

## SEMESTER I

### UCZOA20 – INVERTEBRATA

Year	SEM	Course code	Title of the Course	Course Type	Course Category	H/W	Credits	Marks
I	I	UCZOA20	Invertebrata	Theory	Core	6	6	100

#### Objectives:

- To understand the systematic and functional morphology of various groups of Invertebrates.
- To study their economic importance, affinities and adaptations.

#### Course Outcomes:

**On completion of the course the student will be able to...**

**CO1:** Discuss general classification, binomial nomenclature and Phylum Protozoa.

**CO2:** Explain the classification up to class level, type study and salient features of Phylum Porifera and Coelenterata.

**CO3:** Elaborate the classification upto class level, type study and salient features of Phylum Platyhelminthes and Aschelminthes.

**CO4:** Discuss the classification upto class level, type study and salient features of Phylum Annelida and Arthropoda.

**CO5:** Explain the classification upto class level, type study and salient features of Phylum Mollusca and Echinodermata.

CO/PSO	PSO					
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	H	H	H	H	M	M
CO2	H	H	H	H	M	M
CO3	H	H	H	H	M	M
CO4	H	H	H	H	M	M
CO5	H	H	H	H	M	M

CO /PO	PO					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	H	H	M	H	M	H
CO2	H	H	M	H	M	H
CO3	H	H	M	H	M	H
CO4	H	H	M	H	M	H
CO5	H	H	M	H	M	H

#### Unit 1:(18 Hours)

- 1.1: General character and outline classification of Invertebrata up to class level with examples - Structure, function and life cycle of all the type studies. (K1, K2).
- 1.2: Binomial nomenclature. (K1,K2, K3)
- 1.3: Phylum – Protozoa – General characters and classification. (K1, K2, K3)
- 1.4: Type study: *Plasmodium vivax*. (K1,K2, K3)
- 1.5: General essay: Nutrition in Protozoa. (K1, K2, K3)
- 1.6: General essay: Locomotion in Protozoa. (K1, K2, K3)

#### Unit 2:(18 Hours)

- 2.1: Phylum – Porifera - General characters and classification. (K1, K2, K3)
- 2.2: Type study: Sycon. (K1, K2, K3)
- 2.3: General essay: Canal system in Sponges. (K1, K2, K3)

- 2.4: Phylum – Coelenterata - General characters and classification. (K1, K2, K3)  
2.5: Type study: Obelia. (K1, K2, K3)  
2.6: General essay: Corals and Coral Reef, Polymorphism. (K1, K2, K3)

### **Unit 3:(18 Hours)**

- 3.1: Phylum – Platyhelminthes- General characters and classification. (K1, K2, K3)  
3.2: Type study: Tapeworm. (K1, K2, K3)  
3.3: General essay: Helminth parasites in humans-*Wuchereria bancrofti*. (K1, K2, K3)  
3.4: General essay: Parasitic adaptations in Helminthes. (K1, K2, K3)  
3.5: Phylum: Aschelminthes - General characters and classification. (K1, K2, K3)  
3.6: Type study: Ascaris. (K1, K2, K3)

### **Unit 4:(18 Hours)**

- 4.1: Phylum: Annelida - General characters and classification. (K1, K2, K3)  
4.2: Type study: Nereis. (K1, K2, K3)  
4.3: General essay: Adaptive radiation in Polychaetes. (K1, K2, K3)  
4.4: Phylum: Arthropoda- General characters and classification. (K1, K2, K3)  
4.5: Type study: Prawn. (K1, K2, K3)  
4.6: General essay: Social life in Insects, Peripatus and its affinities. (K1, K2, K3)

### **Unit 5:(18 Hours)**

- 5.1; Phylum: Mollusca- General characters and classification. (K1, K2, K3)  
5.2: Type study: Freshwater Mussel. (K1, K2, K3)  
5.3: General essay: Respiration in Mollusca. (K1, K2, K3)  
5.4: Phylum: Echinodermata- General characters and classification.  
5.5: Type study: Sea star. (K1, K2, K3)  
5.6: General essay: Larval forms in Echinodermata and their significance. (K1, K2, K3)

### **Books for study and Reference:**

#### **Text Books:**

1. Ekambaranatha Ayyar M, and T.N. Ananathakrishnan- Manual of Zoology Vol. I [Invertebrata], Parts I and II – S. Viswanathan (Printers and publishers) Pvt. Ltd; Madras, 1992.
2. Jordan, E.L and P.S Verma – Invertebrate Zoology, Revised Edition – S. Chand and Co. Ltd, New Delhi, 2013.

#### **Reference Books:**

3. Kotpal, R.L. – Protozoa, Porifera, Coelenterata, Helminthes, Arthropoda, Mollusca, Echinodermata- Rastogi Publications, Meerut, 1992.
4. Parker and Haswell, - Textbook of Zoology Vol.I (Invertebrata) – B.S. Publishers and distributors, New Delhi, 1964.
5. Barrington, E.J.W. - Invertebrate Structure and Functions- English Language Book Society, 1969.
6. Hyman L.H. - The Invertebrata, Vol I to VI. – McGraw- Hill Book Co., New York, 1951.

#### **E-Resources:**

<https://www.civilserviceindia.com>  
[www.iaszoology.com](http://www.iaszoology.com)  
<http://www.insects.org>  
<http://www.earthlife.net/begin>.  
<http://faunaofindia.nic.in>

**SEMESTER II**  
**UCZOB20- CHORDATA**

Year	SEM	Course code	Title of the Course	Course Type	Course Category	H/W	Credits	Marks
I	II	UCZOB20	Chordata	Theory	Core	6	6	100

**Objectives:**

- To understand the systematic and functional morphology of various groups of Chordates.
- To study their affinities and adaptations to different modes of life.

**Course Outcomes:**

**On completion of the course the student will be able to...**

**CO1:** Explain taxonomic status of vertebrates and its origin and Evolution.

**CO2:** Describe anatomy and functions of systems in vertebrates.

**CO3:** Discuss adaptive radiations in vertebrates.

**CO4:** Explain the salient features of chordates.

**CO5:** Explain the structural, functional and phylogenetic significance of chordates.

CO/PSO	PSO					
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	H	H	H	H	H	H
CO2	H	H	H	H	H	H
CO3	H	H	M	M	M	M
CO4	H	H	M	M	M	M
CO5	H	H	M	H	M	M

CO/PO	PO					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	H	H	M	H	M	H
CO2	H	H	M	H	M	H
CO3	H	H	M	H	M	M
CO4	H	H	M	H	M	M
CO5	H	H	M	H	M	M

**Unit 1:(18 Hours)**

1.1: General character and outline classification of Chordates up to class level. (K1, K2).

1.2: Protochordata: General characters and classification. (K1, K2).

1.3: Type study: Amphioxus. (K1, K2, K3)

1.4: Affinities of cephalochordates. (K1, K2, K3)

1.5: Retrogressive Metamorphosis in Ascidia. (K1, K2, K3)

1.6: General essay: Origin of Chordates. (K1, K2, K3)

**Unit 2:Pisces (18 Hours)**

2.1: Affinities of Cyclostomata. (K1, K2, K3)

2.2: Type study: Shark. (K1, K2, K3)

2.3: General essay: Migration in Fishes. (K1, K2, K3)

2.4: Accessory respiratory organs. (K1, K2, K3)

2.5: Parental care in Fishes. (K1, K2, K3)

2.6: Electric organs. (K1, K2, K3)

### **Unit 3:Amphibia (18 Hours)**

3.1: Type study: Frog. (K1, K2, K3)

3.2: General essay: Parental care in Amphibians. (K1, K2, K3)

3.3: Adaptive radiations in Amphibians. (K1, K2, K3)

3.4: **Reptilia** - Type study: Calotes. (K1, K2, K3)

3.5: General essay: Poison apparatus and biting mechanism in snakes. (K1, K2, K3)

3.6: Identification of poisonous and non-poisonous snakes. (K1, K2, K3, K4)

### **Unit 4:Aves(18 Hours)**

4.1: Type study: Pigeon. (K1, K2, K3)

4.2: General essay: Flight adaptations in birds. (K1, K2, K3)

4.3: Migration in birds. (K1, K2, K3)

4.4: Flightless birds. (K1, K2, K3)

4.5: Beaks in birds. (K1, K2, K3)

4.6: Feet in birds. (K1, K2, K3)

### **Unit 5:Mammals (18 Hours)**

5.1: Type study: Rabbit. (K1, K2, K3)

5.2: General essay: Dentition in mammals. (K1, K2, K3)

5.3: Adaptive radiations in Mammals. (K1, K2, K3)

5.4: Characteristics of Prototheria with examples. (K1, K2, K3)

5.5: Characteristics of Eutheria with examples. (K1, K2, K3)

5.6: Characteristics of Metatheria with examples. (K1, K2, K3)

### **Books for study and Reference:**

#### **Text Books:**

1. Jordan, E.L and P.S Verma – Chordate Zoology and Elements of Animal Physiology, 10<sup>th</sup> Edition – S. Chand and Co. Ltd, Ram Nagar, New Delhi, 1995.
2. Ekambaranatha Ayyar M, and T.N. Ananathakrishnan- Manual of Zoology Vol. II [Chordata] – S. Viswanathan (Printers and publishers) Pvt. Ltd; Madras, 1992.

#### **Reference Books:**

3. Parker and Haswell, - Textbook of Zoology Vol.II (Chordata) – A.Z.T.B.S. Publishers and distributers, New Delhi, 1964.
4. Newman H.H.- The phylum Chordata- Satish Book Enterprise, Agra, 1981.
5. Modern Text Book of Zoology- Vertebrates-Revised Fourth Edition 2015-16 Rastogi Publications.
6. Kotpal R.L. – Modern Text book of Zoology, Vertebrates, 4<sup>th</sup> edition. Rastogi Publication., Meerut, 2015-16.

#### **E-Resources:**

<https://www.civilserviceindia.com>

[www.iaszoology.com](http://www.iaszoology.com)

<http://www.earthlife.net/begin>.

<http://faunaofindia.nic.in>

<https://www.birds.com>

### SEMESTER III

#### UCZOD20 - CELL BIOLOGY AND BIOINSTRUMENTATION

Year	SEM	Course code	Title of the Course	Course Type	Course Category	H/W	Credits	Marks
II	III	UCZOD20	Cell Biology and Bioinstrumentation.	Theory	Core	7	6	100

**Objectives:**

- To learn the structure and function of various cellular components.
- To learn the basic principle, working and application of instruments.

**Course Outcomes:**

**On completion of the course the student will be able to...**

**CO1:** Recall the cell theory, Distinguish between Prokaryotes and Eukaryotes.

**CO2:** Summarize the structure and functions of Cell Organelles.

**CO3:** Explain the structure and function of Nucleic acids.

**CO4:** Discuss the construction and applications of Microscopes, Centrifuges and Homogenizers.

**CO5:** Describe the types and applications of Chromatography and Electrophoresis.

CO/PSO	PSO					
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	H	H	M	M	L	L
CO2	H	H	H	M	L	M
CO3	H	H	H	M	L	L
CO4	H	H	H	H	L	H
CO5	H	H	H	H	L	H

CO/PO	PO					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	H	H	H	M	M	L
CO2	H	M	H	L	M	H
CO3	H	H	H	L	M	L
CO4	H	H	H	L	M	H
CO5	H	H	H	L	M	H

**Unit 1: Cell Biology:(21 Hours)**

- 1.1: Introduction to cell biology. (K1, K2)
- 1.2: Brief account on cell theory. (K1, K2)
- 1.3: Prokaryotes – PPLO. (K1, K2)
- 1.4: Eukaryotes- animal cell (Structure and Comparison). (K1, K2, K3)
- 1.5: Cell cycle. Cell division- Mitosis - Meiosis. (K1, K2, K3)
- 1.6: Structure and functions of Cell organelles - Cell membrane. (K1, K2, K3)

**Unit 2:(21 Hours)**

- 2.1: Structure and functions of Cell organelles - Mitochondria, Golgi complex. (K1, K2, K3, K4)
- 2.2: Structure and functions of Cell organelles- Endoplasmic reticulum, Ribosomes. (K1, K2, K3, K4)
- 2.3: Structure and functions of Cell organelles- Lysosome and Centriole. (K1, K2, K3, K4)
- 2.4: Structure and functions of Cell organelles- Nucleus and Nucleolus. (K1, K2, K3, K4)
- 2.5: Structure and functions of Cell organelles -Chromosomes. (K1, K2, K3, K4)
- 2.6: Structure and functions of Cell organelles -Giant Chromosomes-Polytene-Lamp brush chromosome. (K1, K2, K3, K4)

**Unit 3:(21 Hours)**

- 3.1: Nucleic acids: DNA- Ultra structure. (K1, K2, K3, K4)
- 3.2: DNA Replication. (K1, K2, K3, K4)
- 3.3: RNA – Structure and types. (K1, K2, K3, K4)
- 3.4: Genetic code. (K1, K2, K3, K4)
- 3.5: Protein synthesis. (K1, K2, K3, K4)
- 3.6: Gene regulation - Lac operon. (K1, K2, K3, K4)

**Unit 4: Bioinstrumentation:(21 Hours)**

- 4.1: Principle, construction and application of– Compound microscope. (K1, K2, K3)
- 4.2: Principle, construction and application of– Inverted Microscope. (K1, K2, K3)
- 4.3: Principle, construction and application of– TEM. (K1, K2, K3)
- 4.4: Principle, construction and application of– SEM. (K1, K2, K3)
- 4.5: Principle, construction and application of– Centrifuge-Ultracentrifuge- Differential centrifugation. (K1, K2, K3)
- 4.6: Cell Homogenization – Fractionation. (K1, K2, K3)

**Unit 5:(21 Hours)**

- 5.1: Chromatography – Paper. (K1, K2, K3)
- 5.2: Thin layer and Column. (K1, K2, K3)
- 5.3: HPLC. (K1, K2, K3, K4)
- 5.4: Electrophoresis – SDS PAGE Gel electrophoresis. (K1, K2, K3, K4)
- 5.5: Disc-gel electrophoresis. (K1, K2, K3, K4)
- 5.6: Immuno-electrophoresis. (K1, K2, K3)

**Books for study and reference:****Textbooks:**

- 1. Verma P.S. and V.K. Agarwal – Cytology - Chand and Co., New Delhi, Revised Edition, 2015
- 2. M. Prakash, C.K. Arora - Microscopical Methods - Anmol Publications Pvt. Ltd., First Edition 1998.

**Reference Books:**

- 3. Philip Sheeler, Donald E. Bianchi - Cell and Molecular Biology - John Wiley and Sons, Inc, 3<sup>rd</sup> Edition, 1987.
- 4. E.D.P.De Robertis, E.M.F.De Robertis Jr. - Cell and Molecular Biology – Indian Edition, B.I. Publications Pvt. Ltd. 8<sup>th</sup> Ed. 2005
- 5. Bruce Alberts, Julian Lewis- Molecular Biology of the Cell- Taylor and Francis 5<sup>th</sup> Edition, 2008
- 6. A.G.E. Pearse - Histochemistry, Theoretical and Applied, Volume One: Preparative and Optical Technology - Churchill Livingstone, 4<sup>th</sup> Edition 1980.
- 7. M. Prakash, C.K. Arora - Laboratory Instrumentation - Anmol Publications Pvt. Ltd. First edition, 1998.

**E-Resources:**

- <https://www.britannica.com>
- <https://www.microscopemaster.com>
- <https://www.ascb.org>
- <http://www.ibiblio.org/virtualcell/index.htm>

## SEMESTER IV

### UCZOE20 – GENETICS AND EVOLUTION

Year	SEM	Course code	Title of the Course	Course Type	Course Category	H/W	Credits	Marks
II	IV	UCZOE20	Genetics and Evolution	Theory	Core	5	4	100

#### Objectives:

- To learn the basics of Genes, heredity and variations.
- To learn the evolution of life and speciation.

#### Course Outcomes:

**On completion of the course the student will be able to...**

**CO1:** Demonstrate the Mendelian inheritance. Understand the genetic interactions.

**CO2:** Discuss Linkage, Crossing over, cytoplasmic inheritance and sex determination.

**CO3:** Analyze the types of Gene Mutation, Chromosomal aberrations, syndromes and inborn errors in metabolism.

**CO4:** Explain Population Genetics

**CO5:** Recall the theories of Evolution, adaptations and human evolution.

CO/PSO	PSO					
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	H	H	L	M	M	L
CO2	H	H	L	L	L	L
CO3	H	H	L	M	M	M
CO4	H	H	L	M	L	L
CO5	H	H	L	L	M	L

CO/PO	PO					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	H	H	H	M	H	L
CO2	H	H	H	H	M	L
CO3	H	H	H	M	M	M
CO4	H	H	H	H	M	L
CO5	H	H	H	H	H	M

#### Unit 1: Genetics: (15 Hours.)

1.1: Mendel's work. (K1, K2, K3)

1.2: Monohybrid cross and modifications of ratio. (K1, K2, K3)

1.3: Law of segregation. Law of independent assortment. (K1, K2, K3)

1.4: Dihybrid cross and modifications of ratio. (K1, K2, K3)

1.5: Genetic interactions- Epistasis, duplicate gene, complementary gene, atavism. (K1, K2, K3, K4)

1.6: Multiple alleles, blood grouping in man. (K1, K2, K3, K4)

#### Unit 2: (15 Hours)

2.1: Linkage and Crossing over. (K1, K2, K3, K4)

2.2: Sex linkage. (K1, K2, K3, K4)

2.3: Sex limited genes and sex influenced genes in Man. (K1, K2, K3, K4)

2.4: Cytoplasmic inheritance in Snail and Paramecium. (K1, K2, K3)

2.5: Non-disjunction and Gynandromorphs. (K1, K2, K3, K4)

2.6: Sex determination - Genic balance theory, theory of heterogenesis and environmental factors. (K1, K2, K3)

**Unit 3:(15 Hours)**

3.1: Gene mutation. (K1, K2, K3, K4)

3.2: Chromosomal aberrations. (K1, K2, K3, K4)

3.3: Genetic disorders – Chromosomal – Autosomal – Down Syndrome. (K1, K2, K3, K4)

3.4: Sex chromosomal – Turner’s and Klinefelter’s Syndrome. (K1, K2, K3, K4)

3.5: Inborn errors in Metabolism - Phenyl alanine metabolism. (K1, K2, K3, K4)

3.6: Genetic counseling. (K1, K2, K3, K4)

**Unit 4:(15 Hours)**

4.1: Gene Pool. (K1, K2, K3, K4)

4.2: Applied genetics: Population genetics. (K1, K2, K3, K4)

4.3: Hardy Weinberg Law. (K1, K2, K3)

4.4: Gene frequency, Factors affecting gene Frequency. (K1, K2, K3)

4.5: Pedigree Analysis. (K1, K2, K3, K4)

4.6: Eugenics, Euthenics and Euphenics. (K1, K2, K3)

**Unit 5: Evolution:(15 Hours)**

5.1: Theories of Evolution – Lamark. (K1, K2, K3)

5.2: Theories of Evolution - Darwin. (K1, K2, K3)

5.3: Mimicry. (K1, K2, K3)

5.4: Isolation and Speciation. (K1, K2, K3)

5.5: Evolution of Man. (K1, K2, K3)

5.6: Geological time. (K1, K2, K3)

**Books for Study and Reference:**

**Textbooks:**

1. Verma P.S. and V.K.Agarwal – Genetics - Chand and Co., New Delhi, 2006
2. Gopalakrishnan T.S. - Itta Sambasivaiah and A.P.Kamalakara Rao – Introduction to Genetics - Himalaya Publishing House, Bombay, 1996.

**Reference Books:**

3. Gardner - Principles of Genetics - Wiley Eastern Pvt. Ltd., 8<sup>th</sup> Edition, 2013.
4. Benjamin Lewin - Genes VII- Oxford University Press, 2000.
5. Philip Sheeler, Donald E. Bianchi - Cell and Molecular Biology - John Wiley and Sons, Inc, 3<sup>rd</sup> Edition, 1987.
6. E.D.P.De Robertis, E.M.F.De Robertis Jr. - Cell and Molecular Biology - Lea and Febiger, 2005.
7. T.S Gopalakrishnan, Itta Sambasivaiah, A P Kamalakara Rao -Principles of Organic evolution- Pearl Publications, 1983.
8. Kavitha- Organic Evolution - A.I.T.B.S Publishers India, 2009.
9. N. Arumugam - Organic Evolution - Saras Publications, 2005.
10. Bernard Wood- Human Evolution- A very short Introduction, Oxford University Press, 2005.

**E-Resources:**

<https://ghr.nlm.nih.gov>

<https://www.genetics.org>

<https://ncse.ngo>

<http://www.evolutionoftheweb.com>

<https://evolution.berkeley.edu/evolibrary/home.php>



## SEMESTER V

### UCZOG20 - DEVELOPMENTAL BIOLOGY

Year	SEM	Course code	Title of the Course	Course Type	Course Category	H/W	Credits	Marks
III	V	UCZOG20	Developmental Biology	Theory	Core	5	5	100

#### Objectives:

- To study the process of development from germ cell to individual.
- To study the recent advancements in the reproductive biology.

#### Course Outcomes:

**On completion of the course the student will be able to...**

**CO1:** Discuss gametogenesis and types of eggs and egg membranes.

**CO2:** Explain the mechanism and physiology of Fertilization, parthenogenesis and cleavage.

**CO3:** Explain gastrulation and organogenesis in mammals.

**CO4:** Discuss human reproduction

**CO5:** Discuss Assisted Reproductive Technologies.

CO/PSO	PSO					
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	H	H	L	M	L	L
CO2	H	H	L	M	L	L
CO3	H	H	L	M	L	L
CO4	H	H	L	M	L	L
CO5	H	H	H	H	H	L

CO/PO	PO					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	H	M	H	M	L	M
CO2	H	M	H	M	L	M
CO3	H	M	H	M	L	M
CO4	H	M	H	M	L	M
CO5	H	M	H	L	M	M

#### Unit 1:(15 Hours)

1.1: Introduction and history of Developmental Biology. (K1, K2, K3)

1.2: Spermatogenesis. (K1, K2, K3)

1.3: Oogenesis. (K1, K2, K3)

1.4: Eggs-Types of eggs. (K1, K2, K3)

1.5: Polarity and symmetry of eggs. (K1, K2, K3)

1.6: Egg membranes- Extra embryonic membranes in Chick. (K1, K2, K3)

#### Unit 2:(15 Hours)

2.1: Fertilization – Mechanism. (K1, K2, K3)

2.2: Physiology of Fertilization. (K1, K2, K3)

2.3: Theories of Fertilization. (K1, K2, K3)

2.4: Experimental works of Spemann and Mangold. (K1, K2, K3)

2.5: Parthenogenesis. (K1, K2, K3)

2.6: Cleavage. (K1, K2, K3)

**Unit 3:(15 Hours)**

- 3.1: Fate map. (K1, K2, K3,K4)
- 3.2: Morphogenetic movements and Gastrulation in Mammals. (K1, K2, K3)
- 3.3: Organogenesis in Mammal – Development of eye. (K1, K2, K3)
- 3.4: Development of Ear. (K1, K2, K3)
- 3.5: Development of Brain. (K1, K2, K3)
- 3.6: Development of Heart. (K1, K2, K3)

**Unit 4:(15 Hours)**

- 4.1: Human reproduction - Puberty, Menstrual cycle and Menopause. (K1, K2, K3)
- 4.2: Classification of Placenta. (K1, K2, K3)
- 4.3: Placenta in Mammals. (K1, K2, K3)
- 4.4: Hormonal changes in pregnancy. (K1, K2, K3)
- 4.5: Parturition and Lactation. (K1, K2, K3)
- 4.6: Contraception- Merits- Demerits. (K1, K2, K3)

**Unit 5:(15 Hours)**

- 5.1: Assisted Reproductive Technology. (K1, K2, K3, K4)
- 5.2: Super Ovulation. Artificial insemination. (K1, K2, K3, K4)
- 5.3: Cryopreservation. (K1, K2, K3, K4)
- 5.4: In Vitro Fertilization (IVF), Test tube babies, Embryo transfer. (K1, K2, K3, K4)
- 5.5: Amniocentesis. (K1, K2, K3, K4)
- 5.6: Bio ethics. (K1, K2, K3, K4)

**Books for Reference:****Textbooks:**

1. P.S.Verma, V.K. Agarwal and Tyagi - Chordate Embryology, S.Chand and Co.,New Delhi 2007.
2. Arumugam N. - Developmental Biology- Saras Publication-15<sup>th</sup> edition 2014.

**Reference Books:**

3. Balinsky B.L - Introduction to Embryology, 5<sup>th</sup> Edition. First Indian, Reprint 2012.
4. Mohan P.Arora –Embryology- Himalaya Publishing House, 2011.
5. Veer Bala Rastogi, Jayaraj- Developmental Biology,2<sup>nd</sup> Edition, Kedar Nath Ram Nath. 1994.
6. Robert S. Mcewen- Vertebrate Embryology, 4<sup>th</sup> Edition, Oxford & IBH Publishing Co. 1949.
7. Bradley M.Patten, Bruce M. Carlson-Foundations of Embryology, 3<sup>rd</sup> Edition. Tata McGraw Hill Publishing Company Ltd. 1977.

**E-Resources:**

- <https://www.sdbonline.org>
- <https://embryology.med.unsw.edu.au>
- <http://www.embryology.ch>
- <https://human-embryology.org>

**SEMESTER V**  
**UCZOH20 – PHYSIOLOGY**

Year	SEM	Course code	Title of the Course	Course Type	Course Category	H/W	Credits	Marks
III	V	UCZOH20	Physiology	Theory	Core	4	4	100

**Objectives:**

- To understand and appreciate the structure and function of organ systems.
- To study the basic physiological processes that supports life.

**Course Outcomes:**

**On completion of the course the student will be able to...**

**CO1:** Interpret digestion and metabolism.

**CO2:** Analyse the interaction between circulatory system and respiratory system.

**CO3:** Analyse the function of excretory system and illustrate muscle contraction.

**CO4:** Illustrate the structure and function of nervous system.

**CO5:** Compare the structure and function of endocrine system.

CO/PSO	PSO					
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	H	H	L	M	M	L
CO2	H	H	L	M	M	L
CO3	H	H	L	M	M	L
CO4	H	H	L	M	M	L
CO5	H	H	L	M	M	L

CO/PO	PO					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	H	H	H	L	M	H
CO2	H	H	H	L	M	H
CO3	H	H	H	L	M	H
CO4	H	H	H	L	M	H
CO5	H	H	H	L	M	H

**Unit 1:**

**(12 Hours)**

- 1.1: Introduction to Physiology.(K1, K2, K3)
- 1.2: Digestion- digestive system of man.(K1, K2, K3)
- 1.3: Process of digestion –absorption.(K1, K2, K3)
- 1.4: Metabolism of carbohydrate.(K1, K2, K3, K4)
- 1.5: Metabolism of protein.(K1, K2, K3, K4)
- 1.6: Metabolism of lipids. (K1, K2, K3, K4)

**Unit 2:**

**(12 Hours)**

- 2.1: Circulation - structure and function of heart.(K1, K2, K3)
- 2.2: Cardiac cycle-Cardiac rhythm- factors affecting it.(K1, K2, K3)
- 2.3: Properties of cardiac muscles.(K1, K2, K3)
- 2.4: Respiration – Respiratory system of man.(K1, K2, K3)
- 2.5: Mechanism of gaseous exchange.(K1, K2, K3)
- 2.6: Role of hemoglobin in respiration. (K1, K2, K3)

**Unit 3:****(12 Hours)**

- 3.1: Excretion -Structure of kidney and Nephron.(K1, K2, K3)
- 3.2: Physiology of urine formation. Hormonal regulation- urine formation. (K1, K2, K3)
- 3.3: Osmo- Iono regulation in man.(K1, K2, K3)
- 3.4: Muscles-Types of muscles.(K1, K2, K3)
- 3.5:Ultrastructure of skeletal muscle-composition.(K1, K2, K3)
- 3.6: Contraction – theories of contraction.(K1, K2, K3)

**Unit 4:****(12 Hours)**

- 4.1: Nervous system –Components of CNS.(K1, K2, K3)
- 4.2: Structure of human brain.(K1, K2, K3)
- 4.3: Structure of neuron, nerve impulse.(K1, K2, K3)
- 4.4: Synaptic transmission, neurotransmitters.(K1, K2, K3, K4)
- 4.5: Physiology of vision.(K1, K2, K3)
- 4.6: Physiology of hearing.(K1, K2, K3)

**Unit5:(12 Hours)**

- 5.1: Endocrine system- Hypothalamus. (K1, K2, K3)
- 5.2: Structure and function of pituitary gland.(K1, K2, K3)
- 5.3:Structure and function of thyroid gland.(K1, K2, K3)
- 5.4: Structure and function of adrenal gland.(K1, K2, K3)
- 5.5:Structure and function of pancreas.(K1, K2, K3)
- 5.6: Sex hormones – estrogen and testosterone.(K1, K2, K3)

**Books for Study and Reference:****Text Books:**

1. P.S Verma, B.S Tyagi and VK. Agarwal- Animal Physiology -S.Chand and Co., Ltd, New Delhi, 1990.
2. Parameswaran, Anantakrishnan and Ananta subramanian - Outlines of Animal Physiology - S. Viswanathan (Printers and Publishers) Pvt. Ltd., 1975.
3. N. Arumugam and A MariakuttikanSaras Publication; 12th edition , January 2019.

**Reference Book:**

4. Sambasivaiah, Kamalakara Rao and Augustine Chellappa - A Textbook of Animal Physiology and Ecology - S.Chand and Co., Ltd, New Delhi, 1990.
5. William S.Hoar - General and Comparative Physiology - Prentice Hall of India Pvt., Ltd., New Delhi, 1976.
6. Wood D.W. - Principles of Animal Physiology, 3<sup>rd</sup> Edition, 1983.
7. Prosser C.L. - Comparative Animal Physiology - Satish Book Enterprise, Agra, 1985.

**E-Resources:**

<https://www.physoc.org/exPSOre-physiology>  
<https://www.physiology.org>  
<https://www.innerbody.com/htm>

**SEMESTER V**

**UCZOI20 – BIOSTATISTICS**

Year	SEM	Course code	Title of the Course	Course Type	Course Category	H/W	Credits	Marks
III	V	UCZOI20	Biostatistics	Theory	Core	4	4	100

**Objectives:**

- To understand the basic concepts and application of biostatistics
- To understand the application of biostatistics in research findings

**Course Outcomes:**

**On completion of the course the student will be able to...**

**CO1:** Identify and collect different types of data and select samples for biological studies

**CO2:** Classify and tabulate the data and present them diagrammatically and graphically

**CO3:** Discuss theoretical distribution. Compute mean, median and mode.

**CO4:** Explain and compute measures of dispersion.

**CO5:** Compute t-test; F-test; Chi square test for biological studies.

CO/PSO	PSO					
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	L	H	M	H	L	L
CO2	L	H	H	H	L	M
CO3	L	H	H	H	L	L
CO4	L	H	H	H	L	L
CO5	L	H	H	H	L	L

CO/PO	PO					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	H	H	H	M	M	H
CO2	H	H	H	L	M	M
CO3	H	H	H	L	M	M
CO4	H	H	H	L	M	L
CO5	H	H	H	M	M	L

**Unit 1:(12 Hours)**

1.1: Biostatistics- Introduction, Definition and Scope. (K1, K2, K3)

1.2: Data Types of data- Raw data, Primary data, Secondary data. (K1, K2, K3)

1.3: Methods of collection of data. (K1, K2, K3, K4)

1.4: Constants and Variables - Discrete variables and continuous variables. (K1, K2, K3)

1.5: Sample- Need for sampling – Advantages and Disadvantages. (K1, K2, K3)

1.6: Methods of Sampling. (K1, K2, K3, K4)

**Unit 2:  
Hours)**

**(12**

2.1: Classification of Data- Types of Classification- Quantitative, Qualitative, Geographical, Chronological. (K1, K2, K3)

2.2: Tabulation- Components of Table. (K1, K2, K3)

2.3: Types of Tabulation- Simple, Complex, General and Special Purpose. (K1, K2, K3)

2.4: Diagrams- Types- Line, Pie, Bar simple, subdivided, multiple, percentage bar diagrams. (K1, K2, K3, K4)

2.5: Graphs- Types- Graph of time series- Line, Range Chart, Band Graph. (K1, K2, K3, K4)

2.6: Graph of frequency distribution- Histogram, Polygon, Cumulative frequency curve, Ogive. (K1, K2, K3, K4)

### **Unit 3: (12 Hours)**

3.1: Theoretical (Frequency) distribution. Normal, Poisson and Binomial. (K1, K2, K3)

3.2: Measures of Central Tendency: Simple Arithmetic Mean, Median, Mode. (K1, K2, K3)

3.3: Mean-Individual and Grouped Observation, Discrete series. (K1, K2, K3, K4)

3.4: Mean-Continuous series. (K1, K2, K3, K4)

3.5: Median - Individual and Grouped Observation- Discrete series, Continuous series. (K1, K2, K3, K4)

3.6: Mode Individual Observation, Continuous series. (K1, K2, K3, K4)

### **Unit 4:(12 Hours)**

4.1: Dispersion- Measures of Dispersion- Absolute and Relative measures of dispersion. (K1, K2, K3)

4.2: Methods of measuring Dispersion. (K1, K2, K3, K4)

4.3: Mean Deviation- Individual and Grouped Observation, Discrete series, Continuous series. (K1, K2, K3, K4)

4.4: Standard Deviation - Individual and Grouped Observation-Discrete series.(K1, K2, K3, K4)

4.5: Standard Deviation - Continuous series. (K1, K2, K3, K4)

4.6: Standard Error -Coefficient of Variation. (K1, K2, K3, K4)

### **Unit 5:(12 Hours)**

5.1: Hypothesis Testing Test for significance Small and Large samples. (K1, K2, K3)

5.2: Student's t test - Test for Significance of Means of Sample. (K1, K2, K3, K4)

5.3: Test for Significance of Difference between Two Sample mean. (K1, K2, K3, K4)

5.4: The Variance Ratio- F test (K1, K2, K3, K4)

5.5: Chi Square test and its significance. (K1, K2, K3, K4)

5.6: Contingency table – degree of freedom. (K1, K2, K3)

### **Books for Study and Reference:**

#### **Textbooks:**

1. Palanichamy, S., Manoharan, M., Statistical Methods for Biologists, Palani Paramount Publications, 1999.

2. Gurumani, N., An Introduction to Biostatistics –N. 2<sup>nd</sup> edition. MJP Publishers, Chennai, 2008.

#### **Reference Books:**

3. Alwin, E. Lewis, Biostatistics, East West Press, 1971.

4. Visweswara Rao K –Biostatistics- Jaypee Publication New Delhi 1996.

5. Rangaswamy, R. A Textbook of Agricultural Statistics New Age International Publishers Ltd., Wiley Eastern Ltd, 1995. .

6. Das, NG., Statistical Methods (Vol. II), Tata McGraw-Hill Publishing Company Ltd., 2009.

7. Pranab Kumar Banerjee, - Introduction to Biostatistics, S. Chand Revised Edition. 2015.

8. Bernard Rosner - Fundamentals of Biostatistics 5th edition – Duxbury Thomson Learning, USA 2000.

9. Clifford Blair R., Richard A. Taylor -Biostatistics for the Health Sciences – (Indian edition) Dorling Kindersley India Pvt. Ltd., New Delhi 2009.

#### **E-Resources:**

<https://www.biostat.washington.edu>

<https://www.statistics.com>

**SEMESTER V  
SKILL-BASED ELECTIVE**

**USZOE520 -ORNAMENTAL FISH KEEPING**

Year	SEM	Course code	Title of the Course	Course Type	Course Category	H/W	Credits	Marks
III	V	USZOE520	Ornamental Fish Keeping	Theory	Core Elective	2	2	100

**Objectives:**

- To learn about the rearing techniques in fish keeping
- To motivate for self-employment

**Course Outcomes:**

**On completion of the course the student will be able to...**

**CO1:** Discuss the importance, design and maintenance of an aquarium.

**CO2:** Explain the aquarium plants and usage of various accessories required for an aquarium.

**CO3:** Discuss the feed requirement, formulation and various live bearing fishes.

**CO4:** Differentiate the Egg laying fishes, marine fishes and other organisms in an aquarium.

**CO5:** Attain understanding on loan availability and export potential.

CO/PSO	PSO					
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	H	H	H	H	M	H
CO2	H	H	M	H	M	M
CO3	H	M	H	H	H	H
CO4	H	H	H	H	H	M
CO5	M	H	M	M	H	M

CO/PO	PO					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	H	H	H	M	M	H
CO2	H	H	H	M	M	H
CO3	H	H	H	M	M	H
CO4	H	H	H	M	M	H
CO5	H	H	H	M	M	H

**Unit 1:(6 Hours)**

1.1: Construction of home aquarium: Materials used- wooden and metal frames. (K1, K2, K3)

1.2: Frameless tanks- Sealants and gums. (K1, K2, K3)

1.3: Design and construction of aquarium tank. (K1, K2, K3)

1.4: Accessories used in aquarium tanks- aerators, filters. (K1, K2, K3)

1.5: Heaters, thermostat, hand nets. (K1, K2, K3)

1.6: Gravel/pebble - objects. (K1, K2, K3)

**Unit 2:(6 Hours)**

2.1: Aquarium plants. (K1, K2, K3)

2.2: Nutritional requirements. (K1, K2, K3)

- 2.3: Kinds of feed - live feeds - artificial feed. (K1, K2, K3)
- 2.4: Feed formulation - balanced diet. (K1, K2, K3, K4)
- 2.5: Culture of live food organisms - Chironomous, mosquito larva, tubifex. (K1, K2, K3)
- 2.6: Problems of over feeding. (K1, K2, K3)

### **Unit 3:(6 Hours)**

- 3.1: Popular ornamental fish - live bearers - Red sword tail. (K1, K2, K3)
- 3.2: Guppy, Molly. (K1, K2, K3)
- 3.3: Egg layers - Gold fish, Siamese fighting fish, Gowrami. (K1, K2, K3)
- 3.4: Angel fish, Oscar. (K1, K2, K3)
- 3.5: Neon tetra, Discus. (K1, K2, K3)
- 3.6: Fish handling. (K1, K2, K3)

### **Unit 4:(6 Hours)**

- 4.1: Aquarium maintenance - water quality-pH. (K1, K2, K3, K4)
- 4.2: O<sub>2</sub>, CO<sub>2</sub>, hardness. (K1, K2, K3)
- 4.3: Ammonia, Nitrite and Nitrate. (K1, K2, K3)
- 4.4: Common diseases - diagnosis – treatment. (K1, K2, K3)
- 4.5: Common marine fish - Anemone fish, Butterfly fish. (K1, K2, K3)
- 4.6: Other marine organism. (K1, K2, K3)

### **Unit 5:(6 Hours)**

- 5.1: Budget for commercial scale. (K1, K2, K3)
- 5.2: Loan availability. (K1, K2, K3)
- 5.3: Credit policies. (K(K1, K2, K3)1, K2, K3)
- 5.4: Export potentials. (K1, K2, K3)
- 5.5: Value addition in ornamental fish culture. (K1, K2, K3)
- 5.6: Transportation. (K1, K2, K3)

### **Books for Study and Reference:**

#### **Textbooks:**

1. K.V. Jayashree, C.B. Thara Devi, N. Arumugam, Home Aquarium and Ornamental Fish Culture, Saras Publication,2015.
2. Dick Mills- Tropical aquarium fishes, Salamander Books Ltd, London, 1982.
3. J.D.Jameson and R.Santhanam- Manual of ornamental fishes and farming technologies- Fisheries College and Research Institute TANVASU, Tuticorin, 1996.

#### **Reference Books:**

4. R. Santhanakumar *et al.*, - Manual of fresh water ornamental fish culture, Dept. of Fisheries extension, Fisheries College and research institute TANVASU, Tuticorin, 2004.
5. V.K.Venkataraman *et al.*, - Biodiversity and stock assessment of marine ornamental fishes. Dept. of Fisheries biology and capture fisheries, Fisheries College and Research Institute TANVASU, Tuticorin, 2004.

#### **E-Resources:**

- <http://www.cifa.nic.in>
- <http://agritech.tnau.ac.in>
- <http://aquaculturetraining.com.au>
- <http://www.oftri.org>



