin of Code, Biocode, Phylocode, ICZN, Rules of Nomenclature

Unit 6:

General outline of animal classification-tree of life, Characters and Classification of Invertebrate Phyla (Protozoa to Echinodermata) 10

Unit 7:

General characters and Classification of Protochordates; General characters and Classification of Chordates 08

Unit 8:

Phylogenetic interrelationship between major Invertebrate Phyla; Phylogenetic interrelationship between Protochordates and Chordates 04

References:

1. Ernest Mayr. *Principles of Systematic Zoology*, Tata-McGraw-Hill, New Delhi, 1997.
2. Simpson, G.G. *Principles of Animal taxonomy*. Columbia University Press, New York, 1961.
3. Barnes, R.D. *Invertebrates Zoology*. IInd Saunders, Philadelphia, 1968.
4. Kapoor, V.C. *Theory of Animal Taxonomy*, Oxford IBH Co. Pvt. Ltd., New Delhi, 1998.
5. Barrington, E.J.W. *Invertebrates structure and Function*, Nelson, London, 1967.
6. Hawksworth, D.L. (Ed). *Biodiversity: Measurement and Estimation*, Chapman and Hall, 1961.
7. Khan, T.I and Y.S. Shishodia. *Biodiversity Conservation and Sustainable Development*. Pointer Publications, Jaipur, 1998.

HCT-1.2: BIOLOGY OF NON-CHORDATES

48 hrs

Course objective: To understand the general characteristics, organization of non-chordates.

Learning Outcomes: Describe general taxonomic rules on animal classification, organizations and their ecological role. Gain knowledge to identify various larval stages and development in invertebrate groups. Explain various modifications in these groups and the need of the modification for survival.

Unit 1

Introduction: Functional Morphology of Non-chordates. Organisation of Coelom: Acoelomates, Pseudocoelomates and Coelomates. Protostomia and Deuterostomia. 05

Unit 2

Locomotion: Amoeboid, Flagellar, Ciliary movements in Protozoa. Hydrostatic movement in Cnidaria, Annelida and Echinodermata. 06

Unit 3

Nutrition: Nutrition in Protozoa and in lower Metazoans. Filter feeding in Polychaetes, Molluscs and Echinoderms, Feeding patterns in Insects. 05

Unit 4

Respiration: Organs of Respiration: Gills, Trachea and Lungs in Invertebrates. Respiratory pigments, Mechanism of Respiration. 08

Circulation: Patterns of Circulation and functions of body fluids.

Unit 5

Excretion: Excretory Organs, Coelomoducts, Nephridia, Coxal Glands and Malpighian tubules. Mechanism of Excretion in Non-chordates. 08

Unit 6

Nervous System: Primitive Nervous system in Coelenterates and Echinodermata. Advanced Nervous System: Nematoda, Annelida, Arthropoda and Mollusca. Sense organs and their importance. 10

Unit 7

Reproduction: Patterns of Reproduction in Non-chordates. Larval forms and their evolutionary significance. 06

References:

1. Barnes, R.D. *Invertebrates Zoology*. IInd Saunders, Philadelphia, 1968.
2. Barrington, E.J.W. *Invertebrates structure and Function*, Nelson, London, 1967.
3. Hyman, L.H. *The Invertebrates* Vol. I-VI. McGraw-Hill, New York, 1940-67.
4. Russel Hunter, W.D. *Biology of Lower Invertebrates*, Macmillan Company, New York, 1968.
5. Marshall, A.J. and Williams W.D. (Eds). *Text book of Zoology- Invertebrates* VII Ed. Vol. I ALTBS Publications, 1995.

HCT- 1.3: CELL AND MOLECULAR BIOLOGY**48 hrs****Course objectives:**

Today's era is the study of living things at the cellular and sub-cellular levels. Without proper approach to these studies the mechanisms and functioning of the cells and organisms at a broader level can't be understood. It is utmost needed to understand the structures and purposes of basic components of prokaryotic and eukaryotic cells, especially macromolecules, membranes, and organelles and how these cellular components are used to generate and utilize energy in cells. And the students will be able to apply their knowledge of cell biology to selected examples of changes or losses in cell function. These can include responses to environmental or physiological changes, or alterations of cell function brought about by mutation.

Course Learning Outcome(CLO) : After completing the course, Students will be able to :

- Understand and utilize the scientific vocabulary used in communicating information in cell and molecular biology
- Represent and illustrate the structural organization of genes and the control of gene expression
- Conceptualize and describe protein structure, folding and sorting
- Explain the structure of membranes and intracellular compartments and relate these to function.
- Relate how cell movement and cell-cell communication occur and discuss mechanisms of signal transduction
- Outline the processes that control eukaryotic cell cycle and cell death.
- Link the rapid advances in cell and molecular biology to a better understanding of diseases, including cancer.

Unit 1:**04**

Introduction: History of cell biology; Levels of cell organization (prokaryotes and eukaryotes), Cell as structural and functional unit of organisms, the scope of modern cell biology.

Unit 2:**06**

Biomembrane: Molecular organization of Bio-membranes, Transport across cell membrane, Cell to cell communication and recognition, Modifications of membranes: Gap junctions and tight junctions, Membrane receptors, Ion channels, Gated channels.

Unit 3:**08**

Molecular organization and functions of Cell Organelles: Endoplasmic reticulum, Golgi complex, Lysosomes, Ribosomes, Peroxisomes, Mitochondria.

Molecular organization and functions of cytoskeleton structures: Microfilaments, Microtubules and their role in cell architecture.

Unit 4:**05**

Nucleus: Molecular structure of chromosomes, Euchromatin and Heterochromatin, Role of Histone in packing DNA, Non-histone proteins, Organization and functions of Nucleolus.

Unit 5:**04**

DNA Replication: Unit of replication, enzymes components involved in replication, replication origin and replication fork, fidelity of replication, Prokaryotic and eukaryotic DNA replication mechanism.

Unit 6:**04**

DNA Transcription: Transcription factors and machinery. RNA polymerases. Mechanism of prokaryotic and eukaryotic transcription. Post – transcriptional modifications in RNA: 5'Cap formation, 3'end processing and polyadenylation, Splicing, editing, Nuclear export of mRNA, mRNA stability.

Unit 7:**06**

Translation: Genetic code, Ribosome, Enzymes, factors and the process (formation of initiation complex, initiation factors, elongation and elongation factors, termination, aminoacylation of tRNA, tRNA-identity, aminoacyl tRNA synthetase), translational proof-reading, translational inhibitors. Co-and post – translational modifications of proteins.

Unit 8:**06**

Cell Cycle: Molecular events during cell cycle, cyclins and cyclin dependent protein kinases (CDK's). Regulation of CDK cyclin activity.

Cell Aging: characteristics and causes of aging; telomeres and aging; **Apoptosis:** Mechanism and significance

Unit 9:

Cancer Biology: Characteristics and properties of cancer; Development and causes of cancer, Diagnosis; treatment; Oncogenes, Tumour viruses, Tumor suppressor genes. 06

References:

1. Alberts, B., Bray Dennis, Lewis Julian, raff Martin, Roberts K. and Watson J.D. *Molecular biology of Cell*. Garland publishing Inc. New York, 1994.
2. Cellis, J.e. *Cell Biology*. ALaboratory hand book Vol. I and II. Academic Press, 1998.
3. Lodish, H., Berk, A Zipuosky, L.S. Matsudaira, P. Baltimore and Darnell, J. *Molecular Cell Biology* IV Ed. W.H. Freeman and Co., 2001.
4. Malacinski, G.M. and Freifelder D. *Essentials of Molecular Biology* III ed. Jones and Bartlett Publishers, 1998.
5. *Molecular Cell Biology*. Lodish, Harvey; Berk, Arnold; Zipursky, S.Lawrence;Matsudaira, Paul; Baltimore, David; Darnell, James E. New York: W.H. Freeman& Co. 1999
6. *Modern Genetic Analysis*. Griffiths, Anthomy J.F. Gelbart, William M, Miller Jeffrey H, Lewontin, Richard C. New York: W.H. Freeman & Co. 1999
7. *Molecular Biology of the Cell*. Alberts, Bruce; Johnson, Alexander; Lewis, Julian,Raff, Martin; Roberts, Keith; Walter, Peter. New York and London: Garland Science 2002
8. *The Cell – A Molecular Approach*. Cooper, Geoffrey M.Sunderland (MA): Sinauer Associates, Inc. 2007
9. *Introduction to Genetic Analysis*. Griffiths, Anthony J.F.; Miller, Jeffrey H.;Suzuki David T.; Lewontin, Richard C, Gelbart, William M. New York: W.H. Freeman & Co. 1999
10. *Principles of Genetics*. Gardner,E.J., Simmon, S. and Snustad, 8th Edition, John Wiley and sons inc. Publication, New York. 1991

SCT-1.4a: BASIC AND APPLIED ENTOMOLOGY

48 hrs

Objectives: To teach basic aspects of arthropod ecology, morphology, parasitology, physiology, systematics and toxicology to applied subjects in apiculture, agricultural, medical and veterinary pest management.

Learning Outcomes: Professional entomologists contribute to the betterment of humankind by detecting the role of insects in the spread of disease and discovering ways of protecting food and crops, and livestock from being damaged. The way beneficial insects contribute to the well-being of humans, animals, and plants.

Unit 1:

Insect Taxonomy: Classification of insects up to orders with suitable examples; Morphology of integument, head, thorax and abdomen and appendages. 03

Unit 2:

- a. **Structure and function:** Digestive system, respiratory system, excretory system.
- b. **Nervous system:** Sense organs, sound producing organs, photoreceptor and photogenic organs
- c. **Endocrine system:** Hormones and their regulation
- d. **Reproductive system:** Reproductive system, metamorphosis and diapauses in insects

10

Unit 3:

- Insect pests:** a. Definition, categories, origin of pest, causes for outbreak, economic damage. 10
- b. **Pest monitoring:** Pest surveillance, forecasting survey and sampling techniques, crop loss estimation.
 - c. **Insect pests of major crops:** Damage, life cycle, seasonal history, status and control of major pests of important crops such as Cereals: Rice, Sorghum, Maize, Wheat; Oil seeds: Sun flower, Saff flower

& Groundnut; Vegetable crops: Brinjal, Ladies finger, Cabbage and Beans; Commercial crops: Sugarcane, cotton, Coconut and Coffee.

Unit 4:

10

Integrated Pest Management: History, different phases of pest control, (Quarantine, Physical, Chemical, Biological control and, genetic and biotechnological methods) control. Pheromones- Types, chemical characteristics, biosynthesis and their use in pest management, Pheromone traps.

Unit 5:

05

Medical Entomology:

Common insects attacking humans and domestic animals; their life history, mode of attack, type of injury or infection, treatment and control with reference to House fly, Blow flies, Blood sucking insects.

Unit 6:

10

Culture of commercial Insects:

- Honey bee: Species, role in pollination, bee keeping and management, bee products.
- Silk worm: species, silkworm rearing and management, pests of silkworm
- Lac Insect: Host plants, Lac cultivation, commercial importance.

References:

- Awasti V.B. 2009 Introduction to general entomology 3rd Ed. Scientific publication (India), Jodhpur
- Awasti V.B. 2007, Agricultural Insect Pests and their control. Scientific publishers (India) Jodhpur
- Trigunayat M.M. 2009, A Manual of practical entomology, scientific publishers, Jodhpur, India.
- Dhaliwal G.S. Ramsingh and B.S. Chillar 2006, Essentials of Agricultural entomology. Kalyani Publishers, New Delhi.
- L. K. Jha. Applied Agricultural Entomology. New central book agency. Calcutta
- Rajendra singh. 2007. Elements of Entomology. Published by Rakesh kumar. Rastogi and Rastogi Publications. Gangotri, Shivaji Road. Meerut.

SCT-1.4 b: BIODIVERSITY

48 hrs

Objective: Diversity of life on earth is an essential factor for the healthy functioning of ecosystems. The aim to study biodiversity is to protect, preserve and manage natural resources.

Learning Outcomes: Biodiversity is also considered to have intrinsic value, economic, ecological life support, recreation, cultural and scientific sustenance.

Unit 1:

03

Introduction: Concepts, Definition, Values of diversity, Consumptive use and productive use, Social and Aesthetic values.

Unit 2:

09

Genetic diversity: Genetic diversity, Species diversity, Ecosystem diversity, Biodiversity at global, National and local levels.

Hot spots of Biodiversity: Biodiversity hot spots in India, India as a mega diversity country, Endemic species.

Unit 3:

06

Concept of biodiversity: Types of biodiversity and biodiversity profile of India. Ramsar wetlands. General theories of biodiversity: biotic and abiotic theories.

Unit 4:

- a. **Threats to Biodiversity:** Deforestation, Habitat destruction, Hunting, and over exploitation, introduction of exotic species, Impact of Pollution on biodiversity. 12
- b. **Wild life status; Endangered, vulnerable, Rare and threatened species**
- c. **Conservation of biodiversity:** Objectives, In-situ and Ex-situ conservation, People movement, Role of Educational Institutes and NGO's Biodiversity awareness, programme, Future strategies for biodiversity conservation in India.

Unit 5:

- a. **Biodiversity Legislation:** Legal aspects with respect to India, Biodiversity Act, 2002; CBD; CITES, IPR. 12
- b. **Biodiversity and Biotechnology:** Assessment of biodiversity and bioresources, biodiversity conservation, utilization of biodiversity, GMO's and their impact on biodiversity.

Unit 6:**Biodiversity and Management:**

06

- a. Organizations associated with biodiversity Management, IUCN, UNEP, UNESCO, WWF, FAD, WCWC, BMC, KBB and BHS; their role and contributions
- b. Bioprospecting, Biopiracy, Biosafety, Bioremediation.

References:

1. Dasmann, F Raymond. Wildlife Biology. Wiley Eastern Ltd. India. 1982.
2. Encyclopedia of Nature and Science. Vols 1-18. Bay Books Pvt.Ltd. Sydney, 1974.
3. Burnie, D. (Ed). Animal: the Definitive Visual Guide to the Worlds Wildlife. D.K.Publications, 2001.
4. Singh, M.P. 2009. Biodiversity. APH Publishing Corporation, New Delhi.
5. Saharia, V.B. 1982. Wildlife in India. Natraj Publishers, Dehara Dun.
6. Kotwal, P.C. and Banerjee, S. 2004. Biodiversity Conservation in managed forests and protected areas. Agrobios (India) Publishers, Jodhpur.
7. NBA. 2004. The Biological Diversity Act (2002) and Biological Diversity Rules (2004). NBA, Chennai, India.
8. Kumar, U. and Asija, M. 2005. Biodiversity: Principles and Conservation. 2nd Edn. Agrobios (India) Publishers, Jodhpur.
9. B. B. Hosetti 2005. Glimpses of biodiversity, Daya Publishers. Delhi-11
10. B.B.Hosetti and M.Venkateshwarlu 2004. Trends in wildlife biodiversity, conservation and management. Vol. I and II Daya Publishers, Delhi-11.
11. B.B. Hosetti 2008. Concepts in wildlife management, III edition, Daya Publishers, Delhi.

SCT-1.4 c: VECTORS AND COMMUNICABLE DISEASES.

48 hrs.

Objectives: To learn biology of vectors and their respective diseases, epidemics, pandemics, prevention, and control measures.

Outcomes: Basic scientific awareness and identification of vectors and their clinical applications.

Unit 1: Introduction to vector borne diseases and vectors- World scenario; Indian scenario. Historical perspective- Epidemics, discoveries; Scientists and major events involved in the discovery of vectors and pathogens of communicable diseases

08

Unit 2: Epidemiology, biology of vectors and pathogens, transmission cycles and symptoms- of malaria, filariasis, yellow fever, leishmaniasis and anthrax.

08

Unit 3: Epidemiology, biology of vectors and pathogens, transmission cycles and symptoms- of dengue, chikungunya, Japanese encephalitis, schistosomiasis and plague. 08

Unit 4: Distribution, epidemiology and control of Yellow fever, African sleeping sickness, oncocerciasis and chagas disease. 08

Unit 5: Mechanical vectors- House flies, cockroaches and bedbugs- Transmission of dysentery, diarrhea, typhoid, cholera, epidemic conjunctivitis and skin infections. 08

Unit 6: Control of vector borne diseases; Vector control- Chemical, Biological, Genetic and Environmental. Insecticide resistance in vectors. Drug resistance in pathogens. Importance of education, awareness and Community participation. 08

References:

1. Clements, A. N., 1992. The biology of Mosquitoes, Vol-I, Chapman and Hall, London.
2. Clements, A. N., 1999. The biology of Mosquitoes, Vol-II, Chapman and Hall, London.
3. Fenemore, P. G. and Alka Prakash., 1992. Applied Entomology, Wiley Eastern Ltd., New Delhi.
4. Gullan, P. J. and Cranston. 1994. The Insects: An outline of Entomology, Chapman and Hall, London.
5. Kenneth, G. V. Smith, 1973. Insects and other arthropods of medical importance. Trustees of British Museum, London.
6. Manson- Bahr, P. E. C. and Bell, D. R., (Ed) 1987. Manson's tropical diseases. English Language Book Society, Barillien Tindall.
7. Metcalf, R. L. and W. B. Flint. 1962. Destructive and useful insects, their habits and control. McGraw Hill Publ. Co., N. Y.
8. Rao, T. R., 1984. The Anophelines of India. Publ. by Malaria Research Centre, Delhi.
9. Service, M. W., 1976. Mosquito ecology. Applied Science Publication Ltd., London.
10. Srivastava, K. P., 1988. A Textbook of Applied Entomology, Publ. Kalyani Publishers, New Delhi.
11. WHO (Geneva), 1989. Geographical distribution of arthropod borne diseases and their principal vectors. WHO. Geneva.

OET-1.8. Offered by the Department of Women's Studies.

HCT-2.1: BIOLOGY OF CHORDATES

48 hrs

Course objectives :

The study of classic zoological subjects is needed to understand the modern subjects and therefore the paper is designed for the students to understand the origin and evolutionary relationship in different subphylum and classes of chordates. This course imparts the knowledge to learn and recognize the concepts of Adaptive radiations. The course aims teaching the special characters of different classes of chordates like migration in fishes and birds and parental care in different classes as well, additionally it covers the comparative study of internal organs among the different vertebrate classes and also the study of endoskeleton.

Course Learning Outcome(CLO):

After undergoing the course study the students will be able to :

- Able to describe the body plan of few protochordate species and their unique characters.
- Understand the evolutionary relationship among the different subphyla and classes of Chordates and their origin
- Know the diversity in snakes and the current status of reptilian fauna.
- Able to describe the behavioural aspects in reproduction in some of the vertebrates.
- Able to describe the structural differences in the organs among different chordate groups.

Unit 1:

Introduction: Origin of Chordates and recent theories, General organization and features of chordates. 08
Protochordata: Life cycle of Salpa, Doliolum and Amphioxus, Significance of Retrogressive Metamorphosis.

Unit 2:

Origin and Evolution of Agnatha, Placoderms and Chondrichthyes, Osteichthyes: Lateral line system, Migration in fishes 06

Unit 3:

Origin and Evolution of Amphibians, Breeding Behavior and Parental care in living Amphibia, Neoteny and Adaptive radiation Amphibians. 06

Unit 4:

Origin and Evolution of Reptiles, Adaptive radiation in living Reptiles, Poisonous and Non-poisonous Snakes in India and Extinct Reptiles. 06

Unit 5:

Origin and evolution of Birds, aerial adaptations and Mechanism of flight, Courtship and Breeding Behaviour and Migration in Birds. Aquatic and Flightless Birds. 06

Unit 6:

Origin and Evolution of Mammals. Adaptive radiations in Monotremes, Marsupials. Aquatic Mammals. Dentition in Mammals. 06

Unit 7:

Comparative anatomy: Integument and its derivatives, Heart and aortic arches, Brain and Kidney 10
Mammalian endoskeleton: Axial and Appendicular skeleton

References:

1. Marshall, A.J. and Williams W.D. (Ed). *Text Book of Zoology: Vertebrates-VII* (Ed.) Vol. II AITBS Publishers and Distributors, 1995.

2. Young, J.Z. *The Life of Vertebrates*. III Ed Clarendon Press, Oxford, 1981.
3. William, N. Mcfarland, F. and Harvey Pough Tom J.C. and Heiser J.B. *Vertebrate Life*. Collier-Macmillan Publihers, London, 1979.
4. Romer, W.B. *The Vertebrates Body*. Saunders, Philadelphia, 1956.

HCT-2.2: MOLECULAR GENETICS**48 hrs**

Objective: The course aims to provide students with a basic understanding of DNA, genes and genome control of all living processes.

Learning Outcomes: This helps to better understand human biology in health and disease. The tools used in molecular genetics, and their potential applications to medical and veterinary science and R&D.

- Unit 1:** **05**
Introduction: Overview of Mendelian and post Mendelian Genetics; Concept of alleles, complementation test; Cistron, Muton, Recon, Genome imprinting.
- Unit 2:** **10**
DNA structure and functions: DNA as the hereditary material- Experiments; Watson- Crick model and alternative models; Replication- Enzymology of replication, initiation, elongation and termination; Models of replication; Protein Synthesis; Central dogma of molecular biology, *colinearity* hypothesis of transcription, translation, post translation modifications; Molecular basis of genetic recombination and repair
- Unit 3:** **05**
Genetics of bacterium and bacteriophage: Transformation, transduction and conjugation in bacteria and life cycle of bacteriophage
- Unit 4:** **08**
Gene Regulation: Operon model- Positive and negative regulation; Transcription factors, Cis & Trans acting elements in eukaryotes; Dosage compensation in Man, *Drosophila* and *Caenorhabditis elegans*
- Unit 5:** **06**
Genome Rearrangement: Cytogenetic implications of duplication, deletion, inversion, translocation; Transposons; Lampbrush and polytene chromosomes
- Unit 6:** **06**
Genomics and Proteomics: Organization of eukaryotic genome; Salient features of yeast, *Drosophila* and human genome, evolutionary genomics; Proteomics
- Unit 7:** **08**
Techniques in Molecular genetics: Electrophoresis and electro focusing; Northern, southern and western blotting techniques; PCR; Gene sequencing, RFLP.

References:

1. Altherly, A. G., Girten, J. R. and McDonald, J. F. The Science of Genetics. Saunders College, 1999.
2. Gardner, E. J., Simmons, M. J. and Snustad, D. P. Genetics III Ed. John Willy and Sons, New York, 1990.
3. Stickberger, N. W. Genetics. MacMillan Publishing Co. New York, 1985.
4. Watson, J. D. et al. Recombinant DNA. W. H. Freeman and Co., 1992. Trevor, B. B. and Julian Burke. Gene Structure and Transcription. Oxford University Press. 1998.
5. Benjamin, Lewin. Genes Vol. I-IV. Oxford University Press, 1995.

HCT- 2.3: DEVELOPMENTAL BIOLOGY**48 hrs****Course objectives :**

It aims to cover the basic and fundamental embryonic developmental stages as well as the post embryonic developmental aspects of animals. It imparts the knowledge of early development, including the axis formation in few animals. This course aims to study the later embryonic development like metamorphosis, regeneration and ageing and abnormal development like teratology. This course imparts knowledge about the cellular differentiation, organogenesis and morphogenesis in a generalised way.

Course Learning Outcome(CLO): After learning this course the students will be able to :

- Differentiate between embryology and developmental biology .
- Understand the very basic embryonic developmental processes in different organisms.
- List out the different stages of both embryonic and post embryonic development.
- Understand that embryonic development is affected by external factors leading to abnormalities.
- Describe the development of specific cells and tissues.
- Describe the different stages that animals pass through before reaching the final structure.

Unit 1:

Introduction: Overview of Animal Development, Anatomical and Experimental approach to Developmental Biology, Concepts of totipotency. **03**

Unit 2:

Fertilization and early development: **09**

Fertilization- Structure of gametes, cellular and biochemical processes during early fertilization, strategies for monospermy and conservation of species, Signal transduction and Egg activation, Prevention of Polyspermy, Nucleo-cytoplasmic interaction during early development in Amoeba, Acetabularia, Frog. Cleavage, Blastula, Gastrulation in Frog and Chick, Fate maps.

Unit 3:

Early Development in Drosophila: Development of Larva. Origin of anterior and posterior Polarity, Generation of dorso-ventral polarity. Maternal effects of genes, Segmental genes, Homeotic selector genes. **08**

Unit 4:

Axis formation of in Amphibians: Mechanism of progressive determination of Amphibian axis, Primary embryonic induction, Regional specificity of induction, Organizer-functions and diffusible proteins of organizer. **08**

Unit 5:

Cell differentiation and Organogenesis: Development of somites and differential cell proliferation in shaping organ primordial, Differentiation of neural tube-anterior posterior axis, Dorso-ventral axis. Differentiation of erythrocytes, Haematopoiesis, Myogenesis- differentiation of bH LH protein, muscle cell fusion; Fate maps. **10**

Unit 6:

Post-embryonic development and growth: Regeneration in animals with reference to Hydra, Planaria and Salamander limb. Metamorphosis in Amphibia: Morphological and Biochemical changes and hormonal control of Metamorphosis. **06**
Growth: Concept, isometric and allometric physiological mechanisms.

Unit 7:

Abnormal development: Teratology, Causation of abnormal development, Experimental studies and Teratogens. **04**

References:

1. Gilbert, S.F. *Developmental Biology*. IV Ed. Sinauer Associates Inc. Publishers, Massachusetts, 2000.
2. Kalthoff, K. *Analysis of Biological Development*. McGraw Hill Inc. New York, 1996
3. Rao, K.V. *Developmental Biology: A Modern Synthesis*. Oxford and IBH Publishing Co. Pvt. Ltd., 1993.
4. Subramanian, T. *Developmental Biology*, Narosa Publishing House, 2002.
5. Twyman, R.M. *Instant Notes Developmental Biology*. Bio-scientific Publishers Ltd., 2001.
6. Wolpert, L., Beddington R. Brooks, J. Jessel T. Lawrence P. and Meyerwitz E. *Principles of Development*. Oxford University Press, 1998.
7. The text book of Embryology by Balansky.

SCT-2.4a: ECONOMIC ZOOLOGY**48 hrs****Objective:** To teach basic breeding biology of economically important species.**Learning Outcomes:** Entrepreneurship, Livelihood, Value addition skills.**Unit 1:****02****Introduction:** Overview and scope of Applied Zoology, Economically important animals.**Unit 2:****08****Sericulture:** Brief History and Development of Sericulture. Types of Silk Moths, Rearing methods of Silkworms. Grainage activity, Silk production. Silkworm diseases.**Unit 3:****08****Apiculture:** Importance, History and Development of Bee keeping. Different species of honey bees and their distribution. Management of beekeeping. Product and byproduct of Apiculture and their uses.**Unit 4:****08****Vermiculture:** Importance of Vermiculture. Types of earthworms, Life cycle of earthworm, Use of Earthworms for biodegradation of organic waste materials, Techniques of Vermiculture, Harvesting of Vermicompost and Vermimass, Vermicompost as Soil Conditioner and Earthworms as source of Protein. Vermi-wash.**Unit 5:****09****Aquaculture:** Freshwater, brackish water and Marine fish culture in India, Prawn and Pearl culture, Preservation and processing of fish; Fish byproducts.**Unit 6:****04****Poultry Science:** Introduction, Breeds of fowls, Poultry rearing (Broiler and layer farming), Nutritive value of egg and meat, Poultry diseases.**Unit 7:****05****Dairy Technology:** Introduction, Breeds of cattle, Breeding and Cattle improvement in India. Nutritive value of Milk and Milk by products.**Unit 8:****04****Lac culture:** Lac insect, strains of Lac insects, host plants Cultivation, lac culture, composition of Lac, processing of Lac and its uses.**References:**

1. Srivasthava, K.P. *Text Book of Applied Entomology*, Vol. I and II Kalyani Publishers, 1996.
2. Mishra, R.C. *Perspectives in Indian Apiculture*. Allied Scientific Publishers, Bikaner, India, 1999.
3. Lee, K.E. *Earthworms: Their Ecology and Relationship with Soils and Land use* Academic Press. London, 1985.
4. Snathanam, R. Sukumaran, N. and Natarajan, P.: *A Manual of Freshwater Aquaculture*, Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, 1990.
5. Bell, F.W. and Canterbury, E.R. *Aquaculture for Developing Countries- A Feasibility Study*. Cambridge: Ballinger Publishing Co. 1976.

SCT-2.4b: WILDLIFE AND CONSERVATION

48 hrs

Objective: To study the rare species in protected areas such as national parks, sanctuaries etc. Protection of wild life through legislation such as banning hunting etc.

Learning Outcomes: Awareness to protect and nurture nature and wildlife which is integral in maintaining balance in nature and generate knowledge for conservation of wildlife.

Unit 1:

Introduction, History and Scope:

12

Importance and values of wildlife. Wildlife categories: Endangered, Threatened, Vulnerable, rare; data Deficient categories, Red Data Book. Causes of wildlife depletion: Degradation and destruction of natural habitats, exploitation for commercial purposes, deforestation, agricultural expansion and grazing, urbanization and industrialization, Forest fires.

Unit 2:

Wildlife Conservation: Conservation strategies, Role of NGO's in Conservation, Global and Indian bodies concerned with wildlife conservation, Wildlife conservation projects in India – Project Tiger, Gir Lion sanctuary project, elephant, Musk deer and Crocodile breeding and management project.

10

Unit 3:

In situ and ex situ conservation: Biodiversity and Biodiversity hotspots, Bioreserves, National Parks and Wildlife sanctuaries– their characteristics. Ex situ Conservation: Zoos and their significance – Captive breeding of animals– Zoos, Cryo – preservation, Modern methods of ex situ conservation, Artificial insemination for conservation: Germplasm stations; pollen banks; sperm bank.

10

Unit 4:

Wild Life census and Management: General methods; Census Methods for vertebrate species (Mammals and Birds)

10

Wild life management: Range lands: status, types and management. Case studies (Gudavi and Mandagadde bird sanctuary, Bhadra wildlife sanctuary). Wildlife-Human conflicts.

Unit 5:

Wild life protection Acts: Wild life protection Act 1972 and its amendments; Wildlife schedules.

06

References:

1. Ali, S. and Ripley S.D. 1969. Handbook of Birds of India and Pakistan, Oxford University.
2. Chatrath, K.J.S. 1992. Wetlands of India, Ashish Publishing House, New Delhi.
3. Heywood, V.H. (Eds) 1995. Global Biodiversity, Published for UN Environmental Programme, Cambridge University Press.
4. Hosetti, B.B. 2006. Concepts in Wildlife Management, Daya Publishing House, Delhi. III edition
5. Hosetti, B.B. and Venkateshwarlu M. 2001. Trends in Wild life, Biodiversity, Conservation, and Management, Daya publishing House, Delhi-35, India. Vol. I and II
6. Hosetti, B.B. 2002. Glimpses of Biodiversity, Daya Publishing House, Delhi-35, India.
7. Stiling, P, 2002. Concepts in Ecology: Theories and Applications IV Ed. Prentice Hall of India Pvt. Ltd., New Delhi-110 001.
8. Khanna, D.R. and P.R.Yadav, 2005. Biology of Birds, Discovery Publishing House, New Delhi 110 002.

9. Sharma, B.B. 1994. High altitude Wildlife of India, IBH Publ. House New Delhi. Ganguly, G. Sinclair and R.E.
Anthony, 1994. Wildlife Ecology and Management, Blackwell Scientific Publ. Boston.
10. Negi, S.S. 2002. Hand book of National Parks, Wildlife Sanctuaries and Biosphere reserves in India. Indus. Publ., New Delhi.

SCT-2.4.c: ORNITHOLOGY

48 hrs

Objectives: To learn basic biology of birds, economic values, distribution and bird census with special emphasis on tools and techniques of identification.

Outcomes: Conservation, passion about birds and birding, application of digital tools.

Unit – 1: Habitat ecology of birds : Habitat ecology of Indian birds; Coastal birds, Inland water birds, Birds of high altitude and deserts. Distribution of birds in India. Morphometric measurement used in food habit studies.

06

Unit-2: Feeding ecology of Birds; Insectivores, Frugivores, Nectarivores, Granivores, Carnivores and Scavengers.

06

Unit-3: Territoriality; Functions and types of territoriality, sizes and shapes of territory, Defense and site fidelity.

05

Unit-4: Songs and calls; Functions of voice, birds vocabularies, nature of song, non-vocal songs.

05

Unit-5: Nesting; Functions, choice of nest sites, colonial nesting, forms of nests, nest materials and nest building and multiple nests.

05

Unit-6: Reproduction; Breeding seasons, Factors influencing breeding seasons, seasonal reproductive cycles, photoperiodism, courtship and display, sexual selection, pair bond, sexual dimorphism, mating systems, polyandry, polygyny, promiscuity, co-operative breeding, brood parasites. Egg laying-Timing of egg laying, clutch size, incubation patterns, hatching. Parental care - Feeding, nest sanitation.

08

Unit-7: Feathers and Moulting – Types, Functions, growth, Moulting.

04

Unit- 8: Birds Migration; Economic values of birds, endangered and threatened birds.

05

Unit-8: Field identification tools and techniques, Importance of birds, Modern methods for birds research.

04

References:

1. Ali, S and S.D. Ripley. 1969. The Handbook of Birds of India and Pakistan. Oxford University Press – New Delhi
2. Ali, Salim, 1997. The Book of Indian Birds, Oxford University Press, Mumbai.
3. Arora B. M. , 2002. Editor, Indian Wildlife Yearbook, AIZ & WV, Bareilly and Central Zoo Authority, New Delhi.
4. Arora, B.M. 2007. Rehabilitation in free living wild animals . AIZ & WV, Bareilly and Central Zoo Authority, New Delhi.
5. Singh, S.K. 2005. Text Book of Wildlife Management. IBDC, Lucknow.
6. Welty, J. 1982. The Life of Birds. Saunders College Publishing, New York
7. William Sutherland, 1984. Ecological census techniques, Cambridge

OET-2.9. Offered by the Department of Women's Studies

HCT- 3.1: ANIMAL PHYSIOLOGY**48 hrs****Course Objectives :**

This course is aimed to impart the knowledge on the physiology and its related mechanisms considering the overall animal kingdom. This course offers an insight through the various metabolic processes like respiration, circulation, digestion, neurophysiology that runs the animal life. The study also focusses on broad aspects of homeostatic regulatory mechanisms like hormonal activities, osmoregulation & thermoregulation.

Course Learning Outcome (CLO): After learning the course the students will be able to :

- Know the historical aspects of animal physiology, its disciplines and its importance in Zoological studies.
- Understand how the animal body functions with the help of various control & co-ordination centres.
- Describe about the organs and their structures pertaining to their physiology.
- Describe about the flow of energy that is required to run the metabolism.
- Understand about the various strategies that different animals undertake to survive their habitats.

Unit 1: **02**

Introduction: History and central themes of Animal Physiology and its sub-disciplines

Unit 2: **10**

Respiration, Blood and Circulation: Respiration; The atmosphere, solubility of gases, respiratory organs in the vertebrates; Respiratory mechanisms in air breathing fishes, birds and mammals; Respiration in eggs; Blood- Facilitated diffusion, acid-base balance regulation and functions of blood; Circulation- General principle, vertebrate circulation, the physics of flow in tubes.

Unit 3: **04**

Hormones and Homeostasis: Calcium glucose; Intermediary metabolism and hormonal regulation; Carbohydrate, nitrogen and lipid; hormones and behavior.

Unit 4: **08**

Osmoregulation: Osmotic and other properties of water; Problems of osmoregulation, osmoregulators and conformers; Obligatory exchanges of ion and water; Osmoregulatory organs; Osmoregulation in aqueous and terrestrial animals

Unit 5: **08**

Feeding and Digestion: Feeding methods and motility of the alimentary canal; Digestion and gastrointestinal secretions; Absorption and Nutritional requirements; Electron transport system; Energy production (ATP); Efficiency of energy metabolism

Unit 6: **05**

Thermoregulation: Classification of animals based on thermal biology; Mechanism of thermoregulation; Neuronal mechanism of temperature control; Thermoregulation and specialized metabolic states

Unit 7: **05**

Movement: Mechanism of muscle contraction; Adaptations of muscle for various activities

Unit 8: **06**

Neurophysiology: Structure, organization and functions of nervous system; Electrochemical, resting and action potential; Transmission of information within and between neurons; Neurotransmitters; Synapse and postsynaptic neurons; synaptic junction.

References:

1. Neilsen, K.S. *Animal Physiology: Adaptation and Environment*. IV Ed. Cambridge University Press, 1995.
2. Prakash, M. and arora C.K. *Encyclopedia of Animal Physiology*, Anmol Publications New Delhi, 1998.
3. Pestonjee, D.M. *Stress and Coping*, Sage Publications, London, 1999.
4. Poole, M.C., Pilkey, Grant and Johnson E.C. *Biology in Action*, Harcourt Brace, Canada, 1995.
5. Hoar, W.S. *General and Comparative Animal Physiology*. Prentice Hall Inc., New Delhi, 1983
6. Randall David, Burggren, W and French, K. *Animal Physiology*. W.H. Freeman and Co., New York, 1997.

HCT-3.2: REPRODUCTIVE BIOLOGY AND ENDOCRINOLOGY**48 hrs****Course Objectives :**

The course offers a combination of two related and intermingled studies of reproduction and endocrine control of various physiological actions. It gives vast idea about the reproductive organs, their development and functioning, with keen emphasis on gametogenesis. This course also covers the details of the specific structures pertaining to mammals like placenta and the process of implantation. The course also focusses on study of pre-natal, natal & post-natal processes, with reproductive techniques.

The course also has the advanced study of various endocrine functions including the basic techniques involved in endocrinological studies. It also emphasises on the synthesis, chemical structure and the biological actions of hormones and their receptors on various tissues of the body. It highlights on the classification of hormones and study of growth factors.

Course Learning outcome(CLO): After the study of this course the students will be able to :

- Know the importance of co-ordination between the two studies in the course.
- Explain the anatomy and physiology of reproduction.
- Describe the different Assisted Reproductive Techniques (ARTs) & fertility control methods, that are much required today.
- Know the importance of growth factors & hormones in the current research field.
- Know the comprehensive knowledge of hormones.

Unit 1:**02**

Introduction: Genetic basis of sex determination and differentiation of gonads and gonadal ducts, their hormonal regulation.

Unit 2:**06**

Male reproduction: Anatomy of male reproductive system, Histoarchitecture of Testis, Spermatogenesis; Hormonal control of spermatogenesis; Functional role of androgens.

Male reproductive organs: Epididymis, Vas-deferens, Prostate gland, Seminal vesicle, Coagulating and Cowper's glands. Biochemistry of semen and Biology of spermatozoa.

Unit 3:**06**

Female reproduction: Anatomy of female reproductive system, histoarchitecture of Ovary, Folliculogenesis, Follicular atresia, Ovulation, Luteinisation, and Luteal function. Estrous and Menstrual cycle and its hormonal regulation.

Unit 4:**08**

Implantation: Types of Implantation and hormonal regulation. **Placenta:** Types, Endocrine functions of Placenta.

Gestation: Corpus luteum, Endocrine control of pregnancy in Rat. Metabolic activity during pregnancy.

Parturition: Activation and stimulus of Uterus. Factors involved in Parturition-prostaglandin, Oxytocin, Corticosteroids and other factors.

Lactation: Morphological and functional development of Mammary glands and Milk ejection.

Unit 5:**04****Fertility control:**

Fertility control in male and female: Natural methods, Barrier methods, IUD's, Hormonal contraceptives, surgical methods.

Reproductive techniques: IVF, Embryo transfer, Surrogate Mother, Artificial insemination, Intra-Cytoplasmic Sperm Injection (ICSI).

Unit 6:**02**

Aim and scope of Endocrinology: Techniques in endocrinology; Hormones as biological signals; Classification of hormones

Unit 7:**04**

Structure and Biological actions of hormones of Pituitary, hypothalamus pineal, thyroid, parathyroid, adrenal and pancreas; Neurovascular hypothesis; Endocrine hypothalamus

- Unit 8:** 06
Hormone action: Hormone receptors- types and structure, regulation; Mechanism of hormone action- peptide hormone, receptor signal transduction, G proteins, other membrane messengers, role of protein kinase C; Mechanism of action of steroid hormones; Calmodulin; Termination of hormone action
- Unit 9:** 04
Biosynthesis and secretion of hormones: Steroid hormones, catecholamines, thyroid hormones, peptide hormones- Insulin; Hormonal inactivation
- Unit 10:** 06
Growth factors: Insulin, Prolactin, placental lactogen and IGFs; Neurotrophic growth factors; Hematopoietic growth factors; Epidermal growth factors; Transforming growth factors; Fibroblast growth factors; Cytokines, chalone; Growth factor receptors and cancer

References:

1. Bentely, P. J. Comparative Vertebrate Endocrinology, III Ed. Cambridge University Press, 1998.
2. Degroot, L. J. and Neill, J. D. (Eds). Endocrinology. Vol. I-III. W. B. Saunders Co., 2001.
3. Knobil, E. and Neill, J. D. (Eds). The Physiology of Reproduction. Vol. I and II. Raven Press Ltd. 1994.
4. Mandal, A Hand Book of Neuroendocrinology. EMKAY Publications, 1994.
5. Turner, C. D. and Bangara, J. T. General and Comparative Endocrinology, 1998.
6. Martin, C. R. Endocrine Physiology. Oxford University Press. 7. Saidapur, S. K. (Ed). Reproductive Cycle of Indian Vertebrates. Alloed Publications Ltd., New Delhi, 1989.

SCT-3.3a: ANIMAL BEHAVIOUR

48 hrs

Objective: To teach molecular and physiological aspects of biology and the ecological studies. To study behavior in connection with critical role in biological adaptations.

Learning Outcomes: General awareness on animal communication and helps to live in harmony with other animals.

- Unit 1:** 05
Animal Behavior: Introduction, definition and history (Lorenz, Tinbergen, von Frisch); Questions about animal behavior
- Unit 2:** 08
Development of Behavior: Behavior and genes; Innate behavior; Parent-offspring, Interaction; Imprinting- Filial Imprinting and Sexual imprinting; Instinct- Interaction between instinct and learning; Biological clock; Cultural transmission as a form of behavior and development
- Unit 3:** 10
Learning: Definition and forms: Habituation; Associative learning/ conditioning (Classical conditioning- Pavlov; Operant conditioning, instrumental learning, Skinner), Spatial learning; Insight learning; Social learning; Cognitive maps; Observational learning/imitation; Insight learning; Social learning; Memory – increased synapses, increased neurons; Memory and cognition
- Unit 4:** 09
Communication: Sign and normal stimuli; Channels of communication; Pheromones and acoustic signals; Evolution of display and mimicry, aposematic coloration, deception and honesty; communication in social groups, alarm calls, alarm pheromones, trail pheromones; Dance language in honey bee; Primate language
- Unit 5:** 08
Evolution of Social system: Society, benefits and costs of sociality; Social interactions of groups- Altruism – concept of inclusive fitness, (Kin selection, parental care); Reciprocal Altruism, selfish, spite, conflict and infanticide; Insect eusociality:

SCT-3.3b: MICROBIOLOGY**48 hrs**

Objectives: To learn a fundamental understanding microbes and their biology. Microbial economics and industrial applications.

Outcomes: Generates skilled human resources to address disease and epidemics. Research and development in science and technology.

Unit 1:

Introduction: History of Microbiology, biodiversity, distribution, general classification and distinguishing features of various groups of microorganisms. **08**

Unit 2:

Isolation and culture of microorganisms: Principle and technique of isolation; microbial nutrition (types of microbial culture and microbial media), microbial growth, enumeration of microbes and microbial biomass **10**

Unit 3:

Sterilization techniques: Physical methods (Dry and wet), Radiation (ionizing and non ionizing), Filtration (porcelain, sintered glass and membrane filters), Chemical methods (Asepsis, disinfection); phenol alcohols: halogens and phenol coefficient). **10**

Unit 4:

Viruses: Structure and classification, replication, bacteriophages, life cycle of phage typing, Viroids and prions. **05**

Unit 5:

Mycoplasma: Chlamydiae, Rickettsia, their Properties, classification and their role in animal and human diseases. **05**

Unit 6:

Yeast: Structure, classification, culture and economic importance. **04**

Unit 7:

Industrial microbiology: Importance of bacteria and Yeasts; production of alcohol, microbial pesticides, microbial antibiotics and microbial enzymes **06**

References:

1. Alexander N. Glazer, Hiroshi Nikaido 1998. Microbial biotechnology. Fundamentals of Applied biotechnology, W.H. Freeman and Company, NY.
2. Edward. 1996, Fundamentals of microbiology, 4th edition. The Benjamin/Cumming Publication Corp.
3. Lancing M. Prescott, John P. Harley and Donald A. Klein. 2002. Microbiology. 5th edition. McGraw Hill publication. New Delhi.

SCT-3.3C: TOXICOLOGY

48 hrs

Objectives: To learn about basic toxicological science. Methods to determine the adverse effect of xenobiotics on living forms and environment.

Outcomes: Qualified human resources to interpret and communicate the nature of toxicological impacts. Basic preventive and control measures of toxicants. Entrepreneurship, R&D.

Unit 1: Scope and concept, Basic principles of toxicology	02
Unit 2: Principles of bioassay, Dose-response, LC, LD, LT values, EC, ED and ET values, lethal dose, sub-lethal dose. Introduction, Definition of toxicology	08
Unit 3: Bio concentration, Biotransformation, Bioaccumulation, Biomagnification, Biomassformation of organophosphates and organochlorines	08
Unit 4: Biomonitoring of toxic chemicals	08
Unit 5: Heavy metals toxicity, cosmetic toxicity, animal toxin, mycotoxin, plant toxin, biotoxin and their disease	08
Unit 6: Smoking aids: Active and Passive smoking, Consumption of tobacco, Marijuana (Ganja), their effects and Prevention measures.	03
Unit 7: Risk assessment: Exposure assessment, Dose-Dosage, Risk characterization, Risk analysis and communications, Occupational health and illness.	03
Unit 8: Pesticides: Classification of pesticides, Sources and their effects to human, toxicity of Pesticides- viz. Hematotoxicity, Nephrotoxicity, Neurotoxicity, Immunotoxicity and Biopesticides.	08

Reference:

- . Gorge W. Warne, 1988. Reviews of Environmental contamination of Toxicology, Springer-verlag, New York.
- . Subramanian, M.A. 2004. Toxicology Principles and methods MJP Publishers Chennai.
- Philip, L. Williams, Robert C. Jawes, Stephen M. Roberts, 2000. Principles of Toxicology, II Ed. A Wiley science publication John Wiley & Sons. INC. New York.
- . Pandey, K. and J.P. Shukla, 1990. Elements of Toxicology. Radha publ. New Delhi.
- Bohmont, B.L., 1999. The standard Pesticide user's guide. Prentice hall, PRT, New York.
- Hassall, K.A. 1990. The Biochemistry and uses Pesticides structure, metabolism and Mode of action and as in crop protection, John Wiley & Sons. Inc.
- Hornshy, A.G., Herner, A.E., and Don Wauchope, R. 1995. Pesticide properties in Environment. Springer-verlag, New York.
- Carmin, M.A., 1997. Pesticide Profiles: Toxicity, Environmental Impacts and Fate. CRC press Ohio, A.

OET-3.8: PARASITOLOGY**48hrs****Objectives: To study basics of parasites and their pathogenicity.****Outcomes: Generates skilled human resource to address parasite borne diseases. R&D in various related disciplines.**

- Unit 1:** **2**
Introduction: Origin and Evolution of Parasitism. Kinds of Hosts and Parasites
- Unit 2:** **10**
Pathogenic Microorganisms: Classification of Microorganisms and structural details; Food and Water borne diseases. Sexually transmitted bacterial diseases. Skin and Wound bacterial diseases.
- Unit 3:** **10**
Pathogenic Protozoan's: Amoebiasis, Giardiasis, Trypanosomiasis, Haemosporidians, Coccidiosis to Poultry; Myxosporians of fishes; Nosema and other pathogenic Protozoa of Insects.
- Unit 4:** **07**
Pathogenic Nemetodes; Etiology of diseases due to *Wuchereria sp*, *Trichinella spiralis* and Hook worms.
- Unit 5:** **07**
Pathogenic Trematodes: Etiology of diseases due to *Fasciola hepatica*, *Fasciolopsis buski* and *Systosoma sp*.
- Unit 6:** **07**
Pathogenic Cestodes: Etiology of diseases due to *Echinococcus*, *Hhymenolepis* and *Diphyllobothrium*.
- Unit 7:** **05**
Host and parasitic interaction: physical, chemical and biological; Effect of parasitism on host and parasites.

References:

1. Hoare, C. A. *Hand Book of Medicinal Protozoology*. London, Baltimore, Tindall and Cox, 1950.
2. Levine, N. D. *Protozoan parasites of Domestic Animals and Man*. II Ed. Minncapolis: Burgess, 1978.
3. Noble, E.R. and Noble, G.A. *Parasitology: The Biology of Animal Parasites*. London Kimpton, 1961
4. Smith, K.G.V. *Insects and other Arthropods of Medical Importance*, London: British Museum of National History. 1973.
5. Soulsby, E.J.L *Biology of Parasites*. New York: Academic Press, 1966.
6. Smyth, J.D. *Introduction to Animal Parasitology*. London: Hodder and Stoughton. 1976.

HCT-4.1: ENVIRONMENTAL BIOLOGY**48hrs**

Objectives: To study fundamental principles and laws of nature, pollution and related issues, natural resources and their limitations, and conservation and related laws.

Outcomes: Awareness and conservation, to develop action plan for sustainable development, waste management and bioremediation.

Unit 1:**02**

Introduction: Concept, Scope and awareness of environment.

Unit 2:**10**

Ecosystems and Productivity: Types and components, energy flow, food chain and food web; Ecological pyramids, ecological succession.

Productivity of an ecosystem: Primary and secondary, productivity of different ecosystems.

Unit 3:**08**

Natural resources: Concept and classification, Non-renewable resources: Mineral, land and soil resources;

Renewable resources: Water, forest, wildlife, Agriculture; live-stock.

Energy resources: Sources and use, declining resource of crude oil, alternative fossil fuels, nuclear energy, solar and other renewable resources; Management strategies of resources

Unit 4:**08**

Environmental pollution: Important episodes of environmental pollution, Water pollution, eutrophication; Air pollution; Greenhouse effect, photochemical smog; Thermal pollution; Noise pollution; Radioactive pollution; Solid waste pollution control.

Unit 5:**06**

Climate Change: Global warming, Ozone layer depletion, Acid rain. Disaster Management: Floods, Earthquake, Tsunami, Cyclones and Land slides.

Unit 6:**06**

Human population and environment: Population growth, population explosion, Age structure, environment and human health; Human rights, value education, Role of information technology in environment and human health

Unit 7:**08**

Environment and social Issues: Resettlement of Rehabilitation of people; Waste land reclamation; Environmental ethics. Environmental Awareness: Environmental Education-role of educational institutions and other agencies; Environmental legislation and protection Acts.

References:

1. Mckinney, M. L. and Schoh, R. M. environmental Science: System and Solutions, Jones and Bartlett Publishers, 1998.
2. Chapman, J. L. and Reiss, M. J. Ecology: Principles and Applications. Cambridge University Press, 1999.
3. Eldon, D. Enger and Bradley, F. Smith. Environmental Sciences, 1995.
4. Willmer, P., Stone, G. Johnson, I. Environmental Physiology of Animals. Blackwell Science Ltd.
5. Arrora, R. K. Air Pollution, causes and effects, control. Mangaldeep Publications, Jaipur, 1999.
6. Chakraborti, N. K. Environmental Protection and Law. 1994
7. Chikara, M. G. Encyclopedia of Ecology. Environment and Pollution. Vol. I – XIII, 1997.

HCT-4.2: PROJECT WORK AND SUBMISSION OF DISSERTATION

HCT- 4.3: APPLIED ANIMAL BIOTECHNOLOGY

48 hrs

Course Objective :

This is a practical based course focussing on providing students with a theoretical, practical and applied understanding of animal biotechnology. The course covers cell & tissue cultures, animal molecular biology, recombinant DNA technology, production of transgenic animals, reproductive biotechnology, animal cloning, recombinant vaccines ,histochemical techniques and ethics. The course also emphasises in detail about the biophysical, biochemical and separation techniques that are currently the basics of any molecular biology lab and research work.

Course Learning Outcomes(CLO): After learning the course the student will be :

- Able to handle and culture animal cells & tissues in the laboratory conditions.
- Able to take up a job as embryologist in the Infertility centres.
- Aware about the animal cloning & its ethical concerns and patenting.
- Able to take up the knowledge of biochemical, biophysical and separation techniques in research and development of animal sciences.

Able to describe advancement in vaccination and DNA derived products for therapeutics.

Unit 1: 02

Introduction: Concept and Scope of Biotechnology, Current Status and Future

Unit 2: 06

Animal Cell and Tissue Culture: Definition, Principles of cell and tissue culture; cell lines. Requirement: Equipments, Culture media, Application of cell culture.

Stem Cell Technology: Definition, types and properties of stem cells, Differentiation of stem cells, Advantages and Disadvantages of Stem cell technology.

Unit 3: 06

Gene Cloning and Gene Transfer Techniques: Somatic cell nuclear transfer; Recombinant DNA Technology- Molecular tools, Cloning vectors: Gene transfer methods- Microinjection, Electroporation, Polycations, Lipofection, Retroviral infection.

Unit 4: 06

Invitro-fertilization, Embryo transfer and cloning in Mammals: Procedure and limitations of IVF, Embryo Transfer Technique, Cloning of different Mammals.

Unit 5: 06

Trangenic animals and Gene Therapy: Production of transgenic animals, Gene targeting, Knock-out and Knock-in Technology. Transgenic animals- Ethical concerns and Patenting. Gene therapy: Somatic versus- germ line therapy, Gene therapy in animals.

Unit 6: 08