

**PUNYASHLOK AHILYADEVI HOLKAR**

**SOLAPUR UNIVERSITY, SOLAPUR**



NAAC Accredited-2015  
'B' Grade (CGPA 2.62)

**Name of the Faculty: Science & Technology**

**CHOICE BASED CREDIT SYSTEM**

**Syllabus: ZOOLOGY**

**Name of the Course: M.Sc. I (Sem-I & II)**

**(Syllabus to be implemented from w.e.f. June 2020)**

**M. Sc. Sem– I & II (Zoology) w. e. f. 2020-21**

Semester	Code	Title of the Paper	Semester Examination			L	T	P	Credits
			Theory	IA	Total				
Sem-I		<b>Hard Core</b>							
	HCT1.1	Biosystematics	80	20	100	4	--	--	4
	HCT1.2	Tools and Techniques in Biology.	80	20	100	4	--	--	4
	HCT1.3	Cell and molecular Biology	80	20	100	4	--	--	4
		<b>Soft Core (Any one)</b>							
	SCT1.1	Population Genetics and Evolution	80	20	100	4	--	--	4
	SCT1.2	Protozoology	80	20	100	4	--	--	4
		<b>Seminar/Tutorial/ Industrial Visit/ Field Tour</b>	---	25	25	--	1	--	1
	HCP1.1	Biosystematics	40	10	50	--	--	03	2
	HCP1.2	Tools and Techniques in Biology.	40	10	50	--	--	03	2
	HCP1.3	Cell and molecular Biology	40	10	50	--	--	03	2
	SCP 1.1/1.2	Population Genetics and Evolution / Protozoology	40	10	50	--	--	03	2
	<b>Total for Semester-I</b>	<b>480</b>	<b>145</b>	<b>625</b>	<b>--</b>	<b>--</b>	<b>--</b>	<b>25</b>	
Sem-II		<b>Hard Core</b>							
	HCT2.1	Developmental Biology	80	20	100	4	--	--	4
	HCT2.2	General and Comparative Endocrinology	80	20	100	4	--	--	4
		<b>Soft Core (Any one)</b>							
	SCT2.1	Environmental Physiology	80	20	100	4	--	--	4
	SCT2.2	Helminthology	80	20	100	4	--	--	4
		<b>Open Elective(Any one)</b>							
	OET2.1	Computational Biology	80	20	100	4	--	--	4
	OET2.2	Research Methodology and Intellectual Property Right	80	20	100	4	--	--	4
		<b>Seminar/Tutorial/ Industrial Visit/ Field Tour</b>	---	25	25	--	1	--	1
	HCP2.1	Developmental Biology	40	10	50	--	--	03	2
	HCP2.2	General and Comparative Endocrinology	40	10	50	--	--	03	2
	SCP2.1/2.2	Environmental Physiology/ Helminthology	40	10	50	--	--	03	2
OEP2.1/2.2	Computational Biology / Research Methodology and Intellectual Property Right	40	10	50	--	--	03	2	
	<b>Total for Semester-II</b>	<b>480</b>	<b>145</b>	<b>625</b>	<b>--</b>	<b>--</b>	<b>--</b>	<b>25</b>	

**HCT=Hard Core Theory    HCP=Hard Core Practical    SCT=Soft Core Theory**  
**OET=Open Elective Theory    IA=Internal Assessment    SCP=Soft Core Practical**

**L=Lecture**

**T=Tutorials**

**P=Practical**

**Punyashlok Ahilyadevi Holkar Solapur University, Solapur**

**M.Sc. ZOOLOGY Part I Syllabus  
(Choice Based Credit System)  
To be implemented from year 2020-2021**

**HCT1.1 Biosystematics**

**Teaching periods 60=4 credits**

**Unit 1.**

- 1.0** Definition and basic concept of Biosystematics and Taxonomy. (12)
- 1.1 Historical resume of Systematics.
  - 1.2 Importance and applications of Biosystematics in Biology.
  - 1.3 International code of Zoological nomenclature.

**Unit 2.**

- 2.0** Trends in Biosystematics –concepts of different conventional and newer aspects. (12)
- 2.1 Chemotaxonomy.
  - 2.2 Cytotaxonomy.
  - 2.3 Molecular taxonomy.

**Unit 3.**

- 3.0** Dimensions of speciation and taxonomic characters. (12)
- 3.1 Mechanism of speciation in panmictic and apomictic species.
  - 3.2 Species concepts- category, different concepts, sub-species and other intraspecific categories.
  - 3.3 Theories of biological classification, hierarchy of categories.
  - 3.4 Taxonomic characters- different kinds, origin of reproductive isolation- biological mechanism genetic incompatibility.

**Unit 4.**

- 4.0** Procedure and keys in taxonomy. (12)
- 4.1 Taxonomic collection, preservation and curation process of identification.
  - 4.2 Taxonomic keys- different kinds of taxonomic keys, their merits and demerits.
  - 4.3 Systematic publications- different kinds of publications.
  - 4.4 Process of typification of different Zoological types.

**Unit 5.**

- 5.0** Molecular phylogenetics. (12)
- 5.1 How to construct phylogenetic trees?
  - 5.2 Phylogenetic inference- Distance methods, parsimony methods, Maximum likelihood methods.
  - 5.3 Amino acid sequences and phylogeny.
  - 5.4 Nucleic acid phylogeny

**Suggested Reading Material**

1. M.Kato- The Biology of Diversity.
2. J.C. Avise – Molecular markers. Natural History and Evolution, Chapman & Hall, New York.
3. E.O. Wilson- Biodiversity, Academic Press, Washington.
4. G.G. Simpson –Principle of Animal Taxonomy, Oxford IBH Publishing Company.
5. E. Mayer- Elements of Taxonomy.
6. E.O. Wilson- The Diversity of Life. W.W. Northern and Company.
7. B.K. Tikedar- Threatened Animals of India, ZSI Publication, Calcutta.
8. E. Mayer- Principles of Systematic Zoology, M. Hill Publication.

## **Learning Outcomes**

After successfully completing this course, the students will be able to:

- Develop understanding on the diversity of life with regard to protists, non chordates and chordates.
- Group animals on the basis of their morphological characteristics/ structures.
- Develop critical understanding how animals changed from a primitive cell to a collection of simple cells to form a complex body plan.
- Examine the diversity and evolutionary history of a taxon through the construction of a basic phylogenetic/ cladistics tree.
- Understand how morphological change due to change in environment helps drive evolution over a long period of time.

**M.Sc. SEMESTER - I**  
**HCT 1.2 Tools and techniques in Biology**

**Teaching periods 60 = 4 credits**

**Unit 1.**

**1.0 Principles and uses of analytical Instruments. (12)**

- 1.1 Spectroscopy (Spectrophotometers, NMR, FTIR/PCR/ DNA Sequencing)
- 1.2 Lasers in Biology.
- 1.3 X- rays in Biology.
- 1.4 Electron microscope (TEM, SEM)
- 1.5 Proteomics- MALDI- TOF-TOF

**Unit 2.**

**2.0 Cell culture techniques. (12)**

- 2.1 Design and functioning of tissue culture laboratory.
- 2.2 Culture media preparation.
- 2.3 Types of culture- monolayer, suspension, capillary culture units, feeder layers, cell secretions and metabolic harvesting.
- 2.4 Cell viability testing.
- 2.5 Cell-characterization.
- 2.6 Cell-transformation.
- 2.7 Modern Advances in cell culture techniques.

**Unit 3.**

**3.0 Cell-based techniques. (12)**

- a) Cell Characterization
- b) Fusogens-somatic cell - fusion and its application.
- c) Fusion in different cell-cycle phases and its applications.
- d) Cell hybrids and its applications.

**Unit 4.**

**4.0 Cryotechnique. (10)**

- 4.1 Cryopreservation of cells, tissues, organs and organisms.
- 4.2 Cryotomy.
- 4.3 Freeze - drying and freeze fracturing techniques.

**Unit 5.**

**5.0 Separation techniques and Radiolabelling techniques: (14)**

- 5.1 Chromatography-TLC, Paper chromatography, HPLC, electrophoresis and its types, column fractionation.
- 5.2 Ultracentrifugation and sub-cellular fractionation. Cell separation by - flowcytometry, centrifugation
- 5.3 Radiolabel techniques in biology.
- 5.4 Radioactivity counter Geigometry and Scintillation.
- 5.5 Autoradiography.

**Suggested Reading Material**

1. John R.W. Masters. Animal Cell Culture. IRL Press.
  2. Robert Braun. Introduction of Instrumental Analysis. McGraw Hill International Editions.
  3. K. Wilson and K.H. Goulding. A Biologist Guide to Principles and Techniques of Practical Biochemistry. ELBS Ed.
  4. Patabhi, V. Biophysics. Narosa Publishing House.
  5. Bisen, P.S.; Mathur. Tools and Techniques in Life Sciences. CBS Publishers and Distributors.
    - 6. Keith Wilson & John Walker. Practical Biochemistry. Cambridge low price.
    - 7. Cell Cooper, A molecular approach Second Edition
    - 8. Cell : Alberts, 2002
    - 9. Rediscovering Biology: Annenberg E Edition
    - 10. Cell Physiology
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## **Learning outcomes**

After successfully completing this course, the students will be able to:

- Understand the purpose of the technique, its proper use and possible modifications/improvement.
- Learn the theoretical basis of technique, its principle of working and its correct application.
- Learn the construction repair and adjustment of any equipment required for a technique.
- Learn the accuracy of technique.
- Learn the maintenance laboratory equipments/ tools, safety hazards and precautions.
- Understand the technique of cell and tissue culture. Learn the preparation of solution of given percentage and molarity.
- Understand the process of preparation of buffer. Learn the techniques of separation of amino acids, proteins and nucleic acids.

## M.Sc. SEMESTER - I

### HCT 1.3 Cell and Molecular Biology

Teaching periods 60=4credits

#### Unit 1.

- 1.0 Biomembranes. (14)
- 1.1 Molecular composition, arrangement and functional consequences.
  - 1.2 Transport across the cell membrane - Passive and active transport, pumps, uniports, symports and antiports.
  - 1.3 Transport across epithelia
  - 1.4 Membrane potential
  - 1.5 Integrins.
  - 1.6 Collagens
  - 1.7 Cell junctions (tight, adhesion belts, focal contacts, septate, desmosomes, Hemidesmosomes, gap, chemical synapses, plasmodesmata.)  
Cell matrix and cell matrix adhesion

#### Unit 2.

- 2.0 Structural organization and function of intracellular organelles: (12)  
nucleus, mitochondria, Golgi bodies, lysosomes, endoplasmic reticulum.

#### Unit 3.

- 3.0 Cytoskeleton. (10)
- 3.1 Microfilaments and microtubules - structure and dynamics.
  - 3.2 Cilia, flagella - structure and dynamics.
  - 3.3 Microtubules and mitosis.
  - 3.4 Microtubular organizing centers - centriole, kinetochore, basal bodies.
  - 3.5 Intermediate filaments- Structure and function.
  - 3.6 Actin- binding proteins.
  - 3.7 Cell movement and cytoskeleton.

#### Unit 4.

- 4.0 Cell organelles and cell traffic. (14)
- 4.1 Protein synthesis on free and bound polysomes.
  - 4.2 Uptake into ER.
  - 4.3 Membrane proteins and other proteins in ER.
  - 4.4 Post transcriptional modification and protein sorting in Golgi apparatus.
  - 4.5 Lysosomal assembly and functions.
  - 4.6 Biogenesis of mitochondria.

#### Unit 5.

- 5.0 Biology of cancer- causes of cancer, treatment of cancer, cancer cell morphology and properties. (10)

## Suggested Reading Material

1. B. Alberts et al. The Molecular Biology of Cell Garland Publishing Inc. New York and London.
2. De. Robertis et al. Cell and Molecular Biology. Saunders College Publishing, Philadelphia.
3. W. H. Elliot and D.C. Elliot. Biochemistry and Molecular Biology. Oxford University Press. Oxford, New York.
4. Giese A.C. Cell Physiology. Saunders College Publishing, Philadelphia.
5. P.S. Verma& V.K. Agrawal. Cell Biology, Genetics, Molecular Biology, Evolution and Ecology. S. Chand and Company, New Delhi-55
6. SandhyaMitra. Genetic Engineering, Macmillan.
7. R.C. Dubey .A text Book of Biotechnology. S. Chand and Company, New Delhi-55.
8. Mohan Arora. Genetic Engineering. Himalaya Publishing House.
9. Becker, Klein smith. The World of the Cell. Pearson Education.
10. Geoffrey M. Cooper. Cell. A Molecular Approach. ASM Press. Washington.
11. Gerald Karp. Cell and Molecular Biology. Willey International Edition.
12. Watson et al... Molecular Biology of the Gene. Pearson Education.

## Learning outcomes

After successfully completing this course, the students will be able to

- Understand the functioning of nucleus and extra nuclear organelles and understand the intricate cellular mechanisms involved.
- Acquire the detailed knowledge of different pathways related to cell signaling and apoptosis thus enabling them to understand the anomalies in cancer
- Develop an understanding how cells work in healthy and diseased states and to give a ‘health forecast’ by analyzing the genetic database and cell information.
- Understand how tissues are produced from cells in a normal course and about any malfunctioning which may lead to benign or malignant tumorDevelop an understanding of concepts, mechanisms and evolutionary significance and relevance of molecular biology in the current scenario.
- Apply their knowledge in problem solving and future course of their career development in higher education and research.
- Get new avenues of joining research in related areas such as therapeutic strategies or related opportunities in industry.



## M.Sc. SEMESTER – I

### SCT 1.1 Population Genetics and Evolution

Teaching periods 60=4credits

#### Unit 1.

1.0 Concepts and theories of evolution and theories of organic evolution. (12)

Emergence of evolutionary thoughts: Lamarck; Darwin—concepts of variation, adaptation, struggle, fitness and natural selection; Mendelism; spontaneity of mutations; the evolutionary synthesis.

#### Unit 2.

2.0 Neo Darwinism. (12)

2.1 Hardy - Weinberg Law of genetic equilibrium.

2.2 A Detailed account of destabilizing forces a) Natural selection b) Mutation c) Genetic drift d) Migration e) Meiotic drive

#### Unit 3.

3.0 Molecular population genetics. (12)

3.1 Patterns of change in nucleotide and amino acid sequences.

3.2 Ecological significance of molecular variations.

3.3 Emergence of Neo-Darwinism-neutral hypothesis.

#### Unit 4.

4.0 Molecular evolution. (12)

4.1 Gene evolution.

4.2 Evolution of gene families, Molecular drive in evolution.

4.3 Assessment of molecular variation.

4.4 Evolutionary links based on gene and protein families and eukaryotic evolution based on different gene families

#### Unit 5.

5.0 Genetics of speciation. (12)

5.1 Phylogenetic and biological concept of speciation.

5.2 Patterns and mechanisms of reproductive isolation.

5.3 Models of speciation (Allopatric, Sympatric Parapatric).

#### Suggested Reading Material

1. Hart, D.L. A primer of Population Genetics. Suinuaer associates, Inc. Massachusetts.
  2. King. M. Species Evolution. The Cambridge University Press, Cambridge.
  3. Smith J.M. Evolutionary Genetics. Oxford University Press. Oxford, New York.
  4. Merrel D.J. Evolution and Genetics. Holt, Rinchart and Winston, Inc.
  5. Jha A.P. Genes and Evolution. John Publication, New Delhi.
  6. Boylan. Genetic Engineering: Science and Ethics on the New Frontier. Pearson Education. Delhi
  7. Human Biology: G.A. Harrison, G.M. Tanner, D.R. Pilbeam , P.T. Baker ; Oxford Science Publication. 1988.
  8. Evolution The triumph of an Idea : Carl Zimmer Harper Collins Publishers 2001
  9. PBS Org. Website for Evolution concept
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## **Learning outcomes**

After successfully completing this course, the students will be able to:

- Acquire an in-depth knowledge on the diversity and relationships in animal world.
- Develop a holistic appreciation on the phylogeny and adaptations in animals.
- Enable the students to understand the evolution of universe and life.
- Understanding on the process and theories in evolutionary biology.
- Develop an interest in the debates and discussion taking place in the field of evolutionary biology. Understand the uses and limitations of phylogenetic trees.
- Appreciate the complexities and difficulties of various species concepts.

## SCT 1.2 PROTOZOLOGY

Teaching periods 60= 4 Credits

### Unit –1. (10)

- i. Classification of Protozoa
- ii. Factors influencing the distribution of protozoa: Oxygen, Carbon dioxide, pH, Light, Food , Nutrition
- iii Ecology of free living Protozoa

### Unit –2 (10)

- Nutrition in Protozoa
- i. Methods of feeding
    - a. Filter feeding
    - b. Raptorial feeding
    - c. Diffusion feeding
  - ii. Digestion
  - iii. Nutritional requirements

### UNIT – 3 (14)

1. General organization and morphology of the parasitic flagellates occurring in digestive tract of man.
  - i. *Retartomonas intestinalis*
  - ii. *Chilomastix mesnili*
  - iii. *Giardia lamblia*
  - iv. *Trichomona stenax*

### UNIT – 4 (12)

1. General morphology, life cycle, transmission and pathology of parasitic : Amoebae of man and domestic animals. i. *Entamoeba histolytica* ii. *E. gingivalis*

### UNIT – 5 (14)

1. Structure and life cycle pattern of acephaline and cephaline Gregarines.
2. Coccidia of poultry with special reference to the structure, treatment and control.
3. Parasitism in ciliophora – structure, Life cycle, Pathogenesis and control of
  - i. *Ichthiophtherius multifilis*
  - ii. *Balantidium coli*

#### Text Books:

1. Aikawa and Sterling - Intracellular Parasitic Protzoa
2. Baker - Prasitic Protozoa
3. Chandler and Read - An introduction to Parasitology
4. Chatterjee K. D. Parasitology (Protozoology and Helminthology)
5. Thomas C. Cheng - General Parasitology
6. Corliss - The ciliate Protozoa
7. Dogiel - An Introduction to Protozoology
8. Faust, Russel and Jung - Clinical Parasitology
9. Hall - Protozoology
10. Hoare - Trypanosomes of mammals
11. Kudo - Protozoology
12. Levine - An introduction to Protzoan parasites of domestic animals and of man

#### Learning outcomes

After successfully completing this course, the students will be able to:

- Students learn protozoan parasites infestation .
- Assess the importance of incidence, prevalence and epidemiology
- Know how resistance development and resistance

**M.Sc. SEMESTER – I**  
**PRACTICAL PAPER**

**HCP 1.1 BIOSYSTEMATICS**

1. Calculation diversity indices to zooplankton populations from freshwater resources.
2. Classification of Invertebrates -40 Specimens.

3. Study of types of invertebrate larvae –Peculiarities and evolutionary significance.
4. Classification of Vertebrates -40 Specimens.
5. Identification of Venomous and Non venomous snakes.
6. Study of temporal vacuities in skulls of reptiles.

### **HCP 1.2 TOOLS AND TECHNIQUES**

1. Study of different laboratory equipments
  2. Study of different microscopes
  3. Cell separation by density gradient centrifugation
  4. Separation of amino acids by paper chromatography.
  5. Separation of Sugars by paper chromatography.
  6. Isolation of active ingredients from natural resources by using column chromatography.
  7. Sub cellular fractionation by using ultra centrifugation.
  8. DNA Extraction and Isolation.
  9. Analysis of DNA samples by gel electrophoresis.
  10. Visit to ZSI, Seashore/ National Institutes /Wildlife Sanctuary/ National Parks/ Water reservoirs
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**M.Sc. SEMESTER – I**

**PRACTICAL PAPER**

### **HCP 1.3 Cell and Molecular Biology**

1. Sub cellular fractionation of suitable material to show nucleus and mitochondria.
2. Estimation of marker enzyme – succinic dehydrogenase in mitochondrial fraction.

3. Demonstration of collagen in Liver section.
4. Metaphasic chromosome preparation of mitosis
5. Preparation /Demonstration of meiosis in Onion bud.
6. Preparation of Drosophila Culture and observe morphological Characters.
7. Polytene chromosomes from slide/photo of salivary glands of Chyromomous/ Drosophila larva.

### **SCP 1.1 Population genetics and evolution**

1. Migration influenced examples identification with pictures.
  2. Isolation influenced examples identification with pictures.
  3. Evolution influenced examples identification with pictures.
  4. Estimation of genes & genotypic frequencies in light of Hardy Weinberg law.
  5. Construction of Phylogenetic trees based on DNA and RNA.
  6. Prezygotic Isolation in some Sp. of Drosophila.
  7. Case / field studies related to population genetics and evolution and submit the report.
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### **SCP 1.2**

#### **PROTOZOOLOGY (Practical)**

1. Classification of parasitic protozoa by charts and models.
2. Planktonic protozoa
3. Study of ciliates in alimentary canal of vertebrates and invertebrates by charts and models
4. Demonstration by video: Impregnation of ciliates with dry silver nitrate for study of kinetic structure.
5. Preparation of blood smear, staining and identification of staining of Protozoans
6. Examination of fecal sample of vertebrate host for oocyst of coccidia.
7. Observation of oocysts for sporulation.
8. Study of different mosquito vectors of protozoan parasites.
9. Study of binary fission and conjugation in ciliates.

## **M.Sc. SEMISTER – II**

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**HCT2.1 Developmental Biology**

**Teaching periods60 =4credits**

**Unit 1**  
Evolution of sexual reproduction in Eukaryotes (10)

**Unit 2**  
Study of eggs, blastula, gastrula and three germ layers in Amphioxus, Frog, Chick and Mammals and process of Fertilization , Capacitation (16)

**Unit 3**  
Introduction to Organogenesis – neural tube formation in mammals (08)

**Unit 4** (12)  
Development of limbs in fishes, amphibians, reptiles, birds, and mammals.  
Genetic Regulation of limb development in chordates.

**Unit 5** (14)  
Development of Drosophila.  
Regulation of development in Drosophila. Cell apoptosis, its role in development of human limbs.

### **Suggested Reading Material**

1. Turner, C.D. and Bangara J.T. General Endocrinology
2. R.G. Edwards. Human Reproduction.
3. Austen C.R. and Short R.V. Reproduction in Animals.
4. F.T. Longo. Fertilization, Chapman & Hall.
5. Mathur, Ramesh. Embryology,.Anmol Publications .
6. Morgan, T. H. .Embryology And Genetics. Agrobios India
7. Balanski. Introduction to Embryology.
8. Developmental Biology ;Scott F Gilbert Sixth Edition, Sinaur Publications

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### **Learning outcomes**

After successfully completing the course, the students will be able to

- Develop critical understanding how a single-celled fertilized egg becomes an embryo and then a fully formed adult by going through three important processes of cell division, cell differentiation and morphogenesis.
- Understand how developmental processes and gene functions within a particular tissue or organism can provide insight into functions of other tissues and organisms.
- Realize that very similar mechanisms are used in very diverse organisms; and development is controlled through molecular changes resulting in variation in the expression and function of gene networks.
- Understand how the field of developmental biology has changed since the beginning of the 19th century with different phases of developmental research predominating at different times.
- Examine the evolutionary history of the taxa based on developmental affinities.
- Understand the relevance of developmental biology in medicine or its role in development of diseases.

**M.Sc. SEMESTER - II**  
**HCT2.2 General and Comparative endocrinology**  
**Teaching periods 60 = 4 credits**

- Unit 1** Neuroendocrine system of vertebrates and neurosecretion of invertebrates. (10)
- Unit 2** Endocrinology: General consideration. (16)
- i. Discovery of hormones.
  - ii. Classification and chemical nature of hormones.
  - iii. Experimental methods of hormone study.
  - iv. Hormones of gastrointestinal tract
- Unit 3.** Biosynthesis and mechanism of hormone secretion. (10)
- i. Biosynthesis of amino acid derivative peptide and steroid hormones.
  - ii. Hormones: Secretion, transport and degradation.
  - iii. Hormones and homeostasis.
  - iv. Hormone receptors and mechanism of hormone action.
  - v. Hormonal regulation of metabolism.
- Unit 4.** Hormone action in different facets of life. (10)
- i. Growth
  - ii. Migration and color change.
  - iii. Behavior
  - iv. A study on role of insulin in diabetes
- Unit 5** Hormones and reproduction in vertebrate( w.r.t. mammals). (14)
- a. Reproductive System: Development and differentiation of gonads, genital ducts, external genitalia, mechanism of sex differentiation.
  - b. Outline and histological of male reproductive system and female reproductive system.
  - c. Hormonal control of implantation;
  - d. Hormonal regulation of gestation, pregnancy diagnosis,
  - e. Mechanism of parturition and its hormonal regulation;
  - f. Lactation and its regulation
  - g. Causes of infertility , diagnosis and treatment .

**Suggested Reading Material**

1. E.J.W. Barrington. General and Comparative Endocrinology. Oxford, Clarendon Press.
2. Turner. C.D. General Endocrinology,
3. A. Gorbman et al. Comparative Endocrinology. John Wiley & Sons.
4. R.H. Williams. Text Book of Endocrinology. Press. Oxford, New York.
5. Turner, C.D. and Bangara J.T. General Endocrinology
- 7 .Mac E. Hadley. Endocrinology. Pearson Education.
- 8 Burch, Warner M.; Burch; Endocrinology, Lippincott Williams & Wilkins.
- 9 Felig; Endocrinology And Metabolism .McGraw-Hill ISE.
- 10 Prosser Brown. Comparative Animal Physiology. Saunders Publication.
11. Endocrinology: An integrated approach S.S. Nussey and S.A. Whitehead (NCBI ) 1999

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**Learning outcomes**

- Understand neurohormones and neurosecretions.
- Learn about hypothalamo and hypophysial axis.
- Understand about different endocrine glands and their disorders.
- Understand the mechanism of hormone action.



## Teaching periods: 60=4credits

### Unit 1.

- 1.0 Homeostasis and physiological regulations. (06)
- 1.1 Concept of homeostasis
  - 1.2 Acclimatization- acclimatization with reference to temperature, noise and toxins. adaptation

### Unit 2.

- 2.0 Physiology of stress. (14)
- 2.1 Fundamental concept of stress
  - 2.2 Causes and effects of stress.
  - 2.3 Stress, strain and fatigue.
  - 2.4 Environmental stresses (temperature, light, humidity, vibration, noise and toxins.
  - 2.5 Physiological responses to stresses.
  - 2.6 Stress management and Yoga.
  - 2.7 Man under stress.

### Unit 3.

- 3.0 Environment and Health. (10)
- 3.1 Environmental health hazards.
  - 3.2 Industrial health hazards.
  - 3.3 Occupational diseases.
  - 3.4 Man – machine and environment system.

### Unit 4.

- 4.0 Space physiology (10)

### Unit 5.

- 5.0 Blood and circulation (20)
- Blood corpuscles, haemopoiesis and formed elements,  
Comparative anatomy of heart structure, myogenic heart, specialized tissue,  
ECG – its principle and significance, cardiac cycle,  
heart as a pump, blood pressure,  
neural and chemical regulation of all above.

### Suggested Reading Material

1. Echert R. Animal Physiology: Mechanisms and Adaptations. W.H. Freeman and Company, New York.
2. Hoar W.S. General and comparative Animal Physiology, Prentice Hall of India.
3. Pummer L. Practical Biochemistry , Tata McGraw –Hill.
4. Wilson K. and Walker J. Practical Biochemistry.
5. Strand F.L. Physiology : A Regulatory System Approach. Macmillan Publishing Co. New York.
6. Wilma P.G. et al. Environmental Physiology, Blackwell Sci. Oxford, UK.
7. Frederic Martini. Fundamentals of Anatomy and Physiology. Prentice Hall.
8. Tortora. Principles of Anatomy and Physiology. Wiley Publications.
9. Ezeilo, Gabriel C. .Textbook of Physiology. Oxford University Press.

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### Learning outcomes

After successfully completing this course, the students will be able to

- Realize that very similar physiological mechanisms are used in very diverse organisms.
- Get a flavor of research by working on project besides improving their writing skills. It will further enable the students to think and interpret individually.
- Undertake research in any aspect of environmental biology and physiology in future
  
- Understand what makes the scientific study of animal ecology a crucial and exciting endeavour.
- Engage in field-based research activities to understand well the theoretical aspects taught besides learning techniques for gathering data in the field.
- Analyse a biological problem, derive testable hypotheses and then design experiments and put the tests into practice.
- Solve the environmental problems involving interaction of humans and natural systems at local or global level.

## Teaching periods 60=4 credits

### Unit I Introduction, history and scope of Helminthology (12)

1. General organization and Classification of Platyhelminthes.
2. General organization and Classification of Nematelminths
3. Cestodes (Cestodarians and Eucestodes).
4. Trematodes (Monogenea, Aspidobothria and Digenea)
5. Host – parasite Interaction

### Unit- II (12)

Geographical distribution, habitat, morphology (Structure), life cycle, pathogenicity, diagnosis, treatment and prevention of the following type.

#### **Trematode:-**

- 1) *Fasciola hepatica*
- 2) *Fasciolopsisbuski*
- 3) *Schistosomahaematobium*
- 4) *Paragonimuswestermani*

### Unit- III (12)

Geographical distribution, habitat, morphology (Structure), life cycle, pathogenicity, diagnosis, treatment and prevention of the following type.

#### **Cestode:-**

- 1) *Taenia saginata*
- 2) *Dipylidium caninum*
- 3) *Hymenolepis nana*
- 4) *Echinococcus granulosus*

### Unit- IV (12)

Geographical distribution, habitat, morphology (Structure) , life cycle, pathogenicity, diagnosis, treatment and prevention of the following type.

#### **Nematode:-**

- 1) *Ascaris lumbricoides*
- 2) *Ancylostoma duodenale*
- 3) *Wuchereria bancrofti*
- 4) *Enterobius vermicularis*

### Unit-V: Clinical Helminthology (12)

- 1) Chemicals and reagents used in preservation of parasitic materials
- 2) Collection, processing and identification of parasites,
- 3) Recovery of parasite eggs and larvae from faecal specimens
- 4) Antihelminthicdrugs

## Reference Books

1. Medical Parasitology by Markell, Voge and John, 8thed. W.B. Saunders Co.
2. The Biology of animal parasites, Cheng T.C. (1964)-Saunders International Student Edition.

3. The Invertebrates Vol II, McGraw Hill, New York.- Dawes B. (1946).
4. Text book Medical Parasitology Jaypee Brothers, - Medical Publishers, New York. - Panikar C.K.J (1988)
5. The Parasitology of Trematodes Oliver and Boyd Ltd. Edinburgh - Smyth J.D (1977)
6. Parasitology (Protozoology and Helminthology) -SoodPannik (1993) CBS Publication and Distrubution, Delhi.
7. Human helminthology Manual for Clinical, Sanitarians Medical Zoologists – Faust, EmerestCaroll.
8. SystemaHelminthum Vol. IV Monogenea and Aspidobothria - Yamaguti S. (1963) Inter- Science Publishers, London.
9. Synopsis of Digenetic Trematodes of Vertebrates - Yamaguti S. (1971) Vol. I & II Keigaku Publishing Co., Tokyo, Japan.
10. Parasitology (Protozoology and Helminthology) -Chatterjee K. D. (1969)
11. The Zoology of Tapeworm. - Wardle and Mcleod (1952)
12. The advances in the Zoology of tapeworm from Wardle and Mcleod (1952)
13. SystemaHelminthum Vol. II Cestoda. - SatyuYamaguti (1959)
14. The Physiology of Cestodes. - J.D Smyth
15. Vertebrate Nematodes - York and Mapelston

### **Learning Outcomes**

- After successfully completing this course, the students will be able to-
- Understand parasitological perspective of infection and treatment

**M.Sc. SEMESTER – II**  
**OET 2.1 Computational Biology**

**Teaching periods 60=4credits**

**Unit 1**

1.0 Measures of Central Tendency and measures of dispersion: **(12)**

1.1 Arithmetic mean, median and mode

1.2 Absolute and relative measures of dispersion:

Range and its coefficient,

Mean deviation and its coefficient,

Quartile deviation and its coefficient,

Standard deviation and its coefficient,

Coefficient of variation.

1.3 Simple Examples

**Unit 2.**

2.1 Correlation and regression (ungrouped data) : **(12)**

2.2 Concept of correlation and regression,

2.3 Methods of studying correlation

a) Scatter diagram

b) Karl Pearson's coefficient of correlation and

c) Rank correlation

2.4 Simple examples

**Unit 3.**

3.1 Probability **(10)**

3.2 Elements of Probability, classical definition of probability

3.3 Simple Examples

**Unit 4.**

4.1 Probability distributions **(12)**

4.2 Introduction to probability distribution

4.3 Definition and properties of binomial distribution and normal distribution.

4.4 Simple Examples

**Unit 5.**

5.1 Tests of simple hypothesis **(14)**

5.2 Based on normal distribution

5.3 Student's 't' test (paired, unpaired)

5.4 Chi-square tests for goodness of fit and for independence of attributes.

5.5 One way Analysis of variance

5.6 Simple Examples

### **Suggested Reading Material**

1. Sokal R.R. and F.J. Rohit. Biometry, Freeman, San Fransisco.
2. Gupta- Fundamentals of Statistics.
3. Snedecor, G.W. and W.G. Cochran, Statistical Methods, East-West Press, New Delhi.
4. Green, R.H. sampling design and statistical methods for environmental biologist. John Wiley & sons, New York.
5. Pranab Kumar Banerjee. Introduction to Biostatistics. S. Chand and Company, New Delhi-55.
6. Zar. Biostatistician Analysis. Pearson Education. Delhi.
7. Deshpande A.V. Introduction to Probablity and Statistics. VipulPrakashan.
8. Arora P.N. and Malhan P.K. Biostatistics. HimalayaPublishing House.

### **Learning Outcomes**

- After successfully completing this course, the students will be able to
- Analyse the data statsticaly and interprete the results.
- Tests simple hypothesis

## OET2.2 Research Methodology and Intellectual Property Right

Teaching periods 60 =4credits

### Unit I (10)

Collection of literature- Books - Journals. Digital library and search of articles - Key words and search - Internet – Google Scholar – Pub med – Inlibnet – Medline – Agricola – Science direct -Open access Journals - other sources. Short communications –review articles.Funding agencies UGC, DBT, DST.

### Unit II(10)

Collection of samples / data – Data analysis – Microsoft Excel – Construction of tables – headings - footer - hypothesis testing – Test of Significance – Tabulation – Presentation of results - Use of SPSS.

### Unit III(10)

Publishing of Articles in National and International Journals - Selection of Journals – ISSN Number – Peer reviewed Journals – Science citation index – impact factor and its importance. Manuscripts preparation for Journals – components – Submission and Publication – reprints and pdf formats. Paper presentation in Conferences.

### Unit IV(05)

Thesis structure –Components - Writing Introduction – review of literature – Materials & Methods – Presentation of results – Discussion of Results based on literature – Arriving conclusions – Briefing of Summary – Arrangement and how to quote reference in thesis - Appendix.

### Unit V(10)

Intellectual property rights -Introduction- Protection of intellectual property, copyright, trademark, geographical indications, trade secrets, Layout design of integrated circuits. Patent- Criteria and procedure of patenting, patenting biological material.Patent procedure inIndia.Revocation of Turmeric and Neempatent.Patenting of biological material with example and case studies.

### Reference Books

1. Anderson, Durston&Polle 1970: Thesis and assignment, writing Wiley Eastern Limited
2. G. Vijayalakshmi and C. Sivapragasam. (2008) Research Methods –Tip & Techniques, MJP Publishers, Chennai. WWW.mjppublishers.com
3. Malter K, 1972: Statistical analysis in Biology, Chapman Hall, London.
4. Kothari C. R., Research Methodology: Methods & Techniques. New Age Publ., New Delhi, 2012

### Learning Outcomes

- After successfully completing this course, the students will be able to
- Understand the research methodology and inculcate research attitude among themselves.

## **M.Sc. SEMESTER – II PRACTICAL**

### **HCP 2.1 Developmental Biology**

1. Sperm motility test and analysis.
2. Study of Different Phases of Oestrus Cycle in Rat.
3. To demonstrate acrosomal development in Rat testis by PAS method.
4. Procedure to understand embryological stages of chick up to 72hrs' by non invasive method' using CD/Model/Chart
5. To observe and interpret metamorphic stages of insect egg with help of models and submit the report.

### **HCP 2.2 General and Comparative endocrinology**

1. Study of testicular cells- Sertoli cells, Interstitial cells and sperm cells in the sections of testis.
  2. Study of ovary cells : Sections of ovaries
  3. Demonstration of pituitary cell types,
  4. Demonstration of neurosecretory cells.
  5. Bioassay of estrogen by vaginal smear technique by photos / pictures
  6. Effect of Adrenalin and Atropine Sulphates.
  7. Study of different endocrine glands of vertebrates and invertebrates.
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### **SCP 2.1 Environmental Physiology**

1. Heart perfusion and recording of cardiogram of frog by CD/Model/Virtual demonstration.
2. Estimation of rate of O<sub>2</sub> consumption by the freshwater fish.
3. Effect of Temperature on pulse rate/heart rate .
- 4: Mounting of spiracle and trachea – CD/Slide/Model
5. Effect of aflatoxins, or CCl<sub>4</sub> induced in rat liver
6. Estimation of Blood lactic Acid in frog
7. To study digestive enzyme(Amylase, Protease and lipase), by standard methods
- 8 To study effects of various Physical and chemical factors on enzyme activity and to demonstrate the protein nature of enzyme.

### **SCP 2.2 Helminthology**

- 1) Identification of trematodes from various hosts.
- 2) Identification of cestodes from various hosts.
- 3) Identification of nematodes from various hosts.
- 4) Procedure for collection, Preservation, staining and identification of trematodes.
- 5) Procedure for collection, Preservation, staining and identification of cestodes.
- 6) Procedure for collection, Preservation, staining and identification of parasitic nematodes.
- 7) Identification of helminth eggs and larval stages.
- 8) Study and use of antihelminthic drugs

### **OEP 2.1 Computational Biology**

1. Measures of central tendency.
2. Measures of dispersion.
3. Coefficient of variation.
4. Correlation coefficient and regression coefficient (Ungrouped data)
4. Problems based on classical definition of probability.
5. Example based on Chi-square test.
6. Example based on Student's t test.
7. ANOVA.



## **OEP 2.2 Research Methodology and Intellectual Property Right**

1. Preparation of project proposal for Funding agencies (UGC) and other agencies.
2. To suggest a title to the given abstract/paper.
3. Assigning legends to given graphs, figures and captions to given tables.
4. Study of proof correction symbols; proof- reading the given text and correcting the proofs.
5. Designing of tables and graphs from the given data.
6. How to write materials and methods, observation section of a research paper.
7. Write discussion section for the given discussion less research paper.
8. Citations/ References: how to find and cite references from journals, books and databases`.
9. Oral presentation: Rhythm, style, control, mock presentation for 10 minutes
10. Procedure for copyright, trademark.
11. Writing of Indian patent.