



**Parishkar College of Global Excellence
(Autonomous), Jaipur**

CHOICE BASED CREDIT SYSTEM (CBCS)

B. Sc. Honours (3 Year Program)

ZOOLOGY

Faculty Members

Prof. Shalini Jauhari

Dr. Shilpa Choudhary

Mr. N K Nagar

Ms. Mamta Sharma

PREAMBLE

The University Grants Commission (UGC) has initiated several important measures taken to enhance academic standards and quality in higher education include innovation and improvements in curriculum, teaching-learning process, examination and evaluation systems, besides governance and other matters. The UGC has formulated various regulations and guidelines from time to time to improve the higher education system and maintain minimum standards and quality across the Higher Educational Institutions (HEIs) in India. The academic reforms recommended by the UGC in the recent past have led to overall improvement in the higher education system. The HEIs must have the flexibility and freedom in designing the examination and evaluation methods that best fits the curriculum, syllabi and teaching-learning methods, there is a need to devise a sensible system for awarding the grades based on the performance of students.

Presently the performance of the students is reported using the conventional system of marks secured in the examinations or grades or both. The grading system is considered to be better than the conventional marks system and hence it has been followed in the top institutions in India and abroad. So it is desirable to introduce uniform grading system. This will facilitate student mobility across institutions within and across countries and also enable potential employers to assess the performance of students. To bring in the desired uniformity, in grading system and method for computing the cumulative grade point average (CGPA) based on the performance of students in the examinations, the UGC has formulated these guidelines.

CHOICE BASED CREDIT SYSTEM (CBCS)

The CBCS provides an opportunity for the students to choose courses from the prescribed courses comprising core, elective/minor or skill-based courses. The courses can be evaluated following the grading system, which is considered to be better than the conventional marks system. Therefore, it is necessary to introduce uniform grading system in the entire higher education in India. This will benefit the students to move across institutions within India to begin with and across countries. The uniform grading system will also enable potential employers in assessing the performance of the candidates. In order to bring uniformity in evaluation system and computation of the Cumulative Grade Point Average (CGPA) based on student's performance in examinations, the UGC has formulated the guidelines to be followed.

Outline of Choice Based Credit System:

1. **Core Course:** A course, which should compulsorily be studied by a candidate as a core requirement is termed as a Core course.

2. **Elective Course:** Generally, a course which can be chosen from a pool of courses and which may be very specific or specialized or advanced or supportive to the discipline/subject of study or which provides an extended scope or which enables an exposure to some other discipline/subject/domain or nurtures the candidate's proficiency/skill is called an Elective Course.

2.1 **Discipline Centric Elective (DCE) Course:** Elective courses may be offered by the main discipline/subject of study is referred to as Discipline Specific Elective. The University/Institute may also offer discipline related Elective courses of interdisciplinary nature (to be offered by main discipline/subject of study).

2.2 **Dissertation/Project:** An elective course designed to acquire special/advanced knowledge, such as supplement study/support study to a project work, and a candidate studies such a course on his own with an advisory support by a teacher/faculty member is called dissertation/project.

2.3 **Generic Elective (GE) Course:** An elective course chosen generally from an unrelated discipline/subject, with an intention to seek exposure is called a Generic Elective. P.S.: A core course offered in a discipline/subject may be treated as an elective by other discipline/subject and vice versa and such electives may also be referred to as Generic Elective.

3. **Skill Enhancement Course (SEC)** SEC courses are value-based and/or skill-based and are aimed at providing hands-on-training, competencies, skills, etc.

Duration of the Course

The duration of Bachelor of Science with Zoology shall be of three academic years. Each year shall be divided in two semesters i.e. semester-1, semester-2. Accordingly, the three years shall consist of six semesters. However, a student is required to pass out the said course within a maximum period of 6 years from the date of admission to 1st semester where after he/she shall stand unfit for the course.

Types and Nomenclature of Courses in Zoology for BSc Honours Course

Core Courses

1. Diversity and Evolution of Non-Chordate (Protista- Coelomates)
2. Diversity and distribution of Chordate
3. Physiology: Life Sustaining Systems
4. Cell biology
5. Comparative Anatomy of Vertebrates
6. Developmental Biology
7. Physiology: Controlling and Coordinating Systems
8. Principle of Genetics
9. Biochemistry of Metabolic Processes
10. Molecular Biology
11. Immunology
12. Perspectives in Ecology
13. Animal Biotechnology
14. Evolutionary Biology

Discipline Centric Elective Courses (Any 4)

1. Animal Behavior and Ecology
2. Fish and Fisheries
3. Research Methodology
4. Parasitology
5. Reproductive Biology
6. Applied Zoology

Skill Enhancement Courses (Any 2). Student can opt any SEC offered by any Department.

1. Medical Diagnostic
2. Bioinformatics and Biostatistics
3. Food Nutrition Health and Disease.
4. Apiculture

Ability Enhancement Courses

1. English/ Hindi Communication
2. Environmental Science

Generic Courses

1. Principles of Ecology
2. General Physiology
3. Fundamentals of Molecular Biology
4. Basics of Cell biology

Department Overview

With the new era of education under CBCS system of UGC the department aims to develop a curriculum for **Parishkar** in such a way that the students have a complete holistic development of their character and values. Many qualified minds worked together to provide “a cut above” to the ever-growing demands of the industry and to prepare students for higher studies and research devoted to society. The interactive method of teaching at **Parishkar College of Global Excellence** is to bring about attitudinal changes to future professionals of the industry with an edge of creativity.

The department of Zoology was established in Parishkar 2014 onwards. The department imparts equal importance to practical, theoretical and co-curricular activities apart from experiential and digital modes of learning. Projects and Industrial projects form an integral part of the curriculum. Along with the syllabus, **Parishkar College of Global Excellence** emphasizes on Value Addition Programs and a complete Holistic development of students open elective programmes and Placement Training Programs, training students in group discussions, facing interviews and so on.

Programme Outcomes

On successful completions of the B.Sc. Programme students will be able to

- Understand and apply the fundamental principles, concepts and methods in key areas of science and multidisciplinary fields
- Demonstrate problem solving, analytical and logical skills to provide solutions for the scientific requirements.
- Develop the critical thinking with scientific temper.
- Communicate the subject effectively.
- Understand the importance and judicious use of technology for the sustainable growth of mankind in synergy with nature.
- Understand the professional, ethical and social responsibilities.
- Enhance the research culture and uphold the scientific integrity and objectivity.
- Engage in continuous reflective learning in the context of technological and scientific advancements.
- Express proficiency in oral and written communications to appreciate innovation in research.
- Develop industry-focused skills to lead a successful career.

PROGRAMME HIGHLIGHTS

- Approaching the subject from theoretical and practical points of view.
- Opportunity to attend seminars, workshops etc.
- Extra-curricular activities for peer interaction, growth of organizational skills and personality development.
- Well-equipped and spacious laboratories.
- Well qualified and experienced staff.
- Industrial collaboration/training.
- Placement opportunities.
- Good library and internet facilities.
- Industrial /Institutional projects. Guest lectures by experts from the field.

Course Description

The student will have to study fourteen core courses, two ability enhancement courses, four skill enhancement courses and six discipline specific elective course for successful completion of the BSc degree Programme. The programme includes Dissertation and a minor project by students.

For subject Generic Course

Students have to study the given 4 generic courses of any one subject of their choice from the stream.

Course Assessments

- Assessments will be in form of written exams, Assignments and lab work.
- Examinations in one semester will be one midterm and one final.
- Assignments will be judged upon the timely submission and contents.
- Lab work will be assessed as routine lab work, lab assignment and project.

Grading system

Grades for one semester would depend on routine work of a student. It will be in form of written exams, assignments and projects and/or any other type directed by UGC.

Projects and Assignments will be graded for total 10 marks, with a division of timely submission and content of the assignment.

Midterms, project and assignment grades will be converted into internal marks earned by the students and will reflect in for final markings.

Grading Scheme:

Mid-term Exam

Final Exam

Assignment

Project (including a paper and poster)

To qualify the grade, minimum 50% is required.

Parishkar College of Global Excellence Autonomous

Proposed Scheme for Choice Based Credit System for BSc Honours Zoology

Semester	Core Courses	Ability Enhancement Course	Skill Enhancement Course	Discipline Specific Elective Course	Generic Elective Course
1	Diversity and Evolution of Non-Chordata (Protista - Coelomates)	English/Hindi Communication			
	Cell Biology				
2	Physiology I (Life Sustaining System)		SEC I		GE I Basics of Cell Biology
	Diversity and distribution of Chordata				
3	Comparative Anatomy of Vertebrates		SEC II		GE II Principles of Ecology
	Developmental Biology				
	Physiology II (Controlling and Coordinating System)				
4	Principles of Genetics				GE III General Physiology and Biochemistry
	Biochemistry and Metabolic Processes				
	Molecular Biology				
5	Immunology			DSE I Reproductive Biology	GE IV Fundamentals of Molecular Biology
	Perspectives in Ecology			DSE II Fish and Fisheries/ Research Methodology	
6	Animal Biotechnology	EVS		DSE III Applied Zoology/ Parasitology	
	Evolutionary Biology			DSE IV Animal Behaviour	

Credit Scheme for BSc Zoology Honours

S.No.	Course	Credits	Total Credits	
1.	Core Course– 14	6	14 × 6	84
2.	Ability Enhancement Course 2	4	2 × 4	8
3.	Skill Enhancement Course 2	4	2 × 4	8
4.	Discipline Specific Elective Course – Paper 4	6	4 × 6	24
5.	Generic Elective Course – Paper 4	6	4 × 6	24
Total Credits				148

- Student can opt any SEC offered by any Department.

SEMESTER I

CORE COURSE 1 DIVERSITY AND EVOLUTION OF NON-CHORDATES (Protista –Coelomates)

THEORY (CREDITS 4)

Course objectives

- The course intends to explore the diverse animals in a systematic manner.
- The course would define the gradual development of complexity in the process of evolution.
- This gives a broad outlook of diverse animal kingdom and their specific features in detail.

Learning outcomes

After the successful completion of this course the students will be able

1. To identify the vast animal kingdom.
2. To understand the basics of Taxonomy.
3. The organization of animal body from simple to complex forms.
4. To understand the specific feature of organism in general context to nature.

Unit 1: Protista, Parazoa and Metazoa

15 hours

Taxonomy, Vocabulary of Zoology, Institutions of Zoology, Scope of Zoology, Level of organisation in organisms.

Protista: Criteria for classification of multicellular animals: Symmetry, Early development: spiral and radial cleavage (Protostomes and Deuterostomes) Body cavities: acoelomates, pseudocoelomates, coelomates (schizo- and entero coelomates) Homology and analogy. Taxonomy, vocabulary of Zoology, Scope of Zoology,

General characters of the phylum up to classes with examples. Study of Euglena, Amoeba and Paramecium, Life cycle and pathogenicity of Plasmodium vivax and Entamoeba histolytica, Locomotion and Reproduction in Protista, Evolution of symmetry and segmentation of Metazoa.

Economic Importance of Protozoans in respect to human, diseases, regulation of environment and useful Protozoa.

Porifera: General characteristics and Classification up to classes, Canal system and spicules in sponges and their development

Cnidaria: General characteristics and Classification up to classes, Metagenesis in *Obelia* and *Aurelia*, Polymorphism in Cnidaria, Corals and coral reefs

In contribution of carbon storage of environment.

Ctenophora: General characteristics and Evolutionary significance

Unit 2**15 hours**

Platyhelminthes: General characteristics and Classification up to classes Life cycle and pathogenicity of *Fasciola hepatica* and/or *Taenia solium*

Nemathelminthes: General characteristics and Classification up to classes Life cycle, and pathogenicity of *Ascaris lumbricoides* and/or *Wuchereria bancrofti*
Parasitic adaptations in helminthes.

Unit 3**15 hours**

Introduction to Coelomates: Evolution of coelom and metamerism

Annelida:

Excretion in Annelida, General characteristics and Classification up to classes, Nereis: Structural features and reproduction, Trochophore larva, Introduction to Metamerism. Annelidas significance in regulation of self-fertilization. Vermicompost.

Arthropoda:

General characteristics and Classification up to classes, Vision and Respiration in Arthropoda, Metamorphosis in Insects Social life in bees and termites, Palaemon: Structural features and reproduction. Crustacea and crustacean larva.

Onychophora

Economic Importance of Arthropoda their secretions as pesticides and attractants.
General characteristics and Evolutionary significance

Unit 4**15 hours**

Mollusca: General characteristics and Classification up to classes, Respiration in Molluscs, Torsoin and Detorsion. Pearl formation, Evolutionary significance of trochophore larva, Modification in Foot in Molluscs, Pila features and reproduction and its economic importance.

Echniodermata

General characteristics and Classification up to classes, Water Vascular system in Asteroidea, Larval forms of Echinodermara and their significance, Asterias: Structural features and hydrostatic system Origin and evolution of Echinoderm Larvae. Feeding in Asteroidea to explain importance of mouth.

NON-CHORDATES**PRACTICALS****Credit 2**

- Study of whole mount of *Euglena*, *Amoeba* and *Paramecium*, Binary fission and Conjugation in *Paramecium*
- Examination of pond water collected from different places for diversity in Protista
- Study of *Sycon* (T.S. and L.S.), *Hyalonema*, *Euplectella*, *Spongilla*
- Study of *Obelia*, *Physalia*, *Millepora*, *Aurelia*, *Tubipora*, *Corallium*, *Alcyonium*, *Gorgonia*, *Metridium*, *Pennatula*, *Fungia*, *Meandrina*, *Madrepora*
- One specimen/slide of any ctenophore
- Study of adult *Fasciola hepatica*, *Taenia solium* and their life cycles (Slides/micro- photographs)

- Study of adult *Ascaris lumbricoides* and its life stages (Slides/micro-photographs)
- Study of following specimens:
Annelids - *Aphrodite*, *Nereis*, *Heteronereis*, *Sabella*, *Serpula*, *Chaetopterus*, *Pheretima*, *Hirudinaria*
- Arthropods - *Limulus*, *Palamnaeus*, *Palaemon*, *Daphnia*, *Balanus*, *Sacculina*, *Cancer*, *Eupagurus*, *Scolopendra*, *Julus*, *Bombyx*, *Periplaneta*, termites and honey bees Onychophora - *Peripatus*
- Molluscs - *Chiton*, *Dentalium*, *Pila*, *Doris*, *Helix*, *Unio*, *Ostrea*, *Pinctada*, *Sepia*, *Octopus*, *Nautilus*
- Echinodermates - *Pentaceros/Asterias*, *Ophiura*, *Clypeaster*, *Echinus*, *Cucumaria* and *Antedon*
- Study of digestive system, septal nephridia and pharyngeal nephridia of earthworm
- T.S. through pharynx, gizzard, and typhlosolar intestine of earthworm
- Mount of mouth parts and dissection of digestive system and nervous system of *Periplaneta**

ESSENTIAL READINGS

- Kotpal R.L, (2015) Modern Text Book of Zoology: Invertebrates Rastogi Publications, India
- P.S.Verma, **Invertebrate Zoology** (2001) (Multicolour Edition),S. Chand Publishing, India
- Jordan EL, Verma PS (2021) Invertebrate Zoology, S Chand and Company Publishing, India.

SUGGESDTEED READINGS

- Ruppert and Barnes, R.D. (2006). *Invertebrate Zoology*, VIII Edition. Holt Saunders International Edition.
- Barnes, R.S.K., Calow, P., Olive, P.J.W., Golding, D.W. and Spicer, J.I. (2002). *The Invertebrates: A New Synthesis*, III Edition, Blackwell Science
- Ruppert and Barnes, R.D. (2006). *Invertebrate Zoology*, VIII Edition. Holt Saunders International Edition
- Barnes, R.S.K., Calow, P., Olive, P. J. W., Golding, D.W. and Spicer, J.I. (2002).
- *TheInvertebrates: A New Synthesis*, III Edition, Blackwell Science
- Barrington, E.J.W. (1979). *Invertebrate Structure and Functions*. II Edition, E.L.B.S. and Nelson

SEMESTER I

CORE COURSE 2 CELL BIOLOGY THEORY (Credits 4)

Course objectives

- The course intends to explore the cell in detail in a systematic manner.
- The course would define the gradual development of cellular organization
- This emphasizes on cell division and cell cycle in relation to growth of organism.

Learning outcomes

After the successful completion of this course the students will be able

1. To identify the different types of cells for different functions in animals and its organelles.
2. To understand the basics system in different cells in organisms like blood cells germ cells etc.
3. To understand the specific feature of organelle in general context to their working.

Unit 1:

15 hours

Overview of Cells Prokaryotic and Eukaryotic cells, Virus, Viroids, Mycoplasma, Prions. Plasma Membrane: Various models of plasma membrane structure, Transport across membranes: Osmosis and Diffusion, Active and Passive transport, Facilitated transport.

Cell junctions: Tight junctions, Desmosomes, Gap junctions

Recent diseases Corona and others to be discussed in relation to pathogenicity of cells

Unit 2:

16 hours

Endomembrane System Structure and Functions: Endoplasmic Reticulum, Golgi apparatus, Lysosomes, Ribosome, Centrosome

Targeting lysosome in human disease from basic research to clinical approaches. Lysosome in relation to Alzheimer's disease

Mitochondria and Peroxisomes Mitochondria: Structure, Semi-autonomous nature, Endosymbiotic hypothesis Mitochondrial Respiratory Chain, Chemi-osmotic hypothesis Peroxisomes

Unit 3

14 hours

Cytoskeleton Structure and Functions: Microtubules, Microfilaments and Intermediate filaments

Nucleus Structure of Nucleus: Nuclear envelope, nuclear pore complex, Nucleolus,

Chromatin: Euchromatin and Hetrochromatin and packaging (nucleosome)

Unit 4

15 Hours

Cell Division Mitosis, Meiosis, Cell cycle and its regulation, Cell Signaling GPCR and Role of second messenger (cAMP). Apoptosis

Activities of cell to regrow organs and to stop growth.

CELL BIOLOGY PRACTICAL

(Credits 2)

1. Study of Giant chromosomes in salivary glands of *Chyromomes or* Drosophilla Larva.
2. Study of cell permeability od cell to understand osmosis and diffusion.
3. Study of various stages of mitosis and meiosis from permanent slides.
4. Preparation of permanent slide to show. the presence of Barr body in human female blood cells/cheek cells.
5. Preparation of permanent slide to demonstrate: (by virtual Lab)
 - DNA by Feulgen reaction
 - DNA and RNA by MGP
 - Mucopolysaccharides by PAS reaction
 - Proteins by Merкуро bromophenol blue/Fast Green

ESSENTIAL READINGS

- Powar CB (2016) Cell biology, Himalaya Publications
- Bhaita AL, Kohli KS, Jain SK (2015) Cell biology and Genetics, RBD Publishing House
- Verma PS, Agarwal VK, (2010) Cell Biology, Genetics, Molecular Biology, Evolution and Ecology, S Chand and Company.
- Gupta PK, (2021) Cytology, Genetics and Evolution, Rastogi Publication.

SUGGESTED READINGS

- Karp, G. (2010). Cell and Molecular Biology: Concepts and Experiments. VI Edition. John Wiley and Sons. Inc.
- De Robertis, E.D.P. and De Robertis, E.M.F. (2006). Cell and Molecular Biology. VIII Edition. Lippincott Williams and Wilkins, Philadelphia.

- Cooper, G.M. and Hausman, R.E. (2009). The Cell: A Molecular Approach. V Edition. ASM Press and Sunderland, Washington, D.C.; Sinauer Associates, MA.
- Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. (2009). The World of the Cell. VII Edition. Pearson Benjamin Cummings Publishing, San Francisco.
- Bruce Albert, Bray Dennis, Levis Julian, Raff Martin, Roberts Keith and Watson James (2008). Molecular Biology of the Cell, V Edition, Garland publishing Inc., New York and London.

SEMESTER II

CORE COURSE 3 PHYSIOLOGY I THEORY (CREDITS 4)

Course objectives

- The course intends to explore the working systems of animals inside the body.
- The course would explain the basic vital process of living animal systems like digestion, reproduction and others.
- This gives a broad outlook of what animal body is made of in terms of chemical molecules.

Learning outcomes

After the successful completion of this course the students will be able

1. To identify the vital functions of metabolism in animal body.
2. To understand the basics functioning of system in mammalian organisms.
3. To understand the biomolecules.
4. To understand the functioning of biomolecules in an organised animal system.

Unit 1

15 hour

Tissues Structure, location, classification and functions of epithelial tissue, connective tissue, muscular tissue and nervous tissue. Bone and Cartilage. Diseases and causes of diseases of bones, Osteoporosis.

Structure and types of bones and cartilages, Ossification, bone growth and Resorption.

Unit 2

15 hour

Nervous System: Structure of neuron, resting membrane potential, Origin of action potential and its propagation across the myelinated and unmyelinated nerve fibers; Types of synapse, Synaptic transmission and Neuromuscular junction; Reflex action and its types - reflex arc; Physiology of hearing and vision.

Brainstorming to search re growth of nerves

Unit 3

15 hour

Muscle Histology of different types of muscle; Ultra structure of skeletal muscle; Molecular and chemical basis of muscle contraction; Characteristics of muscle twitch; Motor unit, summation and tetanus

Reproductive System Histology of testis and ovary; Physiology of male and female reproduction; Puberty, Methods of contraception in male and female

To understand mass of muscles and human figure development.

Unit 4

15 hour

Endocrine System Histology of endocrine glands - pineal, pituitary, thyroid, parathyroid, pancreas, adrenal; hormones secreted by them and their mechanism of action; Classification of hormones; Regulation of their secretion; Gonadal Hormones and their functions, Hypothalamus (neuroendocrine gland) hypophysial relationship- principal nuclei involved in neuroendocrine control of anterior pituitary and endocrine system; Placental hormones. Menopause Hormones in social life. Parturition, Lactation post-partum depression, hormones related disorder PCOD. Exercise hormones.

Hormones for control of emotions.

ANIMAL PHYSIOLOGY PRACTICALS

(Credits 2)

1. Recording of simple muscle twitch with electrical stimulation (or Virtual)
2. Demonstration of the unconditioned reflex action (Deep tendon reflex such as knee jerk reflex)
3. Preparation of temporary mounts: Squamous epithelium, Striated muscle fibres and nerve cells
4. Study of permanent slides of Mammalian skin, Cartilage, Bone, Spinal cord, Nerve cell, Pituitary, Pancreas, Testis, Ovary, Adrenal, Thyroid and Parathyroid
5. Microtomy: Preparation of permanent slide of any mammalian tissues.
6. Hormonal disease and functions of hormone.

ESSENTIAL READINGS

- Bhatia A L, Kohli KS, (2015) Animal Physiology and Biochemistry, RBD Publication house.
- Agarwal RA, Srivastava AK, Kumar Kaushal (2016) Animal Physiology and Biochemistry, S Chand and Company.
- Sastri KV, (2013), Animal Physiology and Biochemistry, Rastogi Publication.
- Sharma S K, Goyal PK, (2013) Animal Physiology and Biochemistry, CBH Publication
- Rana Shinde, MN Chatterjea (2008) Textbook of Medical Biochemistry, Jaypee Brothers Medical Publishers Pvt. Limited.
- Prema Sembulingam, K Sembulingam.(2019.) Essentials of Medical Physiology, Jaypee Brothers Medical Publishers Pvt. Limited.

SUGGESTED READINGS

- Guyton, A.C. & Hall, J.E. (2006). Textbook of Medical Physiology. XI Edition. Hecourt Asia PTE Ltd. /W.B. Saunders Company.
- Tortora, G.J. & Grabowski, S. (2006). Principles of Anatomy & Physiology. XI Edition John Wiley & sons
- Victor P. Eroschenko. (2008). diFiore's Atlas of Histology with Functional correlations. XII Edition. Lippincott W. & Wilkins.

SEMESTER II

CORE COURSE IV DIVERSITY AND DISTRIBUTION OF CHORDATES THEORY (CREDITS 4)

Course objectives

- The course intends to explore the diverse animals of Chordates in a systematic manner.
- The course would define the gradual development of complexity in the process of evolution.
- This gives a broad outlook of diverse animal kingdom and their specific features in detail.

Learning outcomes

After the successful completion of this course the students will be able

1. To identify the vast animal Chordates kingdom.
2. To understand the basics of Taxonomy.
3. The organisation of animal body from simple to complex forms.
4. To understand the specific feature of organism in general context to nature.

Unit 1

12 Hours

Protochordates: General features of Urochordates, Hemichordates and Cephalo-chordates, Retrogressive metamorphosis in Urochordates.

Dipleurula concept, Echinoderm theory of origin of chordates, Advanced features of vertebrates over Protochordata

Agnatha

General features of Agnatha and classification of cyclostomes up to classes. Importance of Jaws in classification and process of evolution.

Importance of jaws in the process of evolution

Unit 2

Pisces

15 Hours

General features and Classification up to orders; General characteristics of Chondrichthyes and Osteichthyes. Osmoregulation in Fishes, Parental Care, Types of scales and fins, Migration. Adaptive Radiation

Fishes as food industry

Unit 3:

16 Hours

Amphibia

General features and Classification up to orders; Parental care. Neotony, Regeneration in Amphibia

Adaptations to live out side water.

Reptile: General features and Classification up to orders; General features, Skull in Reptiles and Classification up to orders; Identification of Poisonous and non-poisonous snakes with examples, Snake bite identification, Structure of Fangs, Biting mechanism in snakes, Poison and venom **Venom of snakes and other Reptiles, their application in medicine.**

Unit 4:

17 Hours

Aves

General features and Classification up to order Archaeopteryx, Principles and aerodynamics of flight, Flight adaptations in birds, Migration in Birds. Perching mechanism and Palate in birds

Mammals

Classification and Characters up to orders; Origin of mammals and phylogeny, Affinities with different phylum. Adaptive Radiation, Zoogeographic realms.

Phylogeny and evolution to predict future human.

CHORDATES PRACTICAL

CREDITS 2)

- **Protochordata:** *Balanoglossus*, *Herdmania*, *Branchiostoma*, Colonial Urochordata Sections of *Balanoglossus* through proboscis and branchiogenital regions, Sections of *Amphioxus* through pharyngeal, intestinal and caudal regions. Permanent slide of *Herdmania* spicules
- **Agnatha** *Petromyzon*, *Myxine*
- **Fishes:** *Scoliodon*, *Sphyrna*, *Pristis*, *Torpedo*, *Chimaera*, *Mystus*, *Heteropneustes*, *Labeo*, *Exocoetus*, *Echeneis*, *Anguilla*, *Hippocampus*, *Tetrodon/Diodon*, *Anabas*, Flat fish
- **Amphibia** *Ichthyophis/Ureotyphlus*, *Necturus*, *Bufo*, *Hyla*, *Alytes*, *Salamandra*
- **Reptilia** *Chelone*, *Trionyx*, *Hemidactylus*, *Varanus*, *Uromastix*, *Chamaeleon*, *Ophiosaurus*, *Draco*, *Bungarus*, *Vipera*, *Naja*, *Hydrophis*, *Crocodylus* Key identification of *Crocodiles*, *Aligator* and *Gavalis*. Key for Identification of poisonous and non-poisonous snakes
- **Aves** Study of six common birds from different orders. Types of beaks and claws
- **Mammalia** *Sorex*, Bat (Insectivorous and Frugivorous), *Funambulus*, *Loris*, *Herpestes*, *Erinaceous*. *Ornithorinchus*, *Sea Cow*,
- Waleigo fish for dissection. Accessory respiratory organ in lung fishes. example *Anabas*, *Heterophytus*, *Ophiothicus*
- Power point presentation on study of any two animals from two different classes by students (may be included if dissections not given permission)

ESSENTIAL READINGS

- Kotpal R.L, (2015) Modern Text Book of Zoology: Vertebrates Rastogi Publications, India
- Verma P.S., Agarwal V.K. Chordate and Embryology (2016) S. Chand Publishing, India
- Jordan EL, Verma PS (2021) Chordate Zoology, S Chand and Company Publishing, India.
- Sharma S K, Goyal P.K, (2019) Chordata, CBH, India

SUGGESTED READINGS

- Young, J. Z. (2004). *The Life of Vertebrates*. III Edition. Oxford university press.
- Pough H. *Vertebrate life*, VIII Edition, Pearson International.
- Darlington P.J. *The Geographical Distribution of Animals*, R.E. Krieger Pub Co.
- Hall B.K. and Hallgrimsson B. (2008). *Strickberger's Evolution*. IV Edition. Jones and Bartlett Publishers Inc.

GENERIC COURSE I BASICS OF CELL BIOLOGY THEORY (Credits 4)

Course Objectives

- The course intends to explore the cell in detail in a systematic manner.
- The course would define the gradual development of cellular organization
- This emphasizes on cell division and cell cycle in relation to growth of organism.

Learning outcomes

After the successful completion of this course the students will be able

1. To identify the different types of cells for different functions in animals and its organelles.
2. To understand the basics system in different cells in organisms like blood cells germ cells etc.
3. To understand the specific feature of organelle in general context to their working.

Unit 1:

15 hours

Overview of Cells Prokaryotic and Eukaryotic cells, Virus, Viroids, Mycoplasma, Prions. Plasma Membrane: Various models of plasma membrane structure, Transport across membranes: Active and Passive transport, Facilitated transport.

Cell junctions: Tight junctions, Desmosomes, Gap junctions

Unit 2:

16 hours

Endomembrane System Structure and Functions: Endoplasmic Reticulum, Golgi apparatus, Lysosomes, Ribosomes, Mitochondria and Peroxisomes, centrosome

Mitochondria: Structure, Semi-autonomous nature, Mitochondrial Respiratory Chain.

Unit 3

14 hours

Cytoskeleton Structure and Functions: Microtubules, Microfilaments and Intermediate filaments

Nucleus Structure of Nucleus: Nuclear envelope, nuclear pore complex, Nucleolus, Chromatin: Euchromatin and Hetro-chromatin and packaging (nucleosome).

Unit 4

15 Hours

Cell Division Mitosis, Meiosis, Cell cycle and its regulation, Cell Signaling GPCR and Role of second messenger (cAMP)

CELL BIOLOGY PRACTICAL

(Credits 2)

1. Preparation of temporary stained squash of onion root tip to study various stages of mitosis
2. Study of various stages of meiosis from permanent slides.
3. Preparation of permanent slide to show the presence of Barr body in human female blood cells/cheek cells.

ESSENTIAL READINGS

- Powar CB (2016) Cell biology, Himalaya Publications
- Bhaita AL, Kohli KS, Jain SK (2015) Cell biology and Genetics, RBD Publishing House
- Verma PS, Agarwal VK, (2010) Cell Biology, Genetics, Molecular Biology, Evolution and Ecology, S Chand and Company.
- Gupta PK, (2021) Cytology, Genetics and Evolution, Rastogi Publication.

SUGGESTED READINGS

- Karp, G. (2010). Cell and Molecular Biology: Concepts and Experiments. VI Edition. John Wiley and Sons. Inc.
- De Robertis, E.D.P. and De Robertis, E.M.F. (2006). Cell and Molecular Biology. VIII Edition. Lippincott Williams and Wilkins, Philadelphia.
- Cooper, G.M. and Hausman, R.E. (2009). The Cell: A Molecular Approach. V Edition. ASM Press and Sunderland, Washington, D.C.; Sinauer Associates, MA.
- Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. (2009). The World of the Cell. VII Edition. Pearson Benjamin Cummings Publishing, San Francisco.
- Bruce Albert, Bray Dennis, Levis Julian, Raff Martin, Roberts Keith and Watson James (2008). Molecular Biology of the Cell, V Edition, Garland publishing Inc., New York and London.

GENERIC COURSE II
PRINCIPLES OF ECOLOGY
THEORY (Credits 4)

Course Objectives

- The course intends to explore the environment in detail in a systematic manner.
- The course would define the gradual development of environment and its components.
- This emphasizes on various factors effecting components and thereby environment.

Learning outcomes

After the successful completion of this course the students will be able

1. To describe the different types of components of Environment.
2. To understand the basics system in different cells in organisms like blood cells germ cells etc.
3. To understand the specific feature of each component of environment and their working system.

Unit 1:

Introduction to Ecology

15 Hours

Relevance of studying ecology, levels of organization, Laws of limiting factors. Ecosystem and its components.

Unit 2:

Population

15 Hours

Unitary and Modular populations, Unique and group attributes of population: Density, natality, mortality, life tables, fecundity tables, survivorship curves, age ratio, sex ratio, dispersal and dispersion; Exponential and logistic growth, equation and patterns, r and K strategies,

Unit 3:

Community

15 Hours

Community characteristics: Dominance, diversity, species richness, abundance, stratification; Eco tone and edge effect; Ecosystem development (succession) with example; Theories pertaining to climax community.

Unit 4:

Ecosystem

15 Hours

Types of ecosystems, Food chain, Food web, Energy flow through the ecosystem, Ecological pyramids and Ecological efficiencies. Nutrient and biogeochemical cycle with one example of Nitrogen cycle

Biodiversity Conservation, its significance, loss of biodiversity, Conservation strategies, Application of ecology in wild life conservation.

Practical

1. Experiments on Community Structure Study
2. Experiments on Biomass Study
3. Experiments on Aquatic Ecosystem
4. Experiments on Physico-Chemical Analysis of Water
5. Case study of Tiger conservation in India

ESSENTIAL READINGS

- Veerbala Rastogi and Jairaj MS, (2020), Animal Ecology and Distribution of Animal, Meerut Publication.
- Bhaitia AL and Kohli KS, (2017), Ecology and Environment Biology, RBD Publishing.
- Verma PS and Agarwal VK (2016) Principal of Ecology, S.Chand and Company.

SUGGESTED READINGS

- Colinvau, P. A. (1993). *Ecology*. II Edition. Wiley, John and Sons, Inc.
- Krebs, C. J. (2001). *Ecology*. VI Edition. Benjamin Cummings.
- Odum, E.P., (2008). *Fundamentals of Ecology*. Indian Edition. Brooks/Cole
- Robert Leo Smith Ecology and field biology Harper and Row publisher
- Ricklefs, R.E., (2000). *Ecology*. V Edition. Chiron Pres.

P Eugene, W Gary BARRETT (2015) Fundamentals of Ecology, New Delhi

GENERIC COURSE III GENERAL PHYSIOLOGY AND BIOCHEMISTRY THEORY (CREDITS 4)

Course objectives

- The course intends to explore the working systems of animals inside the body.
- The course would explain the basic vital process of living animal systems like digestion, reproduction and others.
- This gives a broad outlook of what animal body is made of in terms of chemical molecules.

Learning outcomes

After the successful completion of this course the students will be able

1. To identify the vital functions of metabolism in animal body.
2. To understand the basics functioning of system in mammalian organisms.
3. To understand the biomolecules.
4. To understand the functioning of biomolecules in an organised animal system.

Unit 1 Physiology

17 Hours

Digestion: Types of nutrition, feeding mechanism, balanced diet. Physiology of digestion, absorption and assimilation of carbohydrates, proteins and lipids. Gall bladder as an accessory gland for digestion.

Respiration: Organs of respiration gills, lungs and skin. Pulmonary ventilation, Respiratory Quotient, volumes and capacities, Transport of Oxygen and carbon dioxide in blood.

Excretion and its types: Structure of Kidney, Structure of nephron, Mechanism of Urine formation, Counter-current Mechanism, Osmoregulation. Dialysis, Kidney Stone.

Nerve and muscle: Structure of a neuron and synapse, Resting membrane potential, Graded potential, Reflex arc, Origin of Action potential and its propagation in myelinated and non-myelinated nerve fibres, Ultra-structure of skeletal muscle.

Unit 2 Physiology

16 Hours

Cardiovascular system Composition of blood, Homeostasis, Structure of Heart, Heartbeat, Blood pressure, clotting, blood groups, ECG and EEG. Importance of Spleen.

Reproduction and Endocrine Glands Physiology of male reproduction: hormonal control of spermatogenesis; Physiology of female reproduction: hormonal control of menstrual cycle Structure and function of pituitary, pineal, thyroid, Parathyroid, pancreas and adrenal glands.

Unit 3 Biochemistry

14 Hours

Metabolism- Carbohydrate and Lipid

Introduction to metabolism: Anabolism and Catabolism.

Carbohydrate Metabolism Glycolysis, Krebs cycle, Pentose phosphate pathway, Gluconeogenesis, Glycogen metabolism, Review of electron transport chain Glucagon and Insulin activity in sugar level maintenance

Lipid Metabolism Biosynthesis and β oxidation of palmitic acid

Unit 4 Biochemistry

13 Hours

Protein Metabolism and Enzymes

Protein metabolism Transamination, Deamination and Urea Cycle. Types of Enzymes, Enzymes Introduction, Mechanism of action, Enzyme Kinetics, Inhibition and Regulation

PHYSIOLOGY AND BIOCHEMISTRY PRACTICAL (CREDITS 2)

1. Preparation of hemin and hem chromogen crystals.
2. Artificial Respiration techniques
3. ECG reading technique.
4. Study of permanent histological sections of mammalian pituitary, thyroid, pancreas, adrenal gland
5. Study of permanent slides of spinal cord, duodenum, liver, lung, kidney, bone, cartilage
6. Qualitative tests to identify functional groups of carbohydrates in given solutions (Glucose, Fructose, Sucrose, Lactose)
7. Estimation of total protein in given solutions by Lowry's method. 3. Study of activity of salivary amylase under optimum conditions.

ESSENTIAL READINGS

- Bhatia A L, Kohli KS, (2015) Animal Physiology and Biochemistry, RBD Publication house.
- Agarwal RA, Srivastava AK, Kumar Kaushal (2016) Animal Physiology and Biochemistry, S Chand and Company.
- Sastri KV, (2013), Animal Physiology and Biochemistry, Rastogi Publication.
- Sharma S K, Goyal PK, (2013) Animal Physiology and Biochemistry, CBH Publication

- Rana Shinde, MN Chaterjee(2008) Text book of Medical Biochemistry, Jaypee Brothers Medical Publishers Pvt. Ltd.
- Prema Sembulingam, K Sembulingam.(2019.) Essentials of Medical Physiology, Jaypee Brothers Medical Publishers Pvt. Limited.

SUGGESTED READINGS

- Tortora, G.J. and Derrickson, B.H. (2009). Principles of Anatomy and Physiology, XII Edition, John Wiley & Sons, Inc.
- Widmaier, E.P., Raff, H. and Strang, K.T. (2008) Vander's Human Physiology, XI Edition., McGraw Hill
- Guyton, A.C. and Hall, J.E. (2011). Textbook of Medical Physiology, XII Edition, Harcourt Asia Pvt. Ltd/ W.B. Saunders Company
- Berg, J. M., Tymoczko, J. L. and Stryer, L. (2006). Biochemistry. VI Edition. W.H Freeman and Co.
- Nelson, D. L., Cox, M. M. and Leininger, A.L. (2009). Principles of Biochemistry. IV Edition. W.H. Freeman and Co.
- Murray, R.K., Granner, D.K., Mayes, P.A. and Rodwell, V.W. (2009). Harper's Illustrated Biochemistry. XXVIII Edition. Lange Medical Books/Mc Graw3Hill.

GENERIC COURSE IV

FUNDAMENTALS OF MOLECULAR BIOLOGY

THEORY (Credits 4)

Course objectives

- The course intends to explore the cell in detail in a systematic manner.
- The course would define the gradual development of cellular organization
- This emphasize on scell division and cell cycle in relation to growth of organism.

Learning outcomes

After the successful completion of this course the students will be able

1. To identify the different types of cells for different functions in animals and its organelles.
2. To understand the basics system in different cells in organisms like blood cells germ cells etc.
3. To understand the specific feature of organelle in general context to their working.

Unit 1

15 hours

Structure of DNA, Replication Semi conservative method of replication, Repair and Recombination, Unit of Replication, Enzymes Involved, Replication Origin and Replication Fork, Fidelity of Replication, Extrachromosomal Replication, DNA damage and Repair Mechanisms, Homologous and Site-Specific Recombination.

Unit 2**15 hours**

Structure and Function of Different Types of RNA mRNA, rRNA, tRNA. RNA synthesis and Processing: Transcription Factors and Machinery; Formation of Initiation Complex; Transcription activator and Repressor; RNA Polymerases; Capping and Termination; RNA Processing; RNA Editing; Splicing; and Polyadenylation; and Transport.

Unit 3**15 hours**

Protein Synthesis and Processing: Ribosome; Formation of Initiation Complex; Initiation Factors and Their; Regulation and Elongation Factors; Termination; Genetic Code; Aminoacylation of tRNA-Identity; Aminoacyl tRNA Synthetase; and Translational Proof-Reading; Translational Inhibition; Post-Translational Modification of Proteins.

Unit 4**15 hours**

Control of Gene Expression at Transcription and Translation Level; Regulating the Expression of Phages; Prokaryotic and Eukaryotic Genes; Role of Chromatin in Gene Expression and Gene Silencing.

Practical

1. Structure of DNA, A B and Z forms by models
2. Structure of RNA mRNA, t RNA and r RNA by charts
3. Model of Semiconservative replication By charts

Essential Readings

- Verma PS, Agarwal VK, (2010) Cell Biology, Genetics, Molecular Biology, Evolution and Ecology, S Chand and Company.
- Gupta PK, (2019) Molecular Biology, Rastogi Publication.

Suggested Readings

1. De Robertis, E.D.P. and De Robertis, E.M.F. (2006). Cell and Molecular Biology. VIII Edition. Lippincott Williams and Wilkins, Philadelphia.
2. Cooper, G.M. and Hausman, R.E. (2009). The Cell: A Molecular Approach. V Edition. ASM Press and Sunderland, Washington, D.C.; Sinauer Associates, MA.
3. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. (2009). The World of the Cell. VII Edition. Pearson Benjamin Cummings Publishing, San Francisco.
4. Bruce Albert, Bray Dennis, Levis Julian, Raff Martin, Roberts Keith and Watson James (2008). Molecular Biology of the Cell, V Edition, Garland publishing Inc., New York and London.

Skill Enhancement Course I
MEDICAL DIAGNOSTICS
THEORY (Credits 4)

Course objectives

- To develop some knowledge about +different medical tests performing and its need.
- To develop basic skill of test performing ability.
- To organise and perform a test in medical laboratory

Learning Outcomes.

After successful completion of this course the student should be able to

1. To collect samples for testing.
2. To perform the tests independently in a lab.
3. To perform all tasks in any medical lab.

Unit 1:

Introduction to Medical Diagnostics and its Importance **14 Hours**

Overview of medical diagnostic tools and machines and their working principle.

Unit 2:

Diagnostics Methods Used for Analysis of Blood **16 Hours**

Blood composition, Preparation of blood smear and Differential Leucocyte Count (D.L.C) using Leishman's stain, Platelet count using haemocytometer, Erythrocyte Sedimentary Rate (E.S.R), Packed Cell Volume (P.C.V.) BT and Ct, Blood group testing, LFT.SGOT, SGPT essay.

Unit 3:

Diagnostic Methods Used for Urine Analysis **15 Hours**

Urine Analysis: Physical characteristics; Abnormal constituents as blood, albumin, KFT

Unit 4:

Non-infectious Diseases **15 Hours**

Causes, types, symptoms, complications, diagnosis and prevention of Diabetes (Type I and Type II), Hypertension (Primary and secondary), Testing of blood glucose using Glucometer/Kit. Some other tests like X-Ray, PET, MRI, CT scan.

Essential Readings

- Park, K. (2007), *Preventive and Social Medicine*, B.B. Publishers,
- Godkar P.B. and Godkar D.P. *Textbook of Medical Laboratory Technology*, II Edition, Bhalani Publishing House
- Cheesbrough M., *A Laboratory Manual for Rural Tropical Hospitals, A Basis for Training Courses*

SUGGESTED READINGS

- Guyton A.C. and Hall J.E. *Textbook of Medical Physiology*, Saunders
- Robbins and Cortan, *Pathologic Basis of Disease*, VIII Edition, Saunders
- Prakash, G. (2012), *Lab Manual on Blood Analysis and Medical Diagnostics*, S. Chand and Co. Ltd

Skill Enhancement Course II Bioinformatics and Biostatistics Theory (Credit 4)

Course Objective

- To understand the art of developing and presenting into categories
- To understand and present data in form of tables, graphs and diagrams.
- To value and deduce the significance of data.
- To understand the application of Bioinformatics.
- To understand use and generate data categories and then into data base.

Learning Outcomes.

After successful completion of the course the student will be able

1. To develop data and present it in scientific method.
2. To explain data in different form of tables and graphs.
3. To understand the application of Bioinformatics.
4. To use and work on NCBI.
5. To comprehend the databases primary and secondary and structured data base.

Unit 1 Bioinformatics

15 Hours

History scope and importance of bioinformatics and important contributions, Aims and tests of Bioinformatics and its applications. Basics of Internet HTML introduction to NCBI data model, Various file format for biological sequences.

Unit 2 Bioinformatics

15 Hours

Database Tools and their bases, importance of databases, biological databases Primary sequence Database composite sequence, Secondary Database, Nucleic acid sequence database, Protein sequence databases and structured Database bibliographic databases.

Unit 3 Biostatistics

15 Hours

Data collection categorisation and presentation, Primary and Secondary data collection, sampling methods, Merits and demerits, sampling errors categorisation of grouped and ungrouped data with continuous and discontinuous series. Presentation, Tabulation and diagrammatic presentation as line, bar, pie Dot, Ogive and histogram graphs.

Unit 4 Biostatistics

15 Hours

Major of central tendency and significance, mean, median, mode, standard deviation and standard error, Chi Square test, Student's t test simple correlation and linear regression

Essential readings

- Prasad and Satguru (2020) Elements of Biostatistics, Rastogi Publications
- Sharma AK (2005) Text Book of Biostatistics II, Discovery Publishing House.

Suggested Readings

- Design and Analysis of Experiments, by Douglas C. Montgomery 8 edition
- Basics of Biostatistics: A Manual for Medical Practitioners 2017 by Jatinder Bali (Author), Anil Kant (Author)

Skill Enhancement Course III Food, Nutrition, Health and Diseases Theory (Credit 4)

Course Objective

- To understand the concept of food and nutrition
- To understand the importance of Nutrition on health
- To understand the different types of diseases and prevent it.
- To understand the causes diseases and prevent it to maximum.

Learning Outcomes.

After successful completion of the course the student will be able

1. To define health and ill health
2. To define the concept of food nutrition and balanced diet.
3. To work out a balanced diet for maintaining normal health.
4. To understand life style dependent diseases.
5. To identify the causes of exposure and outbreak of infectious disease.

Unit 1

15 hours

Basic concept of food and nutrition

Food function, Components and food-nutrients Concept of a balanced diet, nutrient needs and dietary pattern for various groups adults school children, adolescents and elderly

Unit 2

15 hours

Health and deficiency diseases

Introduction to health- Definition and concept of health Major nutritional Deficiency diseases- Protein Energy Malnutrition (kwashiorkor and marasmus), Vitamin A deficiency disorders, Iron deficiency disorders, Iodine deficiency disorders- their causes, symptoms, treatment, prevention and government programs, if any.

Unit 3

15 hours

Life style related diseases

Life style related diseases- hypertension, diabetes mellitus, and obesity- their causes and prevention through dietary and lifestyle modifications Social health problems- smoking, alcoholism, drug dependence and Acquired Immuno Deficiency Syndrome (AIDS) - their causes, treatment and prevention

Unit 4

15 Hours

Food hygiene

Potable water- sources and methods of purification at domestic level Food and Water borne infections: Bacterial infection: Cholera, typhoid fever, dysentery; Viral infection: Hepatitis, Poliomyelitis, Protozoan infection: amoebiasis, giardiasis; Parasitic infection: taeniasis and ascariasis their transmission, causative agent, sources of infection, symptoms and prevention Brief account of food spoilage: Causes of food spoilage and their preventive measures

Essential Readings

- Mudambi, SR and Rajagopal, MV. Fundamentals of Foods, Nutrition and Diet Therapy; Fifth Ed; 2007; New Age International Publishers
- Srilakshmi B. Nutrition Science; 2002; New Age International (P) Ltd

Suggested Readings

- Srilakshmi B. Food Science; Fourth Ed; 2007; New Age International (P) Ltd.
- Swaminathan M. Handbook of Foods and Nutrition; Fifth Ed; 1986; BAPPCO.
- Bamji MS, Rao NP, and Reddy V. Text Book of Human Nutrition; 2009; Oxford & IBH Publishing Co. Pvt Ltd.
- Wardlaw GM, Hampl JS. Perspectives in Nutrition; Seventh Ed; 2007; McGraw Hill.
- Lakra P, Singh MD. Textbook of Nutrition and Health; First Ed; 2008; Academic Excellence.
- Manay MS, Shadaksharaswamy. Food-Facts and Principles; 1998; New Age International (P) Ltd. Gibney et al. Public Health Nutrition; 2004; Blackwell Publishing

Skill Enhancement Course IV

Apiculture Theory (Credit 4)

Course Objective

- To understand the concept of Apiculture
- To gain knowledge about the honey bees, the social behaviour, management of equipment and colonisation
- To make aware of the economic importance and its diseases.
- To benefit them by culture techniques, develop entrepreneurship bees wax and honey.

Learning Outcomes.

After successful completion of the course the student will be able

1. To know about bee keeping apiculture status in India Honey bee species and diseases
2. To understand honey bee behaviour, bee colony and its management.
3. To know artificial bee hive construction and handling.
4. To manage an apiculture unit.

Unit 1

Honey Bees

15 Hour

Scope of Bee keeping, Present status of Apiculture in India, Honey bee Systematic position, species of Honey bees, Morphology and Life history. Siting apparatus and bee poisoning diseases, Viral, Bacterial fungal and protozoan infections.

Unit 2:

Bees and their Behaviour

15 Hour

Bee colony castes, natural colonies and their yield. Bee forging – pollen and nectar yielding plants. Honey Bee –Behaviour swarming pheromones queen and its management.

Unit 3

Apiary

15 Hour

Apiary Management natural and Artificial Bee Hives, Types-Constriction of Space frames Selection of Sites, handling, Maintenance, instruments Employed in Apiary.

Unit 4

Economic importance

15 Hour

Honey extraction: Honey composition, honey extraction, seasonal maintenance, **bee wax** and its uses: national and international markets for honey and wax; apiculture as self-employment venture.

Essential Readings

1. Bisht D.S., Apiculture, ICAR Publication.
2. Singh S., Beekeeping in India, Indian council of Agricultural Research, New Delhi

Suggested Readings

3. Johnson, J., and Jayachandra, I. 2005. Apiculture, Olympic graphic, Marthandam
4. Shukla, G.S. and Upathway, V.B. 2000. Economic Zoology, Rastogi publication Meerut.
5. Singh, S. Bee keeping in India, Indian Council of Agriculture Research, New Delhi.
6. Prost, P. J. (1962). Apiculture. Oxford and IBH, New Delhi.

