DSC 1

Course Title: Nonchordata - Protists to Pseudocoelomates

Total Credits: 04 (Credits: Theory - 02, Practical - 02)

Total Lectures: Theory - 30 hrs.; Practical - 60 hrs

Objectives: The course would provide an insight to the learner about the existence of different life forms on the earth and appreciate the diversity of animal life. It will help the students to understand the features of non-chordates and their systematic organization based on evolutionary relationships, structural and functional affinities. The course will also make the students aware about the characteristic morphological and anatomical features of diverse animals; the economic, ecological, and medical significance of various animals in human life; and will create interest among them to explore the animal diversity in nature.

Unit I: Introduction to Non-chordates 02 hrs

General characteristics of non-chordates and basis of classification.

Unit II: Protista 07 hrs

General characteristics and classification; Life cycle of *Plasmodium vivax;* Locomotion and reproduction in Protista.

Unit III: Porifera 05 hrs

Introduction to Parazoa; General characteristics and classification; Canal system in sponges.

Unit IV: Cnidaria and Ctenophora 08 hrs

Introduction to Metazoa; General characteristics and classification; Polymorphism in Cnidaria; Corals and coral reefs.

Unit V: Platyhelminthes and Nemathelminthes 08 hrs

General characteristics and classification; Parasitic adaptations of Helminthes; Life cycle of *Taenia solium* and *Ascaris lumbricoides.*

Note: Outline classification up to classes to be followed from "Ruppert, Fox and Barnes (2004). Invertebrate Zoology: A Functional Evolutionary Approach". VII Edition, Cengage Learning, India.

Practical:

1. Study of whole mount of *Euglena, Amoeba, Noctiluca, Paramecium,* Binary fission in *Paramecium* and Conjugation in *Paramecium.*
2. Examination of pond water collected from different places to observe diversity in Protista.
3. Study of *Sycon, Hyalonema, Euplectella, Spongilla,* T.S. of *Sycon,* L.S. *of Sycon.*

4. Study of *Obelia, Physalia, Millepora, Aurelia, Tubipora, Corallium, Alcyonium, Gorgonia, Metridium/Adamsia, Pennatula, Fungia, Meandrina, Madrepora.*
5. Specimen/slide of any one Ctenophore.
6. Study of adult *Fasciola hepatica, Taenia solium* and their life stages (Slides/microphotographs).
7. Study of adult *Ascaris lumbricoides* and its life stages (Slides/microphotographs).
8. To submit a Project Report on the life cycle of any one parasite or pathogen/corals/coral reefs.
9. Examination of soil samples collected from different places to observe diversity in nematodes.

Recommended Books:

1. Ruppert, Fox and Barnes (2004). Invertebrate Zoology. VII Edition,Cengage Learning, India.
2. Pechenik, J. A. (2015). Biology of the Invertebrates. VII Edition, McGraw-Hill Education.
3. 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

Teaching-Learning Process:

Information and concepts about morphology, anatomy and physiology of non-chordates will be imparted not only through classroom lectures to inculcate a conceptual base among the students about the subject but also through observations in nature and through real animals/preserved specimens/models. Hands-on exposure would be provided to the students leading to more comprehensive learning. Blended learning using the chalk and talk method and e-learning using presentations, animations, simple animal model systems, etc. would be used to enhance their conceptual understanding. Inquiry-based collaborative learning environment through presentations, debates and group discussions on the various aspects of non-chordate biology would be created to ensure effective learning and understanding of the concepts. Project activities have been included to create interest among the students to study and explore the biology and behaviour of non-chordates inculcating research aptitude. Furthermore, museology will give them a comprehensive idea of the structural features of non- chordates and the basis of classification. Curriculum-related assignments would improve the reading, writing and abstracting skills; and enhance the critical thinking of the students.

Learning Outcomes:

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

- Learn about the importance of systematics, taxonomy, and structural organization of non-chordates.
- Appreciate the diversity of non-chordates living in varied habits and habitats.

- Understand evolutionary history and relationships of different non-chordates through functional and structural affinities.
- Critically analyse the organization, complexity and characteristic features of non-chordates.
- Recognize the life functions and the ecological roles of the animals belonging to different phyla.
- Enhance collaborative learning and communication skills through practical sessions, teamwork, group discussions, assignments, and projects.

Assessment Methods:

The learners/ students can be assessed in the following ways:

- Presenting the topics in the class *via* blackboard teaching/presentations, group discussions etc.
- Lecture units will be assessed by written exams (multiple-choice, short-answer or essay-based).
- Practical units will be assessed by experimental reports and/or short written assignments and/or written exams.
- From time to time, learners will be given practical problems to test their theoretical skills and promote practical knowledge.
- Students would be provided feedback on their work with a view to improving their academic performance.
- Formative feedback throughout the course and summative feedback as mid-semester and semester-end evaluation.

DSC 2

Course Title: Biology of Cell: Structure and Function

Total Credits: 04 (Credits: Theory - 02, Practical - 02)
Total Lectures: Theory - 30 hrs.; Practical - 60 hrs

Objectives: The objective of the course is to help the students to learn and develop an understanding of a cell as a basic unit of life. This course is designed to enable them to understand the functions of cellular organelles and how a cell carries out and regulates cellular functions.

Unit I: Overview of Cells and Plasma membrane — 05 hrs

Prokaryotic and Eukaryotic cells; Various models of plasma membrane structures, Transport across membranes: active and passive transport, facilitated transport; Cell-cell junctions, structures, and functions: Tight junctions, adherens junctions, gap junctions.

Unit II: Endomembrane System — 10 hrs

Structure and Functions: Endoplasmic Reticulum (ER), Golgi apparatus, Signal hypothesis, Vesicular transport from ER to Golgi apparatus, Protein sorting and transport from Golgi apparatus, Coated Vesicles, Lysosomes, Peroxisomes. Structure of Mitochondria, Semi-autonomous nature, Endosymbiotic hypothesis; Respiratory chain, Chemiosmotic hypothesis, ATP Synthase.

Unit III: Cytoskeleton — 03 hrs

Structure and Functions: Microtubules, Microfilaments and Intermediate filaments.

Unit IV: Nucleus — 04 hrs

Structure of Nucleus, Nuclear envelope, nuclear pore complex, Transport of molecules across nuclear membrane, nucleosome, nucleolus; Chromatin: euchromatin, heterochromatin.

Unit V: Cell Division — 04 hrs

Mitosis, Meiosis, Cell cycle and its regulation.

Unit VI: Introduction to Cell Signaling — 04 hrs

Cell Signaling through G-protein coupled receptor (GPCR) and role of secondary messenger: cAMP and protein kinase A.

Practical:

1. Microscopy: Compound microscope: principle, components and handling; Phase contrast microscope; Electron microscope; Differential Interference Contrast (DIC) Microscope.
2. Principle and types of cell fixation and staining; Cell fractionation.
3. To study prokaryotic cells by Gram staining and eukaryotic cell (cheek cells) by hematoxylin/methylene blue.
4. To study the effect of hypotonic, isotonic, and hypertonic solutions on cell permeability.
5. Preparation of a temporary slide of squashed and stained onion root tip to study various stages of mitosis.

6. Study the effect of colchicine on mitosis at 24 hrs and 48 hrs.
7. Study of various stages of meiosis through permanent slides.
8. Preparation of stained mount to show the presence of Barr body in human female blood cells/cheek cells.
9. Cytochemical demonstration of:
   (a) DNA by Feulgen reaction
   (b) Mucopolysaccharides by PAS reaction
   (c) Proteins by Mercuric Bromophenol Blue/Acid Fast Green

Recommended Books:

1. Cooper, G.M., Hausman, R.E. (2019) The Cell: A Molecular Approach. VIII Edition, ASM Press and Sinauer Associates.
2. Becker, Kleinsmith, and Hardin (2018) The World of the Cell, IX Edition, Benjamin Cummings Publishing, San Francisco.
3. Karp, G. (2015). Cell and Molecular Biology: Concepts and Experiments, VIII Edition, John Wiley & Sons Inc.
4. Renu Gupta, Seema Makhija and Ravi Toteja (2018). Cell Biology Practical Manual, Prestige Publishers, New Delhi
5. VK Sharma (1991). Techniques in Microscopy and Cell Biology, Tata McGraw-Hill Publishing Company Limited, New Delhi

Teaching-Learning Process:

Information and concepts about cell biology will be imparted through classroom lectures to inculcate a conceptual base among the students about the subject. Hands-on exposure would be provided to the students leading to more comprehensive learning. Blended learning using the chalk-n-talk method and e-learning using presentations, animations etc., would be used to enhance their conceptual understanding. Inquiry-based collaborative learning environment through presentations, debates, and group discussions on the various aspects of cell biology would be created to ensure effective learning and understanding of the concepts. Curriculum-related assignments would improve the reading, writing and abstracting skills and enhance the critical thinking of the students.

Learning Outcomes:

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

- Understand the fundamental principles of cell biology.
- Explain the structure and functions of cell organelles involved in diverse cellular processes.
- Appreciate how cells grow, divide, survive, die, and regulate these important processes.
- Comprehend the process of cell signaling and its role in cellular functions.

- Have an insight into how defects in the functioning of cell organelles and regulation of cellular processes can develop into diseases. Learn the advances made in the field of cell biology and their applications.

Assessment Methods:

The learners/ students can be assessed in the following ways:

- Presenting the topics in the class *via* blackboard teaching/presentations, group discussions etc.
- Lecture units will be assessed by written exams (multiple-choice, short-answer or essay-based).
- Practical units will be assessed by experimental reports and/or short written assignments and/or written exams.
- From time to time, learners will be given practical problems to test their theoretical skills and promote practical knowledge.
- Students would be provided feedback on their work with a view to improving their academic performance.
- Formative feedback throughout the course and summative feedback as mid-semester and semester-end evaluation.

DSC 3

Course Title: Concepts of Ecology

Total Credits: 04 (Credits: Theory - 02, Practical - 02)

Total Lectures: Theory - 30 hrs.; Practical - 60 hrs.

Objectives: The primary aim of this course is to develop a scientific understanding of the diverse aspects of the field of ecology. The students will be familiarized with the interactions between the organisms and their physical environment. Additionally, various attributes of populations and communities with help of theoretical concepts and field examples will be discussed. It provides a platform to understand the varied forces that lead to variations among populations of a species.

Unit I: Introduction to Ecology — 03 hrs

Autecology and Synecology, Laws of limiting factors, Study of physical factors: Temperature and Light.

Unit II: Population — 07 hrs

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, equations and patterns, *r* and *k* strategies; Intraspecific population regulation: density-dependent and independent factors.

Unit III: Species Interactions — 06 hrs

Types of species interactions, Interspecific competition: Lotka-Volterra model of competition, Gause's Principle with laboratory and field examples, Niche concept; Predation: Lotka-Volterra equations, Functional and numerical responses, predator defence mechanisms, Resource partitioning.

Unit IV: Community — 05 hrs

Community characteristics: species richness, dominance, diversity, abundance, guilds, ecotone and edge effect; Ecological succession with examples and types.

Unit V: Ecosystem — 06 hrs

Types of Ecosystems: Terrestrial ecosystem, vertical stratification in tropical forest; Food chain: detritus and grazing food chains, linear and Y-shaped food chains, food web; Energy flow through the ecosystem; Ecological pyramids and Ecological efficiencies; Biogeochemical cycle- nitrogen cycle.

Unit VI: Applied Ecology — 03 hrs

Ecology in wildlife conservation and management, Protected areas: National Parks, Biosphere reserves and Sanctuaries; Restoration ecology, Principles of Environmental impact assessment.

Practical:

1. Study of life tables and plotting of survivorship curves of different types from

hypothetical/ real data

2. Determination of population density in a natural or a hypothetical community by quadratemethod and calculation of Shannon-Weiner diversity index.
3. Study of an aquatic ecosystem:
    a. Phytoplankton and zooplankton
    b. Measurement of temperature, turbidity/penetration of light, determination of pH
    c. Dissolved oxygen content (Winkler's method), chemical oxygen demand
    d. Free carbon dioxide and alkalinity
4. Study of ten endemic animals of India with slides/pictures/videos.
5. Report on a visit to a National Park/Biodiversity Park/Wildlife Sanctuary.

Recommended Books:

1. Odum, E.P. and Barrett G. W. (2008). Fundamentals of Ecology. Indian Edition (5th). Publisher: Brooks/Cole.
2. Smith T. M. and Smith R. L. (2015). Elements of Ecology. 9th International Edition. Publisher: Benjamin Cummings.
3. Saha G.K. and Mazumdar S. (2020) Wildlife Biology, An Indian Perspective. Publisher: PHI Learning Private Limited
4. Zimmer C. and Emlen D. J., (2013) 1st Edition. Evolution: Making Sense of Life, Roberts & Co.
5. Futuyma, Douglas and Mark, Kirkpatrick (2017) 3rd Edition. Evolutionary Biology, Oxford University Press

Teaching-Learning Process:

Teaching would encompass board teaching, PowerPoint presentations and field visits. The learning process will include the reading of research papers, participatory activities like focused group discussions, experience sharing, brainstorming sessions, project writing and presentations by students. Field trips to National parks and Eco-parks would complement and enhance understanding of the concepts and information about wildlife and its conservation. Laboratory work will provide students with hands-on experience for a better understanding of the subject.

Learning Outcomes:

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

- Demonstrate an understanding of the basic concepts of the subject
- Explain the characteristics, dynamics, and growth of populations
- Understand the characteristics of the community, ecosystem development and climax

theories

- Gain knowledge about the relationship of the evolution of various species and the environment they live in.
- Design basic field studies, collect data and interpret it
- Carry out population and community studies

Assessment Methods:

The learners/ students can be assessed in the following ways:

- Presenting the topics in the class via blackboard teaching/presentations, group discussions etc.
- Lecture units will be assessed by written exams (multiple-choice, short-answer or essay-based).
- Practical units will be assessed by experimental reports and/or short written assignments and/or written exams.
- From time to time, learners will be given practical problems to test their theoretical skills and promote practical knowledge.
- Students would be provided feedback on their work with a view to improving their academic performance.
- Formative feedback throughout the course and summative feedback as mid-semester and semester-end evaluation.

SYLLABUS

GENERIC ELECTIVES (GE) COURSES
Offered by Department of Zoology

GENERIC ELECTIVES (GE-1): Human Physiology

Credit distribution, Eligibility and Pre-requisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course	Department offering the course
		Lecture	Tutorial	Practical/ Practice			
Human Physiology	4	2	-	2	12th Pass	Nil	Zoology

Learning Objectives

This course offers an overview of the concepts of normal biological functions in the human body. The fundamentals of human physiology and histological structures will be correlated. The concept of homeostasis in response to changes in the external environment will be introduced. Further, students will be provided with knowledge that can be applied in everyday life. The students will be encouraged to pursue further studies in physiology and related fields as well as multidisciplinary subjects that require an understanding of thephysiology of humans.

Learning outcomes

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

- Understand the principles of normal biological function in the human body.
- Outline basic human physiology and correlate it with histological structures.
- Understand the homeostasis in animals in response to changes in their external environment.

SYLLABUS OF GE-1

Unit I: Tissues **(05 Hours)**
Types of Tissues; Structure and Function of Epithelial, Connective, Muscular and Nervous tissues.

Unit II: Functioning of Excitable Tissue (Nerve and Muscle) **(05 Hours)**
Propagation of nerve impulse (myelinated and non-myelinated nerve fibre); Mechanism of muscle contraction (Sliding filament theory).

Unit III: Digestion and Absorption of Food **(05 Hours)**
Structure and function of digestive system; Digestion and absorption of carbohydrates, fats and proteins.

Unit IV: Respiratory Physiology **(04 Hours)**

Structure and function of respiratory tract and lungs; Ventilation, External and Internal respiration; Transport of oxygen and carbon dioxide in blood.

Unit V: Cardiovascular System **(04 Hours)**
Structure of heart, Cardiac cycle, Composition of blood

Unit VI: Renal Physiology **(03 Hours)**
Functional anatomy of kidney

Unit VII: Reproductive Physiology **(04 Hours)**
Structure of testis and ovary; Spermatogenesis and Oogenesis.

Practical component (if any) - (60 Hours)

1. Preparation of temporary mount of neurons and blood cells (blood film preparation).
2. Preparation of haemin and haemochromogen crystals.
3. Haemoglobin estimation using Sahli's haemoglobinometer.
4. Determination of ABO Blood group.
5. Recording of blood pressure using a Sphygmomanometer.
6. Examination and detailed study of permanent histological sections of mammalian Stomach, Duodenum, Liver, Lung, Kidney, Pancreas, Testis and Ovary.

Essential readings

1. Tortora, G.J. and Derrickson, B.H. (2012). Principles of Anatomy and Physiology. XIIIth Edition, John Wiley and Sons, Inc.
2. Widmaier E, Raff H and Strang K. (2013). Vander's Human Physiology: The Mechanism of Body Functions. XIIIth Edition, McGraw-Hill Education.
3. Guyton, A.C. and Hall, J.E. (2011) Textbook of Medical Physiology. XII Edition, Harcourt Asia Pvt. Ltd/ W.B. Saunders Company.
4. Kesar, S. and Vashisht, N. (2007) Experimental Physiology. Heritage Publishers.
5. Prakash, G. (2012) Lab Manual on Blood Analysis and Medical Diagnostics. S. Chand and Company Ltd.