

# **B.Sc. ZOOLOGY**

## **Course Structure and Syllabus**

(For the candidates admitted from the academic year 2023-2024 onwards)

**CHOICE BASED CREDIT SYSTEM- LEARNING OUTCOMES BASED  
CURRICULUM FRAME WORK (CBCS-LOCF)**



**THANTHAI HANS ROEVER COLLEGE (AUTONOMOUS)**  
**(Nationally Re-Accredited by NAAC with B<sup>++</sup>)**  
**(Affiliated to Bharathidasan University, Tiruchirappalli)**  
**ELAMBALUR, PERAMBALUR – 621 220**



## **Vision**

- To impart a sound knowledge on faunal Biology to meet the global challenges
- To provide an opportunity for the first generation learners to get a basic understanding of Animal Science and prepare them for either higher studies and self-employment
- Achieve excellence through teaching and learning
- Envisions inculcating the highest values of life, science education, respect for nature and concern for ethical values among students through good and scientific educational practices.

## **Mission**

- To develop entrepreneurial skills in applied Biological Sciences
- To facilitate students to meet the expanding job opportunities
- To create clean, green awareness
- The Department caters the need for the students from rural and backward area of Perambalur and also for others; making them a very good asset for society.
- To impart a global perspective and such skills among students that benefit humanity

## **Programme Outcomes (POs)**

1. Acquire knowledge, understand concepts and apply new ideas which enable them to be employable or self employed
2. Demonstrate motivation in advancing to higher learning programmes
3. Engage in socially responsible behaviour and have value-added education
4. Have exposure to technical proficiency, analytical capability, soft skills and life skills development
5. Develop broad understanding in the basic concepts of Languages/Commerce/Management Studies/Physical Sciences Computing Sciences Biological Sciences/Life Sciences

## **Program Specific Outcomes (PSOs)**

### **On successful completion of this programme, students will able to:**

1. Develop a broad fundamental knowledge of the fauna.
2. Understand the applications of biological sciences in Aquaculture, Apiculture, Sericulture, Vermiculture, Poultry farming and Insect pest management, their by impart skill as well as source of additional income and self –employment.
3. Able to comprehend and apply accurately and creatively understand the principles of taxonomy and its applications.
4. Able to understand the nature of science applications in daily life.
5. Create platform for higher studies in Zoology and facilitate students to take-up successful career in Zoology.

**Thanthai Hans Roever College (Autonomous), Elambalur, Perambalur - 621 220**

**B.Sc. Zoology**

**CHOICE BASED CREDIT SYSTEM–LEARNING OUTCOMES BASED CURRICULUM FRAME  
WORK (CBCS- LOCF)**

**(For the candidates admitted from the academic year 2023 - 2024 onwards)**

Semester	Part	Course Code	Title of the Course	Ins. Hours/ Weeks	Credits	Exam Hours	CIA (Max)	ESE (Max)	Total (Max)
1	I	23UT1/H1/F1	Language -I	6	3	3	25	75	100
1	II	23UE1	English- I	6	3	3	25	75	100
1	III	23UZO1CC1	Invertebrata	5	5	3	25	75	100
1	III	23UZO1CC2P	Laboratory Course –I (Invertebrata)	3	3	3	40	60	100
1	III	23UBO1AC1	Allied Botany I	5	4	3	25	75	100
1	III	23UBO2AP1	Allied Laboratory Course- I	3	--	--	--	--	--
I	IV	23UZO1SE1	NME- I	2	2	3	25	75	100
			Value Added Course*		2*	2	50	50	100*
<b>Total</b>				<b>30</b>	<b>20</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>600</b>
2	I	23UT2/H2/F2	Language -II	6	3	3	25	75	100
2	II	23UE2	English-II	6	3	3	25	75	100
2	III	23UZO2CC3	Chordata	5	5	3	25	75	100
2	III	23UZO2CC4P	Laboratory Course –II (Chordata)	3	3	3	40	60	100
2	III	23UBO2AC2	Allied Botany II	3	3	3	25	75	100
	III	23UBO2AP1	Allied Laboratory Course- I	3	2	3	40	60	100
2	IV	23UZO2SE2	NME- II	2	2	3	25	75	100
2	IV	23UZO2SE3	Human Reproductive Biology	2	2	3	25	75	100
			Value Added Course*		2*	2	50	50	100*
<b>Total</b>				<b>30</b>	<b>23</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>800</b>
3	I	23UT3/H3/F3	Language - III	6	3	3	25	75	100
3	II	23UE3	English-III	6	3	3	25	75	100
3	III	23UZO3CC5	Cell Biology	4	4	3	25	75	100
3	III	23UZO3CC6P	Cell Biology Laboratory Course- III	3	3	3	40	60	100
3	III	23UCH3AC3	Allied Chemistry I	4	3	3	25	75	100
3	III	23UCH4AP2	Allied Chemistry Laboratory Course- II	2	--	--	--	--	--
3	IV	23UZO3SE4	Biocomposting for Entrepreneurship	2	2	3	25	75	100
3	IV	23UZO3SE5	Economic Zoology	2	2	3	25	75	100
3	IV	23UGS	Gender Studies	1	1	3	25	75	100
			Value Added Course*		2*	2	50	50	100*
<b>Total</b>				<b>30</b>	<b>21</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>800</b>

4	I	23UT4/H4/F4	Language - IV	6	3	3	25	75	100
4	II	23UE4	English-IV	6	3	3	25	75	100
4	III	23UZO4CC7	Genetics	5	5	3	25	75	100
4	III	23UZO4CC8P	Genetics Laboratory Course- IV	3	3	3	40	60	100
4	III	23UZO4AC4	Allied Chemistry II	4	4	3	25	75	100
	III	23UCH4AP2	Allied Chemistry Laboratory Course-II	2	2	3	40	60	100
4	IV	23UZO4SE6	Soft Skill Development	2	2	3	25	75	100
4	IV	23UES	Environmental Studies	2	2	3	25	75	100
			Value Added Course*		2*	2	50	50	100*
<b>Total</b>				<b>30</b>	<b>24</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>800</b>
5	III	23UZO5CC9	Developmental Biology	5	5	3	25	75	100
5	III	23UZO5CC10	Animal Physiology	5	5	3	25	75	100
5	III	23UZO5CC11P	Lab Course-V (Animal Physiology & Developmental Biology )	5	5	3	40	60	100
5	III	23UZO5CC12PW	Project viva voce	5	3	3	80	20	100
5	III	23UZO5DE1	Economic Entomology	4	4	3	25	75	100
5	III	23UZO5DE2	Immunology	4	4	3	25	75	100
5	IV	23UVE	Value Education	2	2	3	25	75	100
			Summer Internship**	-	2*				
			Value Added Course*		2*	2	50	50	100*
<b>Total</b>				<b>30</b>	<b>28</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>700</b>
6	III	23UZO6CC13	Evolutionary Biology	6	5	3	25	75	100
6	III	23UZO6CC14	Environmental biology	6	5	3	25	75	100
6	III	23UZO6CC15P	Evolutionary Biology, Environmental biology Laboratory Course- VI	6	5	3	40	60	100
6	III	23UZO6DE3	Animal Biotechnology	6	4	3	25	75	100
6	III	23UZO6DE4	Microbiology	6	4	3	25	75	100
6	V		Extension activity	-	1	-	-	-	-
			Value Added Course*		2*	2	50	50	100*
<b>Total</b>				<b>30</b>	<b>24</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>500</b>
<b>Grand Total</b>				<b>180</b>	<b>140</b>				<b>4200</b>

\* Extra Credit Courses which will not be included in the total CGPA

- Summer Internship after 4<sup>th</sup> semester during summer vacation -30 Hours

-Value added course (Outside Instruction hours: 30 hours)

S.No	Part	Course Details	Credit
1	I&II	Language & English (Lang - 4x3=12 Eng - 4x3=12)	24
2	III	Core, Allied, Elective Course & Project vivo voce	94
3	IV	NME(2x2)	4
4		Environmental Studies (1x2)	2
5		Value Education (1x2)	2
6		Gender Studies	1
7		<ul style="list-style-type: none"> <li>• Skill Enhancement (5x2=10)</li> <li>• Summer internship/ Industrial training (2x1=2 credits)</li> </ul>	10 2
8	V	Extension Activity (1x1)	1
			<b>140</b>

**Note:**

	Internal Marks	External Marks
1. Theory	25	75
2. Practical	40	60
3. Separate passing minimum is prescribed for Internal and External marks		

**FOR THEORY**

The passing minimum for CIA shall be 40% out of 25 marks [i.e. 10 marks]

The passing minimum for Semester Examinations shall be 40% out of 75 marks [i.e. 30 marks]

**FOR PRACTICAL**

The passing minimum for CIA shall be 40% out of 40 marks [i.e. 16 marks]

The passing minimum for Semester Examinations shall be 40% out of 60 marks [i.e. 24 marks]

- Project : 100 Marks (The Project will be evaluated by an Internal and an External Examiner)  
Dissertation - 80 Marks  
Viva Voce - 20 Marks

**LIST OF CORE COURSES OFFERED**

Core Course I: Invertebrata

Core Course II: Laboratory Course –I (Invertebrata)

Core Course III: Chordata

Core Course IV: Laboratory Course –II (Chordata)

Core Course V: Cell Biology

Core Course VI: Laboratory Course- III

Core Course VII: Genetics

Core Course VIII: Laboratory Course- IV Genetics

Core Course IX: Developmental Biology

Core Course X: Animal Physiology

Core course XI: Project with Viva-Voce - Group Project

Core Course XII: Laboratory Course - V (CC IX & CC X)

Core Course XIII: Evolutionary Biology

Core Course XIV: Environmental Biology

Core Course XV: Laboratory Course - VI (CC XIII & CCXIV)

## LIST OF ALLIED COURSES OFFERED

Allied Course-I: Allied Botany I

Allied Course -II: Allied Botany II

Allied Course -III: Chemistry I

Allied Course -IV: Chemistry II

Allied Practical –I: Allied Botany I & II

Allied Practical –I: Allied Chemistry I & II

## LIST OF SKILL ENHANCEMENT COURSES OFFERED

Skill enhancement Course SEC - 1 (NME): Aquarium Keeping

Skill Enhancement Course SEC - 2 (NME): Medical Laboratory Techniques

Skill Enhancement Course SEC - 3: Human Reproductive Biology

Skill Enhancement Course SEC - 4: Bio composting for Entrepreneurship

Skill Enhancement Course SEC - 5: Economic Zoology

Skill Enhancement Course SEC - 6: Biophysics and Biostatistics

Skill Enhancement Course- SEC -7: Ornamental fish farming and Management

## LIST OF ELECTIVE COURSES OFFERED

Discipline Specific Elective- I: Agricultural Entomology

Discipline Specific Elective II: Immunology

Discipline Specific Elective III: Animal Biotechnology

Discipline Specific Elective IV: Microbiology

## LIST OF VALUE ADDED COURSES

Course Code	Course Title
23VAC01	Apiculture
23VAC02	Health education
23VAC03	Poultry farming
23VAC04	Dairy technology
23VAC05	Parasitology
23VAC06	Sericulture

## QUESTION PAPER PATTERN

UG Programme		
Maximum Marks : 75		Duration: 3 Hours
<b>Section - A</b>	<b>i) a-</b> (5 Questions for Multiple Choice) One question from each unit	5 x 1 = 5 Marks
	<b>b-</b> (5 Questions for Fill in the Blanks) One question from each unit	5 x 1 = 5 Marks
	<b>ii)</b> (5 short answer questions) One question from each unit	5 x 2 = 10 Marks
<b>Section - B</b>	<b>5 Questions</b> (Internal Choice: Either or) One set of questions from each unit	5 x 5 = 25 Marks
<b>Section - C</b>	<b>3 Questions</b> (Answer any 3 out of 5 Questions) One question from each unit	3 x 10 = 30 Marks

## SEMESTER – I

Course Code: 23UZ01CC1

Instruction Hours: 5

Credits: 5

Exam Hours: 3

Internal Marks: 25

External Marks: 75

### CORE COURSE : I– INVERTEBRATA

#### OBJECTIVES:

1. To understand the basic concepts of lower animals and observe the structure and functions.
2. To illustrate and examine the systemic and functional morphology of various group of invertebrates.
3. To differentiate and classify the various groups of animal modes of life and to estimate the biodiversity.
4. To compare and distinguish the general and specific characteristics of reproduction in lower animals.
5. To infer and integrate the parasitic and economic importance of invertebrate animals.

#### COURSE OUTCOMES:

On completion of the course, the student will be able to

1. Understand the basic concepts of invertebrate animals and recall its structure and functions.
2. Illustrate and examine the systemic and functional morphology of various groups of invertebrate.
3. Differentiate and classify the animal's mode of life in various taxa and estimate the biodiversity.
4. To compare and distinguish the various physiological processes and organ systems in lower animals.
5. Infer and integrate the parasitic and economic importance of invertebrate animals.

#### UNIT – I

**Taxonomy:** Definition - Principles of classification- symmetry and coelom - Units of classification - Binomial nomenclature -Outline classification of Animal kingdom up to order level with example.

#### UNIT – II

**Protozoa and Porifera: Type Study:** Plasmodium, General topics: Protozoan parasites – Entamoeba, Trypanosoma, locomotion and nutrition in protozoa. **Type study:** Ascon sponge – General organization and histology-**General topic:** Canal system of sponges.

#### UNIT – III

**Coelenterata and Helminthes: Type Study:** Obelia – Structure of Obelia colony, Medusa, Nematocyst and Life cycle (Metagenesis) -**Type Study:** Fasciola hepatica (Liver Fluke) Ascaris – External characters and Life cycle - **General topic:** Nematode parasitic adaptation

#### UNIT – IV

**Annelida and Arthropoda: Type Study:** Earthworm – External morphology, setae and Nephridia - **Type Study:** Penaeus (Marine Prawn) - External morphology, Appendages, Reproductive System and Development - **General topic:** mouth parts of insects (Mosquito, Honey bee, House fly and Cockroach).

#### UNIT– V

**Mollusca and Echinodermata: Type Study:** Pilaglobosa - External morphology, Digestive System and Respiratory System-General topic: Cephalopods as an advanced Mollusc, Economically important Mollusca, Larval forms in Echinodermata -Type Study: Star fish External morphology, Pedicellaria and water vascular system.

#### TEXT BOOKS:

1. Ekambaranatha Iyer, 2000. A Manual of Zoology, 10th edition, Viswanathan, S., Printers &

Publishers Pvt Ltd

- Jordan, E.L. and Verma P.S, 1995. Invertebrate Zoology, 12th edn. S. Chand & Co.
- Kotpal, R.L, 1992. Protozoa, Porifera, Coelenterata, Annelida, Arthropoda.
- Jordan.E.L and Verma.P.S, Invertebrate Zoology Revised Edn., S.Chand and Co. Ltd. Ram Nagar, New Delhi, 2014
- Invertebrate Zoology by Arumugam N. et al.,Saras Publications, Kottar, Nagercoil –2012
- Ekambaranatha Iyar and T.N. Ananthakrishnan. 1992. A Manual of Zoology, Vol.I. (Invertebrata).Parts I and II.Viswanathanand Co.

#### REFERENCES:

- 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
- Barrington, E.J.W. (1979). Invertebrate Structure and Functions. II Edition, E.L.B.S. and Nelson
- Hyman L.H, 1955. The invertebrates - Vol. I to Vol. VII – Mc Graw Hill Book Co.
- Parker, J. and Haswell , 1978. A text book of Zoology Vol. I - Williams and Williams.

#### WEB RESOURCES:

- <https://www.nationalgeographic.com/animals/invertebrates/>
- <https://bit.ly/3kABzKa>
- <https://www.nio.org/>
- <https://greatbarrierreef.org/>

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits				
I	23UZ01CC1	Invertebrata					5	5				
Course Outcomes (COs)	Programme Outcomes (Pos)					Programme Specific Outcomes (PSOs)						
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5		
CO1	✓	✓	✓	✓	✓	✓				✓		
CO2			✓	✓	✓	✓	✓	✓	✓	✓		
CO3			✓				✓					
CO4	✓	✓	✓	✓	✓	✓		✓	✓	✓		
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
Number of Matches(✓) = 36 Relationship: <b>HIGH</b>												

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

HOD & Chairperson



## SEMESTER – I

Course Code: 23UZO1CC2P

Instruction Hours: 3

Credits: 3

Exam Hours: 3

Internal Marks: 40

External Marks: 60

### LABORATORY COURSE –I: (INVERTEBRATA)

#### OBJECTIVES:

1. To identify the different groups of invertebrate animals by observing their external characteristics.
2. To understand the organs, organ system and their functions in lower animals.
3. To get knowledge about the different modes of life and their adaptation based on the environment.
4. Able to dissect and display the internal organs and mount the mouthparts and scales of invertebrates.

#### COURSE OUTCOMES:

1. Identify and label the external features of different groups of invertebrate animals.
2. Illustrate and examine the circulatory system, nervous system and reproductive system of invertebrate animals.
3. Differentiate and compare the structure, function and mode of life of various groups of animals.
4. To compare and distinguish the dissected internal organs of lower animals.  
Prepare and develop the mounting procedure of economically important invertebrates.

#### PRACTICALS:

**Major Dissection:** Cockroach: Nervous system, Digestive system. Prawn: Nervous system.

**Minor Dissection:** Earthworm: Body setae, Prawn : Appendages

**Mounting:** Cockroach: Salivary apparatus, Mouth parts - Honey Bee, House fly and Mosquito mouth parts.

**Spotters:** (i). **Protozoa:** Amoeba, Paramecium, Paramecium Binary fission and Conjugation, Vorticella, Entamoeba histolytica, Plasmodium vivax (ii). **Porifera:** Sycon, Spongilla, Euspongia, Sycon - T.S & L.S, Spicules, Gemmule (iii). **Coelenterata:** Obelia – Colony & Medusa, Aurelia, Physalia, Velella, Corallium, Gorgonia, Pennatulid (iv). **Platyhelminthes:** Planaria, Fasciola hepatica, Fasciola larval forms – Miracidium, Redia, Cercaria, Echinococcus granulosus, Taenia solium, Schistosoma haematobium (v). **Nemathelminthes:** Ascaris (Male & Female), Dracunculus, Ancylostoma, Wuchereria (vi). **Annelida:** Nereis, Aphrodite, Chaetoptera, Hirudinaria, Trochophore larva (vii). **Arthropoda:** Cancer, Palaemon, Scorpion, Scolopendra, Sacculina, Limulus, Peripatus, Larvae - Nauplius, Mysis, Zoea, Mouth parts of male & female Anopheles and Culex, Mouthparts of Housefly and Butterfly. (viii). **Mollusca:** Chiton, Pila, Unio, Pterido, Murex, Sepia, Loligo, Octopus, Nautilus, Glochidium larva (ix). **Echinodermata:** Asterias, Ophiothrix, Echinus, Clypeaster, Cucumaria, Antedon, Bipinnaria larva

#### TEXT BOOKS:

1. Ekambaranatha Iyyar and T. N. Ananthakrishnan, 1995 A manual of Zoology Vol.I (Part 1, 2) S. Viswanathan, Chennai
2. Ganguly, Sinha and Adhikari, 2011. Biology of Animals: Volume I, New Central Book Agency; 3rd revised edition. 1008 pp.
3. Sinha, Chatterjee and Chattopadhyay, 2014. Advanced Practical Zoology, Books & Allied Ltd; 3rd Revised edition, 1070 pp.
4. Lal, S. S., 2016. Practical Zoology Invertebrate, Rastogi Publications.  
Verma, P. S. 2010. A Manual of Practical Zoology: Invertebrates, S Chand, 497pp.

#### REFERENCES BOOKS:

1. 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.

2. Barnes, R.D. (1982). Invertebrate Zoology, V Edition. Holt Saunders International Edition.
3. Barrington, E.J.W. (1979). Invertebrate Structure and Functions. II Edition, E.L.B.S. and Nelson
4. Boradale, L.A. and Potts, E.A. (1961). Invertebrates: A Manual for the use of Students. Asia Publishing Home.
5. Lal, S.S. 2005. A text Book of Practical Zoology: Invertebrate, Rastogi, Meerut

## WEB RESOURCES

1. <https://nbb.gov.in/>
2. <http://www.agshoney.com/training.htm>
3. <https://icar.org.in/>
4. <http://www.csrtimys.res.in/>
5. <http://csb.gov.in/>  
<https://iinrg.icar.gov.in/>  
<https://www.nationalgeographic.com/animals/invertebrates/>

Semester	Code	Title of the Course					Hours	Credits			
I	23UZO1CC2P	Invertebrata Practical- I					3	3			
Course Outcomes (COs)	Programme Outcomes (Pos)					Programme Specific Outcomes (PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓	✓	✓	✓	✓				✓	
CO2			✓	✓	✓	✓	✓	✓	✓	✓	
CO3			✓				✓				
CO4	✓	✓	✓	✓	✓	✓		✓	✓	✓	
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Number of Matches(✓) = 36 Relationship: <b>HIGH</b>											

<b>Mapping</b>	1-29%	30-59%	60-69%	70-89%	90-100%
<b>Matches</b>	1-14	15-29	30-34	35-44	45-50
<b>Relationship</b>	Very Poor	Poor	Moderate	High	Very High

HOD & Chairperson

## SEMESTER – I

Course Code: 23UZO1SE1

Instruction Hours: 2

Credits: 2

Exam Hours: 3

Internal Marks: 25

External Marks: 75

### SKILL ENHANCEMENT COURSE: I – AQUARIUM KEEPING (NME- I)

#### OBJECTIVES

1. To create knowledge on self employment opportunity of ornamental fishes.
2. To provide the knowledge of ornamental fishes and their equipment.
3. To understand the different breeding techniques of ornamental fishes.

#### COURSE OUTCOME:

1. Students to learn about different ornamental fishes and identify the diseases of them
2. To develop entrepreneur potential in the field of aquarium and get self employment.

#### UNIT I

Introduction and scope - Aquarium fish keeping as hobby and cottage industry. Commercial aspects like national and international market. To create knowledge on self employment opportunity.

#### UNIT II

External morphology of a typical fish. Exotic and endemic varieties of ornamental fishes.

#### UNIT III

Aquarium preparation and maintenance - Kinds of tanks, tank setting, biological filter and aeration, water management, planting, lighting and feeds. Budget for setting up an Aquarium Fish Farm as a Cottage Industry

#### UNIT IV

Live fish transport- handling, feeding and forwarding techniques of fish. Fish Diseases and their control.

#### UNIT V

Breeding – Common characters and sexual dimorphism of Fresh water and Marine aquarium ornamental fish varieties such as Guppies, Mollies, Sword tails, Platy, Siamese fighters and Gold fish, Butterfly fish, Blue morph and Anemone fish.

#### REFERENCE BOOKS:

1. Santhanam, P., Sukumaran, N. & P. Natarajan, A manual of freshwater aquaculture (1987), Reprint 1999, Oxford & IBH Publishing Company Pvt., Ltd., New Delhi.
2. Cliff Harrison, A colour guide to Tropical Fish (1980), Chartwell Books, INC, Cerkshire, printed in Hon Kong.
3. O'Connell, R. F., The freshwater aquarium (1977), Arco Publishing Company, INC New York.
4. Jingran V.G., 1991: Fish and Fisheries in India – Hindustan Publ.co. New Delhi
5. Mill Dick, 1993: Aquarium Fish, Daya Pub.co., New Delhi

Semester	Code	Title of the Course					Hours	Credits			
I	23UZ01SE1	Aquarium Keeping (NME- I)					2	2			
Course Outcomes (COs)	Programme Outcomes (Pos)					Programme Specific Outcomes (PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓	✓	✓	✓	✓				✓	
CO2			✓	✓	✓	✓	✓	✓	✓	✓	
CO3			✓				✓				
CO4	✓	✓	✓	✓	✓	✓		✓	✓	✓	
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Number of Matches(✓) = 36 Relationship: <b>HIGH</b>											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

HOD & Chairperson

## SEMESTER – II

Course Code: 23UZO2CC3

Instruction Hours: 5

Credits: 5

Exam Hours: 3

Internal Marks: 25

External Marks: 75

### CORE COURSE : III– CHORDATA

#### OBJECTIVES:

1. To understand the structures and distinct features of Phylum Chordata.
2. To understand and able to distinguish the characteristic features of each subphylum and class.
3. To understand the economic importance of vertebrates
4. To know about the adaptations of vertebrates
5. To understand the evolutionary position of different groups of vertebrates

#### COURSE OUTCOMES:

1. On completion of this course, students will;
2. Classify, Identify and recall the name and distinct features of different subphylum belonging to phylum Chordata.
3. Explain, and relate the origin, structural organization and evolutionary aspects of vertebrates.
4. Analyze, compare and distinguish the developmental stages and describe the important biological process.
5. Correlate the different modes of life and parental care among different vertebrates. Summarise the morphology and ecological adaptations in vertebrates and list out the economic importance.

#### UNIT I

**General Characters and Classification of Phylum Chordata:** Origin of Chordata, Differences between non-chordates and chordates, General characters, Affinities and Systematic position of Hemichordata (*Balanoglossus*), Urochordata (*Ascidia*), Cephalochordata (*Amphioxus*).

#### UNIT II

**Prochordates and Agnatha:** Characteristics of subphylum vertebrata, Classification of Vertebrata upto Class level, Agnatha (*Petromyzon*), - Pisces (*Scoliodon sorrakowah*) General characters and classification, Origin of fishes, Affinities of Dipnoi - Types of scales and fins - Accessory respiratory organs - Air bladder - Parental care - Migration - Economic importance.

#### UNIT III

**Amphibia** : General characters and classification - Origin of Amphibia - Type study - *Rana hexadactyla* - Adaptive features of Anura, Urodela and Apoda - Neoteny in Urodela - Parental care in Amphibia.

#### UNIT IV

**Reptilia** : General characters and classification - Type study – (*Calotes versicolor* (endoskeleton of *Varanus*) - Origin of reptiles and effects of terrestrialisation, Extinct reptiles. Snakes of India. Poison apparatus and biting mechanism of poisonous snakes - Skull in reptiles as basis of classification

#### UNIT V

**Aves and Mammalia** : Aves: General characters and classification – Type study - *Columba livia* - Origin of birds, Flight adaptations, Migration. Mammalia: General characters and classification - Type study - Rabbit - Adaptive radiation in mammals - Egg laying mammals, Marsupials, Flying mammals, Aquatic mammals, Dentition in mammals.

#### TEXT BOOKS:

1. Ayyar, E.K. and T.N. Ananthakrishnan, 1992. Manual of Zoology Vol. II (Chordata), S. Viswanathan (Printers and Publishers) Pvt Ltd., Madras, 891p.
2. Jordan, E.K. and P.S. Verma, 1995. Chordate Zoology and Elements of Animal Physiology, 10th edition, S. Chand & Co Ltd., Ram Nagar, New Delhi, 1151 pp.
3. Nigam, H.C., 1983. Zoology of Chordates, Vishal Publications, Jalandhar - 144008, 942.

4. Ganguly, Sinha., Bharati Goswami and Adhikari, 2004. Biology of animals Vol.II - New central book Agency (p) Ltd.
5. Kotpal. R.L. A, Modern text book of Zoology Vertebrates- Rastogi publications. 2009

### REFERENCES BOOKS:

(Latest editions, and the style as given below must be strictly adhered to)

1. Darlington P.J. The Geographical Distribution of Animals, R.E. Krieger Pub. Co.
2. Hall B.K. and Hallgrimsson B. (2008). Strickberger's Evolution. IV Edition. Jones and Bartlett Publishers Inc.
3. Hickman, C.P. Jr., F.M.Hickman and L.S. Roberts, 1984. Integrated Principles of Zoology, 7th Edition, Times Merror/Mosby College Publication. St. Louis. 1065 pp.
4. Newman, H.H., 1981. The Phylum Chordata, Satish Book Enterprise, Agra – 282 003, 477 pp.
5. Parker and Haswell, 1964. Text Book of Zoology, Vol II (Chordata), A.Z.T,B.S. Publishers and Distributors, New Delhi - 110 051, 952 pp.
6. Pough H. Vertebrate life, VIII Edition, Pearson International.
7. Waterman, Allyn J. et al., 1971. Chordate Structure and Function, Mac Millan & Co., New York, 587 pp.
8. Young, J. Z. (2004). The Life of Vertebrates. III Edition. Oxford university press.

### WEB RESOURCES:

1. <http://tolweb.org/Chordata/2499>
2. <https://www.nhm.ac.uk/>
3. <https://bit.ly/3Av1Ejg>
4. <https://bit.ly/3kqTfYz>
5. <https://biologyeducare.com/aves/>
6. <https://www.vedantu.com/biology/>

Semester	Code	Title of the Course					Hours	Credits				
I	23UZO2CC3	Chordata					5	5				
Course Outcomes (COs)	Programme Outcomes (Pos)					Programme Specific Outcomes (PSOs)						
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5		
CO1	✓	✓	✓	✓	✓	✓				✓		
CO2			✓	✓	✓	✓	✓	✓	✓	✓		
CO3			✓				✓					
CO4	✓	✓	✓	✓	✓	✓		✓	✓	✓		
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
Number of Matches(✓) = 36 Relationship: <b>HIGH</b>												

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

HOD & Chairperson

## SEMESTER – II

Course Code: 23UZO2CC4P

Instruction Hours: 3

Credits: 3

Exam Hours: 3

Internal Marks: 25

External Marks: 75

### LABORATORY COURSE –II (CHORDATA)

#### OBJECTIVES:

1. To understand the structures and distinct features of phylum chordata.
2. To understand and able to distinguish the characteristic features of each subphylum and class.
3. To understand and compare the structure of various internal organs in different classes of vertebrates.
4. To know about the classification, adaptations and affinities of chordate animals.

#### COURSE OUTCOMES:

1. Identify and recall the name and distinct external and internal features of animals belonging to phylum Chordata.
2. Explain the structural organization of various organs and systems in different classes of vertebrates.
3. Analyse, compare and distinguish the morphological features and developmental stages of chordates
4. Dissect and explain various organs and internal systems in different vertebrates and correlate its function.
5. Summarise the morphology and ecological adaptations in vertebrates and list out the economic importance.

#### PRACTICALS:

##### Dissection: Virtual models

1. Frog: Digestive system, Arterial system

##### Mounting:

2. Shark –Placoid scales
3. Frog – Brain

**Osteology:** Frog: Skull and lower jaw, Vertebral column, Pectoral girdle, Pelvicgirdle, Forelimb, Hindlimb.

**Specimen and Slides:** (i) **Hemichordata:** Balanoglossus, Tornaria larva (ii). **Protochordata:** Amphioxus, Amphioxus T.S. through pharynx (iii). **Cyclostomata:** Petromyzon, Myxine, Ammocoetus larva (iv). **Pisces:** Sphyrna Pristis, Torpedo, Channa, Pleuronectes, Hippocampus, Exocoetus, Echieneis, Labeo, Catla, Clarius, Aaguilla, Protopterus, Scales: Placoid, Cycloid, Ctenoid (v). **Amphibia:** Ichthyophis, Amblystoma, Siren, Hyla, Rachophous, Bufo, Rana, Axolotal larva (vi). **Reptilia :** Draco, Chamaeleon, Gecko, Uromastix, Vipera russelli, Naja, Bungarus, Enhydrina, Typhlops, Testudo, Trionyx, Crocodilus, Ptyas. (vii). **Aves:** Archaeopteryx, Passer, Psittacula, Bubo, Alcedo, Columba, Corvus, Pavo; Collection and study of different types of feathers: Quill, Contour, Filoplume, Down (viii). **Mammalia:** Ornithorhynchus, Tachyglossus, Pteropus, Funambulus, Manis, Loris, Hedgehog

#### TEXT BOOKS:

1. Lal S S, 2009. Practical Zoology Vertebrate, Rajpal and Sons Publishing, 484pp.
- Verma P.S, 2000. A Manual of Practical Zoology: Chordates, S. Chand Limited, 627pp.

#### REFERENCES BOOKS:

2. Robert William Hegner, 2015. Practical Zoology, BiblioLife, 522pp.
- Young, J, Z., 1972. The life of vertebrates. Oxford Uni. London.

**WEB RESOURCES:**

1. [https://www.youtube.com/watch?v=b04hc\\_kOY10](https://www.youtube.com/watch?v=b04hc_kOY10)
2. <https://bit.ly/3CzTEy8>
3. <http://tolweb.org/Chordata/2499>
4. <https://www.nhm.ac.uk/>
5. <https://bit.ly/3Av1Ejg>

Semester	Code	Title of the Course					Hours	Credits				
II	23UZO2CC4P	Chordata Practical II					3	3				
Course Outcomes (COs)	Programme Outcomes (Pos)					Programme Specific Outcomes (PSOs)						
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5		
CO1	✓	✓	✓	✓	✓	✓				✓		
CO2			✓	✓	✓	✓	✓	✓	✓	✓		
CO3			✓				✓					
CO4	✓	✓	✓	✓	✓	✓		✓	✓	✓		
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
Number of Matches(✓) = <b>36</b> Relationship: <b>HIGH</b>												

<b>Mapping</b>	1-29%	30-59%	60-69%	70-89%	90-100%
<b>Matches</b>	1-14	15-29	30-34	35-44	45-50
<b>Relationship</b>	Very Poor	Poor	Moderate	High	Very High

HOD & Chairperson



## SEMESTER – II

Course Code: 23UZO2SE2

Instruction Hours: 2

Credits: 2

Exam Hours: 3

Internal Marks: 25

External Marks: 75

### SKILL ENHANCEMENT COURSE: 2 – MEDICAL LABORATORY TECHNIQUES

#### OBJECTIVES:

1. To understand the different protocols and procedures to collect clinical samples.
2. To explain the characteristics of clinical samples.
3. To demonstrate skill in handling clinical equipment.
4. To evaluate the safety precautions while handling clinical samples.
5. To summarise the control measures to avoid contamination of clinical samples.

#### COURSE OUTCOMES:

1. Understand protocols and procedures to collect clinical samples for blood analysis and to study human physiology.
2. Explain the characteristics of clinical samples.
3. Demonstrate skill in handling clinical equipment.
4. Evaluate the hematological and histological parameters of biological samples.
5. Elaborate the role of medical laboratory techniques in health care industry.

#### UNIT I:

**Laboratory Safety and Human Health and Hygiene :** Laboratory safety –toxic chemicals and biohazards waste- biosafety level- good laboratory practice – hygiene and health issue – physiology effect of alcohol, tobacco, smoking & junk food & its treatment - biomedical waste management.

#### UNIT II:

**Haematology :** Composition of blood and their function- collection of blood & lab procedure- haemopoiesis- types of anaemia- mechanism of blood coagulation- bleeding time- clotting time- determination of hemoglobin-erythrocyte sedimentations rate- packed cell volume- Total count of RBC & WBC- Differential count WBC- blood grouping and typing- haemostasis- bleeding disorder of man - Haemolytic disease of newborn, Platelet count, reticulocytes count, Absolute Eosinophil count.

#### UNIT III:

**Medical Microbiology and Instrumentation Techniques :** Definition and scope of microbiology- structure and function of cells - parasites - Entamoeba- Plasmodium- Leishmania and Trypanosome- Computer tomography (CT scan) – Magnetic Resonance imaging – flowcytometry – treadmill test – PET.

#### UNIT IV:

**Medical Physiology :** Cardiovascular system- Blood pressure - Pulse – regulation of heart rate, cardiac shock. Heart sounds, Electrocardiogram (ECG) – significance – ultra sonography- Electroencephalography (EEG).

#### UNIT V:

**Diagnostic Pathology :** Handling and labelling of histology specimens - Tissue processing - processing of histological tissues for paraffin embedding, block preparation. Microtomes – types of

microtome- sectioning, staining –staining methods- vital staining - mounting- problems encountered during section cutting and remedies - Frozen section techniques- freezing microtome.

### TEXT BOOKS

1. Godker, P. B. and Darshan, P, Godker, 2011. Text book of medical Laboratory Technology, Mumbai.
2. Guyton and Hall, 2000. Text Book of medical Physiology, 10<sup>th</sup> edition, Elseiner, New Delhi.
3. Mukerjee, K.L, 1999. Medical Laboratory Technology- Vol,I,II,III. Tata MC GrawHill, New Delhi.
4. Sood, R, 2009. Medical Laboratory technology, Methods and interpretation.

### REFERENCE BOOKS:

1. Manoharan,A, and Sethuraman, 2003. Essential of Clinical Heamatology, Jeypee brothers, New Delhi.
2. Richard, A, McPherson, Mathew, R, Pincus, 2007. Clinical and management by laboratory methods, Elsevier, Philadelphia.Published by Tata McGraw-Hill Education Pvt. Ltd.,
3. Ochei. J., A. Kolhatkar (2000). Medical Laboratory science: Theory and practice, Published by Tata McGraw-Hill Education Pvt. Ltd, First edition.

### WEB RESOURCES

1. <https://bit.ly/3tUs8In>
2. <https://bit.ly/2XKu7mT>
3. <https://bit.ly/3hNS1EP>
4. <https://bit.ly/2ZgrLga>
5. <https://bit.ly/3hTBO1b>

Semester	Code	Title of the Course					Hours	Credits				
II	23UZO2SE2	Medical Laboratory Techniques (NME- II)					2	2				
Course Outcomes (COs)	Programme Outcomes(Pos)					Programme Specific Outcomes(PSOs)						
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5		
CO1	✓	✓	✓	✓	✓	✓				✓		
CO2			✓	✓	✓	✓	✓	✓	✓	✓		
CO3			✓				✓					
CO4	✓	✓	✓	✓	✓	✓		✓	✓	✓		
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
Number of Matches(✓) = 36 Relationship: <b>HIGH</b>												

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

HOD & Chairperson

## SEMESTER – II

Course Code: 23UZO2SE3

Instruction Hours: 2

Credits: 2

Exam Hours: 3

Internal Marks: 25

External Marks: 75

### SKILL ENHANCEMENT COURSE: HUMAN REPRODUCTIVE BIOLOGY

#### OBJECTIVES:

1. To enable students to understand the endocrine structures and hormones associated with the physiology of reproductive system
2. To enable students to learn about the male reproductive system and accessory glands and regulation
3. To enable students to learn about the female reproductive system and regulation of its function
4. To enable students to comprehend about fertilization, pregnancy, parturition and lactation
5. To equip students with knowledge on causes of infertility, reproductive health, assisted reproductive technology and associated ethical issues

#### COURSE OUTCOMES

On successful completion of the course, students will be able to

1. Recall the structure and functioning of the male and female reproductive system, associated endocrinology, causes for infertility and assisted reproductive technology
2. Describe the structure and physiology functions of male and female reproductive systems.
3. Explain the mechanism of sex determination.
4. Discuss age-associated physiological changes in the reproductive tract
5. Describe physiological changes during pregnancy and benefits of breastfeeding.
6. Identify causes for infertility, treatments available and ethical issues related to treatments.
7. Discuss advantages and disadvantages of available contraceptives. Analyze the different techniques and associated ethical issues related to reproductive technology.

#### UNIT I

Reproductive System: Development and differentiation of gonads, genital ducts, external genitalia, mechanism of sex differentiation; Puberty

#### UNIT II

Outline and histoarchitecture of male reproductive system; Testis: Cellular functions; Spermatogenesis and its hormonal regulation; Androgen synthesis and metabolism; Epididymal function and sperm maturation; Accessory glands functions; Sperm transportation in male tract; Andropause

#### UNIT III

Outline and histoarchitecture of female reproductive system; Ovary: oogenesis and its hormonal regulation; Steroidogenesis and secretion of ovarian hormones; Reproductive cycles and their regulation, changes in the female tract; Menopause

#### UNIT IV

Ovum transport in the fallopian tubes; Sperm transport in the female tract, Fertilization; Hormonal control of implantation; Hormonal regulation of gestation, pregnancy diagnosis, foeto –

maternal relationship; Mechanism of parturition and its hormonal regulation; Lactation and its regulation

## UNIT V

Infertility in male and female: causes, diagnosis and management; Sexually transmitted Infections; Modern contraceptive technologies; Assisted Reproductive Technology: sex selection, sperm banks, frozen embryos, Stem Cell banks, *in vitro* fertilization, ET, EFT, IUT, ZIFT, GIFT, ICSI, PROST; ethical issues related to ART; Surrogate motherhood; ethical issues; Consanguinity; Fetal Loss and Birth Defects; Adoption

### REFERENCE BOOKS:

Cassan, A. (2005). *Human reproduction and Development (Inside the Human Body)*. New York: Chelsea Clubhouse.

Field, M.A. (1990). *Surrogate Motherhood*. Massachusetts: Harvard University.

Gardner, D. K. (2001). *Textbook of Assisted Reproductive Techniques: Laboratory and Clinical Perspectives*. London: Martin Dunitz.

Gardner, D. K. (2006). *In vitro Fertilization: A Practical Approach*. CRC Press.

Johnson, M. H. (2018). *Essential Reproduction*. New Jersey: Wiley-Blackwell.

Jones, R.E. (2013). *Human Reproductive Biology*. Amsterdam: Elsevier.

Neill, Jimmy D. ed (2006). *Knobil and Neill's Physiology of Reproduction*. Volume I. Third edn. Elsevier Academic Press.

Pinon, R. (2003). *Biology of Human Reproduction*. California: University Science Books.

Semester	Code	Title of the Course					Hours	Credits				
II	23UZO2SE3	Human Reproductive Biology					2	2				
Course Outcomes (COs)	Programme Outcomes (Pos)					Programme Specific Outcomes (PSOs)						
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5		
CO1	✓	✓	✓	✓	✓	✓				✓		
CO2			✓	✓	✓	✓	✓	✓	✓	✓		
CO3			✓				✓					
CO4	✓	✓	✓	✓	✓	✓		✓	✓	✓		
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
Number of Matches (✓) = 36 Relationship: <b>HIGH</b>												

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

HOD & Chairperson

## SEMESTER – III

Course Code: 23UZO3CC5

Instruction Hours: 4

Credits: 4

Exam Hours: 3

Internal Marks: 25

External Marks: 75

### CORE COURSE: V - CELL BIOLOGY

#### OBJECTIVES:

1. To understand the structures and purposes of basic components of prokaryotic and eukaryotic cells, especially macromolecules, membranes and organelles.
2. To understand how these cellular components are used to generate and utilize energy in cells.
3. To understand the cellular components underlying mitotic cell division.
4. To apply the knowledge of cell biology to selected examples of changes or losses in cell function.

#### COURSE OUTCOMES:

On completion of this course, students will;

1. To understand and recall the basic structure, origin and development of cell organelles.
2. To integrate and assess the biochemical, cytological and histological tools to infer cellular basis of organization.
3. To analyze and differentiate organisms based on structure, composition and inter and intra cellular interactions.
4. To explain the role of cells and cell organelles in various biological processes.
5. To construct and simulate the role of different cytological tools to explain the structure and complexity of cells and cell organelles.

#### UNIT I

**History of Cell Biology**, Tools and Techniques of Cell Biology Cell Fractionation, Homogenization, Centrifugation, Isolation of sub cellular Components. Histological techniques - Staining - Vital Stains. – Cytoplasmic and Nuclear Stains. Micro Technique Methods, Microscopes - Types - Light, Phase contrast, SEM, TEM - Units of measurement.

#### UNIT II

**The Cell** - Cell theory - Viruses -Types and Structure - Bacteria – Bacterial membrane - Ultra structure of Plant & Animal cell - Cytoplasm - Structure and Composition, Function - Extra Cytoplasmic Structure - Cilia Flagella - Cytoplasmic Inclusions.

#### UNIT III

**Cell components** - Plasma Membrane Ultra Structure - Different Models - Functions - Ultrastructure, Composition and Function of Endoplasmic reticulum, Ribosomes, Golgi Complex, Lysosomes, Centrioles, Microtubules Microfilaments, Mitochondria and Microsomes.

#### UNIT IV

**Nucleus** - Ultrastructure, Composition and Functions - Nuclear Membrane - Nucleoplasm - Chromosomes - Heterochromatin and Euchromatin - Nucleolus - DNA and RNAs - Protein Synthesis & regulation.

#### UNIT V

**Cell Divisions and Cell Cycle** - Amitosis, Mitosis and Meiosis and their Significance - Cancer, Biology – Characteristics of cancer cells, types, theories on Carcinogenesis, Ageing of Cells – Apoptosis and Stem cell studies.

### **TEXT BOOKS:**

1. Ambrose, E.J. and Dorothy, M. Easty, 1970. Cell Biology, Thomas Nelson & Sons Ltd., 500 pp.
2. Kumar P. and Mina U. (2018) Life Sciences: Fundamentals and Practice, Part-I, 6th Edn., Pathfinder Publication. p.608.
3. VeerBala Rastogi, Introductory cytology. Kedar Nath Ram Nath. Meerut 250 001.
4. Verma, P.S. and V. K. Agarwal, 1995. Cell and Molecular Biology, 8th Edition, S.Chand & co., New Delhi - 110 055, 567 pp.
5. Verma P.S. and Agarwal V.K. (2016) Cell Biology (Cytology, Biomolecules, Molecular Biology), Paperback, S. Chand and Company Ltd.

### **REFERENCES BOOKS:**

1. Albert B., Hopkin K., Johnson A.D., Morgan D., Raff M., Roberts K. and Walter P. (2018) Essential Cell Biology 5th Edn.,(paperback) W.W. Norton & Company p.864.
2. Burke, Jack. D., 1970. Cell Biology, Scientific Book Agency, Calcutta.
3. Challoner J. (2015) The Cell: A visual tour of the building block of life, The University of Chicago Press and Ivy Press Ltd., p.193.
4. Cohn, N. S., 1979, Elements of Cytology, Freeman Book Co., New Delhi – 110007, 495 pp
5. Cooper G.M. (2019) The Cell – A Molecular Approach, 8th Edn., Sinauer Associates Inc., Oxford University Press p.813.
6. DeRobertis, E.D.P. and E.M.F. De Robertis, 1988. Cell and Molecular Biology, 8th Edition, International Edition, Info med, Hong Kong, 734pp.
7. Dowben, R., 1971. Cell Biology, Harper International Edition. Harper and Row Publisher, New York, 565 pp.
8. Giese, A.C., 1979. Cell Physiology, Saunders Co., Philadelphia, London, Toronto, 609 pp.
9. Hardin J. and Bertoni G. (2017) Becker's World of the Cell. 9th Edn (Global Edition). Pearson Education Ltd., p. 923
10. Karp G., Iwasa J. and Masall W. (2015) Karp's Cell and Molecular Biology Concepts and Experiments. 8th Edn. John Wiley and Sons. p.832.
11. Loewy, A.G. and P.Sickevitz, 1969. Cell Structure and Function, Amerind Publishing Co., NewDeihi - 110 020, 516 pp.
12. Mason K.A., Losos J.B. and Singer S.R. (2011) Raven and Johnson's Biology. 9th Edn. Mc Graw Hill publications. p.1406.
13. Powar, C.B., 1989. Essential of Cytology, Himalaya Publishing House, Bombay - 400 004, 368 pp.
14. Swansen, C.P. and P.L.Webster, 1989. The Cell, Prentice Hall of India Pvt. Ltd., New Delhi - 110 001, 373 pp.
15. Urry L.A. Cain M.L., Wasserman S.A., Minorsky P.V., Jackson R.B. and Reece J.B. (2014) Campbell Biology in Focus. Pearson Education. p.1080.

### **WEB RESOURCES:**

1. <http://www.microscopemaster.com/organelles.html>
2. <https://bit.ly/3tXwDSB>
3. <https://bit.ly/3tWNpRX>
4. <https://bit.ly/3AuYR9M>
5. <https://rsscience.com/cell-organelles-and-their-functions/>

Semester	Code	Title of the Course					Hours	Credits			
III	23UZO3CC5	Cell Biology					4	4			
Course Outcomes (COs)	Programme Outcomes (Pos)					Programme Specific Outcomes (PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓	✓	✓	✓	✓				✓	
CO2			✓	✓	✓	✓	✓	✓	✓	✓	
CO3			✓				✓				
CO4	✓	✓	✓	✓	✓	✓		✓	✓	✓	
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Number of Matches(✓) = <b>36</b> Relationship: <b>HIGH</b>											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

HOD & Chairperson

## SEMESTER – III

Course Code: 23UZ03CC6P

Instruction Hours: 3

Credits: 3

Exam Hours: 3

Internal Marks: 40

External Marks: 60

### LABORATORY COURSE- III

#### OBJECTIVES:

1. To develop practical skills for the analysis of cell organelles
2. Students will communicate scientific concepts, experimental results and analytical arguments clearly and concisely, both verbally and in writing.

#### COURSE OUTCOMES:

1. To describe, examine and interpret the organization of genomic material and to research theories of genetic inheritance.

#### Major Practical

- Preparation and Identification of slides of Mitotic divisions with onion root tips.
- Preparation and Identification of different stages of Meiosis in Grasshopper Testes.
- Identification and study of different stages of Mitosis and Meiosis.
- Buccal epithelium (Barr body) preparation.

#### Minor practical - Cytometry

- Compound microscope, Stage and Ocular micrometry.

#### Study of prepared slides of histology.

1. Animal cell, Mitochondria, Nucleus, DNA helical structure, Columnar Epithelium, Ciliated epithelium, Glandular Epithelium. Cartilage T.S., Bone T.S., Cardiac Muscle, Striated muscle, Non Striated muscle, Neuron, C.S of mammalian Testis and Ovary.
2. Histochemistry and Micro technique- Fixation and Fixatives: Types of fixatives, Chemistry of fixation, Choice of Fixatives Tissue processing: Dehydration, Clearing and Embedding Microtomy: Types of microtomes, Sectioning of Paraffin blocks Staining of paraffin sections: Principle and methods of staining. Histological stains: Haematoxylin and Eosin

#### TEXT BOOKS:

1. Surya Nandan Meena, Milind Naik, 2019. Advances in Biological Science Research: A Practical Approach, Academic Press, New York, USA.
2. Michael Perlin, William Beckerson, Adarsh Gopinath, 2017. Cell, Genetics, and Molecular Biology: A Lab Manual (First Edition), Cognella Inc., USA.
3. Saxena J., Baunthiyal M., Ravi I., 2015. Laboratory Manual of Microbiology, Biochemistry and Molecular Biology, Scientific Publishers, India.
4. Bansal M.P., 2013. Molecular Biology and Biotechnology: basic experimental protocols, The Energy and Resources Institute (TERI), New Delhi, India.
5. Chaitanya K.V., 2013. Cell and molecular biology: A Lab Manual, Phi Learning Pvt. Ltd., New Delhi, India.

#### REFERENCES BOOKS:

1. Andreas Hofmann, Samuel Clokie, 2018. Wilson and Walker's Principles and Techniques of Biochemistry and Molecular Biology, Cambridge University Press, UK.
2. Bancroft, J.D. and Gamble, M (2007) Theory and Practice of Histological Techniques, 6 th Edition, Churchill Livingstone.
3. Ian Freshney R., 2010. Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications, John Wiley & Sons, USA.



4. John Kiernan (2008) *Histological and Histochemical Methods: Theory and Practice*, 4th edition, Cold Spring Harbor Laboratory Press.
5. Kerr, J. (2013) *Functional Histology*, Elsevier 6. Kiernan, J.A. (2008) *Histological & Histochemical methods: Theory & Practice (4th Ed)*. Cold Spring Harbor Laboratory Press.
6. Leonard Davis, Mark Dibner, James Battey, 2012. *Basic Methods in Molecular Biology*, Elsevier Science Publishing Co., NY, USA.
7. Luiz Carlos (2005) *Basic Histology: Text and Atlas (11th Ed)*. Mc Graw Hill Medical.
8. Robert F. Schleif, Pieter C. Wensink, 2012. *Practical Methods in Molecular Biology*, Springer-Verlag, NY, USA.
9. Ross, M.H., Kaye, G.I. & Pawlina, W. (2002) *Histology: A text and atlas (4th ed)*. Lippincott Williams & Wilkins.
10. Sarah Stauffer, Aaron Gardner, Wilko Duprez, Dewi Ayu Kencana Ungu, Philip Wismer, 2018. *Labster Virtual Lab Experiments: Basic Genetics*, Springer Publishers, NY, USA.

#### WEB RESOURCES:

1. <https://www.jove.com/>
2. <https://vlab.amrita.edu/?sub=3&brch=77>
3. <http://cbii-au.vlabs.ac.in/>
4. [https://media.hhmi.org/biointeractive/vlabs/transgenic\\_fly/index.html](https://media.hhmi.org/biointeractive/vlabs/transgenic_fly/index.html)
5. <https://www.ibiology.org/biology-techniques/>

Semester	Code	Title of the Course					Hours	Credits			
III	23UZO3CC6P	Cell Biology Practical					3	3			
Course Outcomes (COs)	Programme Outcomes (Pos)					Programme Specific Outcomes (PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓	✓	✓	✓	✓				✓	
CO2			✓	✓	✓	✓	✓	✓	✓	✓	
CO3			✓				✓				
CO4	✓	✓	✓	✓	✓	✓		✓	✓	✓	
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Number of Matches(✓) = 36 Relationship: <b>HIGH</b>											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

HOD & Chairperson

## SEMESTER – III

Course Code: 23UZ03SE4

Instruction Hours: 2

Credits: 2

Exam Hours: 3

Internal Marks: 25

External Marks: 75

### **SKILL ENHANCEMENT COURSE: IV – BIOCOMPOSTING FOR ENTREPRENEURSHIP**

#### **OBJECTIVES:**

1. To highlight the importance of Biocomposting for entrepreneurship in waste management.
2. To enable students for setting up Biocompost units and bins for waste reduction.

#### **COURSE OUTCOMES:**

1. The students will gain knowledge about the process of Biocomposting.
2. Students will be able to demonstrate Biocomposting techniques for various end applications like solid waste management, industrial waste recycling using sugarcane bagasse, etc.
3. To gain knowledge about the economic cost of establishing small Biocompost units as a cottage industry.

#### **UNIT – I**

Biocomposting – Definition, types and ecological importance.

#### **UNIT – II**

Types of Biocomposting technology – Field pits/ground heaps/ tank/large-scale/batch and continuous methods.

#### **UNIT – III**

Preparation of Biocompost pit and bed using different amendments.

#### **UNIT – IV**

Applications of Biocompost in soil fertility maintenance, promotion of plant growth, value added products, waste reduction, etc.

#### **UNIT – V**

Economics of establishment of a small biocompost unit – project report proposal for Self Help Group (Income and employment generation).

#### **PRACTICAL**

1. Preparation procedures for Biocompost pit.
2. Selection of Biocompost material, separation of Compostable and Non-compostable materials.
3. Packing and marketing of Biocompost.
4. Field visit to Biocomposting unit.

#### **REFERENCES:**

1. Bikas R. Pati & Santi M. Mandal (2016). Recent trends in composting technology.
2. Van der Wurff, A.W.G., Fuchs, J.G., Raviv, M., Termorshuizen, A.J. (Editors) 2016.
3. Handbook for Composting and Compost Use in Organic Horticulture. BioGreenhouse COST Action FA 1105

#### **WEB RESOURCES:**

[www.biogreenhouse.org](http://www.biogreenhouse.org).

Semester	Code	Title of the Course				Hours	Credits				
III	23UZO3SE4	Biocomposting for Entrepreneurship				2	2				
Course Outcomes (COs)	Programme Outcomes (Pos)					Programme Specific Outcomes (PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓	✓	✓	✓	✓				✓	
CO2			✓	✓	✓	✓	✓	✓	✓	✓	
CO3			✓				✓				
CO4	✓	✓	✓	✓	✓	✓		✓	✓	✓	
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Number of Matches(✓) = 36 Relationship: <b>HIGH</b>											

<b>Mapping</b>	1-29%	30-59%	60-69%	70-89%	90-100%
<b>Matches</b>	1-14	15-29	30-34	35-44	45-50
<b>Relationship</b>	Very Poor	Poor	Moderate	High	Very High

HOD & Chairperson

## SEMESTER – III

Course Code: 23UZ03SE5

Instruction Hours: 2

Credits: 2

Exam Hours: 3

Internal Marks: 25

External Marks: 75

### SKILL ENHANCEMENT COURSE: V – ECONOMIC ZOOLOGY

#### OBJECTIVES:

1. To understand the culturing techniques and production methods of different farm animals.
2. To know the life history of animals and disease control methods used in farming.
3. To understand the concept of breeding, cross breeding and the importance of high yield varieties.
4. To know about the marketing strategies.

#### COURSE OUTCOMES:

1. To identify the breeds and varieties of poultry, fish, bees, and cattle and understand the basic aspects of farming.
2. To assess and integrate the available tools and techniques to increase the productivity in farms.
3. To analyse the pros and cons of different methods of farming and marketing strategies of products.
4. To evaluate the use of available resources in improving the breeds, vermicomposting, farm products etc..
5. To design new methods to improve farm animals with increased productivity and disease resistance and to construct new methods in vermicomposting.

#### UNIT I:

**Economic Entomology** : Apiculture: Species of honey bees – Social organisation of honey bee – selection of bees and location for apiary – Newton's bee hive – products of bee keeping – enemies and diseases of honey bees. Sericulture: Species of silkworm – life history of mulberry silkworm – Rearing of silkworm – pests and diseases of silkworm.

Lac Culture: Introduction – Life history – Host plants – cultivation of Lac – Enemies of lac cultivation – Economic importance of Lac.

#### UNIT II:

**Vermiculture** : Introduction: Types of earthworms – ecological classifications of earthworms – Physical, chemical and biological changes caused by earthworms in the soil – Natural enemies of earthworms. Vermicomposting: vermicomposting methods – factors affecting vermicomposting – Vermiculture unit. Harvesting of vermicompost – vermicast – advantages of vermicompost – vermiwash and its applications.

#### UNIT III:

**Aquaculture** : Fresh water aquaculture: Carp culture – types of ponds – preparation – maintenance – harvesting and management. Integrated and composite culture. Prawn culture. Marine Aquaculture: Edible – pearl oyster culture. Ornamental fish culture: Aquarium fishes – Aquarium maintenance in home.

#### UNIT IV:

**Poultry Farming** : Poultry industry in India – Poultry for sustainable food production and livelihood - Commercial poultry farming – Nutritive value of egg and meat- Broiler management (Definition; Housing and equipment; Brooding, feeding and health cover of broilers; Record keeping; Broiler integration) – Layer management (Brooder; Grower and layer management; Culling of layers; Marketing of eggs and meat). Women in backyard poultry farming.

## UNIT V:

**Dairy Farming** :Dairy farming – advantages of dairying – classification of breeds of cattle – Indigenous and exotic breeds – Selection of dairy cattle. Breeding – artificial insemination – Dairy cattle management – housing – water supply – cattle nutrition feeding standards – Common contagious diseases. Milk - Composition of milk – milk spoilage – pasteurization – Role of milk and milk products in human nutrition – Dairying as a source of additional income and employment.

## TEXT BOOKS

1. Sastry, N.S.R., C.K.Thomas and R.A.Singh, 2015. Livestock Production Management, 4<sup>th</sup>Ed.Kalyani Publishers, New Delhi.  
Mary violet Christy, A. 2014. Vermitechnology, MJP Publishers, Chennai.
2. ICAR, 2013. Hand book of Animal Husbandry, 4<sup>th</sup> Ed., ICAR Publication, Pusa, New Delhi.
3. Awasthi, V.B., 2012. Introduction to General and Applied Entomology, third edition, Scientific publishers, India.
4. Vasanthraj David, B and Ramamurthy, VV., 2012. Elements of Economic Entomology, Seventh edition, Namrutha publications, Chennai.
5. Shukla &Upadhyay, 2014. Economic Zoology, 5<sup>th</sup> edn. Rastogi Publication, Meerut New Delhi.
6. Gupta, S.M., 2010. Text book of fishery, Ann Backer, Mumbai.
7. ShailendraGhosh, 2009. Fisheries and aquaculture management, Adhyayan, New Delhi.
8. David, B and Ananthakrishnan, T. N., 2006. General and Applied Entomology, Second edition, Tata McGraw hill publishing company Ltd., New Delhi, India.
9. Jagadish Prasad, 2002. Principles and practices of Dairy Farm Management, 3<sup>rd</sup> Ed. Kalyani Publishers, Ludhiana.
10. Sukumar, D.E., 2002. Outline of Dairy Technology, Oxford University, New Delhi.
11. Rath, R.K., 2000. Freshwater Aquaculture. Scientific Publishers (India), Jodhpur.
12. Ismail, S.A., 1997. Vermitechnology, The biology of earthworms, Orient Longman, India.
13. Prabakaran, R. 1998. Commercial Chicken production. Published by P. Saranya, Chennai.
14. Hafez, E. S. E., 1962. Reproduction in Farm Animals, Lea &Fabiger Publisher.

## REFERENCE BOOKS:

1. Glenn Munroe, 2017. Manual of on-Farm vermicomposting and vermiculture, Holdanca Farms Ltd, Wallace, Nova Scotia.
2. Hanifa, M.A., 2011. Aquatic resources and aquaculture, Dominent, New Delhi.
3. Gupta, P.K., 2008. Vermicomposting for sustainable agriculture, 2<sup>nd</sup> Edition, Agrobios, India.
4. Talashikar, S.C., 2008. Earthworms in Agriculture, Agrobios, India.
5. Abishek Shukla, D ., 2 0 0 9 . A Hand Book of Economic Entomology, Vedamse Books, New Delhi .
6. Banerjee, G.C., 2006. Text book of Animal Husbandry 8<sup>th</sup>Ed.Oxford and IBH Publishing Company Ltd., New Delhi.
7. Walstra, P. Wouters, J.T.M. and Geurts, T.J. 2006. Dairy Science and Technology. CRC Press, New York.
8. Dunham, R.A., 2004. Aquaculture and Fisheries Biotechnology Genetic Approaches. CABI publications, U.K.
9. Donald.D Bell and William. D. Weaver, 2002. Commercial chicken meat and egg production, Springer, New York.
10. Eckles C.H. and Anthony, E.L., 2001. Dairy Cattle and milk production, Biotech. Tata McGraw Hill Publishing Co.Pvt.Ltd., New Delhi.
11. Edwards, C.A., and Bother, B., 1996. Biology of earthworms, Chapman Hall Publication company.

12. ICAR, 1997. Handbook of Animal Husbandary– The Indian Council of Agricultural Research, New Delhi.
13. Banerjee G.C., 1992. Poultry, Oxford and IBH, New Delhi.
14. Jhingran, AVG, 1991. Fish and Fisheries of India. Hindustan Publishing Co. New Delhi.
15. James. N. Marnar, 1975. Principles of dairy processing, wiley eastern limited, New Delhi.
16. Baradach, JE. Ryther. JH. and, MC larney WO., 1972. Aquaculture. The farming and Husbandry of Freshwater and Marine Organisms. Wiley InterScience, New York.

#### WEB RESOURCES:

1. <https://bit.ly/3tXHjk8>
2. <https://bit.ly/3tUTHBu>
3. <https://bit.ly/3hVv96q>
4. <https://bit.ly/39nztH1>
5. <https://bit.ly/3CzasVO>
6. [https://agritech.tnau.ac.in/org\\_farm/orgfarm\\_vermicompost.html](https://agritech.tnau.ac.in/org_farm/orgfarm_vermicompost.html)
7. <https://bit.ly/3nYvgSF>
8. <http://caa.gov.in/farms.html>
9. <http://www.csrtimys.res.in/>
10. <http://www.agshoney.com/training.htm>

Semester	Code	Title of the Course					Hours	Credits			
II	23UZO2SE2:2	Economic Zoology					2	2			
Course Outcomes (COs)	Programme Outcomes (Pos)					Programme Specific Outcomes (PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓	✓	✓	✓	✓				✓	
CO2			✓	✓	✓	✓	✓	✓	✓	✓	
CO3			✓				✓				
CO4	✓	✓	✓	✓	✓	✓		✓	✓	✓	
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Number of Matches(✓) = 36 Relationship: <b>HIGH</b>											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

HOD & Chairperson

## SEMESTER – IV

Course Code: 23UZO4CC7

Instruction Hours: 5

Credits: 5

Exam Hours: 3

Internal Marks: 25

External Marks: 75

### CORE COURSE: VII - GENETICS

#### OBJECTIVES:

1. To encourage students to interpret the organization of genomic material and to research theories of genetic inheritance
2. To impart the skills required to prepare samples of genetic molecules and to determine their purity, structure and characteristics and to analyze genomic preparations.
3. To comprehend the importance of genetic variation in evolution.
4. To encourage students to report and justify the results of molecular and genetic experiments in an accurate and meaningful manner.

#### COURSE OUTCOMES:

On completion of this course, students will;

1. Understand the basis of inheritance and expression of genes.
2. To prepare samples of genetic molecules and to determine their purity, structure and characteristics.
3. Analyse the causes of variations in genetic material and predict the effect in a population using To experiment with genomic preparations and devise techniques to distinguish genetic material in different organisms to survey biodiversity.
4. To assess the changes in genetic material and to predict and consider the consequences of those changes.
5. Compile the factors which contribute to changes in gene expression and specify the changes which contribute to evolution.

#### UNIT I

**Mendelian Genetics and Inheritance:** Mendelian genetics: Mendelian experiments, laws of Mendel, Monohybrid, Dihybrid, back and test cross; Interaction of genes: Incomplete dominance, co dominance, complementary genes, supplementary genes, inhibiting genes, lethal genes and atavism. Inheritance: Polygenic inheritance- skin colour; multiple alleles- ABO blood groups and coat colour in rabbit; extra chromosomal inheritance- shell coiling, kappa particles; sex linked inheritance – eye colour in Drosophila, colour blindness and hemophilia in man.

#### UNIT II

**Linkage and Crossing Over:** Linkage: Linked genes, complete and incomplete linkage. Crossing over: molecular mechanisms of crossing over, kinds of crossing over, models of recombination. Chromosome mapping: inference and coincidence, haploid mapping, somatic cell hybridization.

#### UNIT III

**Cytogenetics:** Variation in chromosome number and structure: position effect, chromosomal mutation and evolution. Gene mutation: types, molecular basis of mutation, mutational hot spots, reversion; radiation and chemical agents as mutagens; Detection of mutation - CIB method and muller-5 method.

#### UNIT IV

**Human and Microbial Genetics:** Human genetics: Karyotype and ideogram; sex determination - Barr body technique, drumstick method; chromosomal abnormalities in humans, Pedigree analysis;

diagnosis of genetic abnormalities; Eugenics, Euphenics, and Euthenics. Population genetics and evolution: gene pool, gene frequency and genotype frequency; Hardy-Weinberg law of equilibrium. Unit 5: Bacterial genetics : Conjugation, transformation, transduction and chromosome mapping .

## UNIT V

**Molecular Genetics:** Insertion elements, transposable elements, retroelements; integrons and antibiotic resistance cassettes; the lactose system and operon model, tryptophanoperon, role and relative positions of promoters and operators, feedback mechanism.

### TEXT BOOKS:

1. David E Sadava, 1993. Cell Biology - Organelle Structure and Function, Jones Bartlett Publishers.
2. Guptha G. K., 2013. Genetics Classical to Modern, Rastogi publishers, Meerut.
3. Lewin B., 2008. Genes IX, Jones and Bartlett publishers.
4. Veer Bala Rastogi., 2019. Text Book of Genetics, Medtech
5. Verma P.S and Agarwal V.K., 2006. Cell Biology, Genetics, Molecular Biology, Evolution and Ecology, S. Chand & Company Ltd.
6. Verma P. S. and V. K. Agarwal., 2018. Genetics, S. Chand & Company Pvt Ltd.

### REFERENCES BOOKS:

(Latest editions, and the style as given below must be strictly adhered to)

1. Cooper, Geoffrey M., 2018. The cell: A Molecular Approach, Eighth Edition, Oxford University Press.
2. De Robertis, E. D. P and E.M.F Robertis, 2017. Cell and Molecular Biology 8th Edition, LWW.
3. Dobzhansky T., 1982. Genetics and The Origin of Species, Columbia University.
4. Fletcher H and Hickey I., 2015. Genetics, IV Edition. GS, Taylor and Francis Group, New York and London.
5. Gardner, Anne. 2009. Human Genetics, Scion Publishing Ltd.
6. Klug, W. S., Cummings, M. R., Spencer, C. A., 2012. Concepts of Genetics. X Edition. Benjamin Cummings.
7. Lodish, Harvey, Arnold Berk et al .,2007. Molecular cell biology. 6th edition, W. H. Freeman.
8. Russel, Peter J. 2013. iGenetics: A Molecular Approach, Pearson.
9. Strickberger M. W., 1995. Genetics, Prentice Hall India Learning Private Limited.

### WEB RESOURCES:

1. <https://go.nature.com/2XE8V1q>
2. <https://bit.ly/3zoTt6B>
3. <https://bit.ly/2XAm7oa>
4. <https://bit.ly/2XEbhxi>
5. <https://bit.ly/3AB4bso>
6. <https://bit.ly/39pZSE4>
7. <https://www.genome.gov/genetics-glossary/Sex-Linked>
8. <https://www.vedantu.com/biology/mutagens>



Semester	Code	Title of the Course					Hours	Credits			
IV	23UZO4CC7	Genetics					5	5			
Course Outcomes (COs)	Programme Outcomes(Pos)					Programme Specific Outcomes(PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓	✓	✓	✓	✓				✓	
CO2			✓	✓	✓	✓	✓	✓	✓	✓	
CO3			✓				✓				
CO4	✓	✓	✓	✓	✓	✓		✓	✓	✓	
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Number of Matches(✓) = 36 Relationship: <b>HIGH</b>											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

HOD & Chairperson

## SEMESTER – IV

Course Code: 23UZO4CC8P

Instruction Hours: 3

Credits: 3

Exam Hours: 3

Internal Marks: 40

External Marks: 60

### LABORATORY COURSE- IV

#### OBJECTIVES:

1. To develop practical skills for the analysis of cell organelles
2. Students will communicate scientific concepts, experimental results and analytical arguments clearly and concisely, both verbally and in writing.
3. Be able to describe the genetics and its mechanisms.

#### COURSE OUTCOMES:

1. The learner will understand the importance of cell as a structural and functional unit of life.
2. The learner understands and compares between the prokaryotic and eukaryotic system and extrapolates the life to the aspect of development.
3. To understand how the behaviour of chromosomes during meiosis can explain mendelian traits.
4. To understand how inheritance patterns are affected by position on chromosomes.
5. To understand the similarities and differences between how genetic information is passed on in male and female.

#### MAJOR & MINOR PRACTICALS

1. Mono hybrid Cross
2. Di hybrid Cross
3. Verification of the Mendelian laws of inheritance using coloured beads.
4. Observation of simple Mendelian traits in man.
5. Karyotyping (with the help of photographs) – normal male and female karyotypes and study of karyotypes of different genetic syndromes (Down, Klinefelter and Turner- syndromes).
6. Study of multiple alleles - Human Blood Grouping (ABO blood grouping)
7. Drosophila – male and female identification, Mutant forms (from pictures), Genetic importance.

#### TEXT BOOKS:

1. Surya Nandan Meena, Milind Naik, 2019. Advances in Biological Science Research: A Practical Approach, Academic Press, New York, USA.
2. Michael Perlin, William Beckerson, Adarsh Gopinath, 2017. Cell, Genetics, and Molecular Biology: A Lab Manual (First Edition), Cognella Inc., USA.
3. Saxena J., Baunthiyal M., Ravi I., 2015. Laboratory Manual of Microbiology, Biochemistry and Molecular Biology, Scientific Publishers, India.
4. Bansal M.P., 2013. Molecular Biology and Biotechnology: basic experimental protocols, The Energy and Resources Institute (TERI), New Delhi, India.
5. Chaitanya K.V., 2013. Cell and molecular biology: A Lab Manual, Phi Learning Pvt. Ltd., New Delhi, India.

#### REFERENCES BOOKS:

1. Andreas Hofmann, Samuel Clokie, 2018. Wilson and Walker's Principles and Techniques of Biochemistry and Molecular Biology, Cambridge University Press, UK.
2. Bancroft, J.D. and Gamble, M (2007) Theory and Practice of Histological Techniques, 6 th Edition, Churchill Livingstone.
3. Ian Freshney R., 2010. Culture of Animal Cells: A Manual of Basic Technique and Specialized

Applications, John Wiley & Sons, USA.

4. John Kiernan (2008) *Histological and Histochemical Methods: Theory and Practice*, 4th edition, Cold Spring Harbor Laboratory Press.
5. Kerr, J. (2013) *Functional Histology*, Elsevier
6. Kiernan, J.A. (2008) *Histological & Histochemical methods: Theory & Practice (4th Ed)*. Cold Spring Harbor Laboratory Press.
6. Leonard Davis, Mark Dibner, James Battey, 2012. *Basic Methods in Molecular Biology*, Elsevier Science Publishing Co., NY, USA.
7. Luiz Carlos (2005) *Basic Histology: Text and Atlas (11th Ed)*. Mc Graw Hill Medical.
8. Robert F. Schleif, Pieter C. Wensink, 2012. *Practical Methods in Molecular Biology*, Springer-Verlag, NY, USA.
9. Ross, M.H., Kaye, G.I. & Pawlina, W. (2002) *Histology: A text and atlas (4th ed)*. Lippincott Williams & Wilkins.
10. Sarah Stauffer, Aaron Gardner, Wilko Duprez, Dewi Ayu Kencana Ungu, Philip Wismer, 2018. *Labster Virtual Lab Experiments: Basic Genetics*, Springer Publishers, NY, USA.

### WEB RESOURCES:

1. <https://www.jove.com/>
2. <https://vlab.amrita.edu/?sub=3&brch=77>
3. <http://cbii-au.vlabs.ac.in/>
4. [https://media.hhmi.org/biointeractive/vlabs/transgenic\\_fly/index.html](https://media.hhmi.org/biointeractive/vlabs/transgenic_fly/index.html)
5. <https://www.ibiology.org/biology-techniques/>

Semester	Code	Title of the Course					Hours	Credits			
IV	23UZO4CC8P	Genetics Practical					3	3			
Course Outcomes (COs)	Programme Outcomes (Pos)					Programme Specific Outcomes (PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓	✓	✓	✓	✓				✓	
CO2			✓	✓	✓	✓	✓	✓	✓	✓	
CO3			✓				✓				
CO4	✓	✓	✓	✓	✓	✓		✓	✓	✓	
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Number of Matches(✓) = 36 Relationship: <b>HIGH</b>											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

HOD & Chairperson

## SEMESTER -V

Course Code: 23UZO5CC9

Instruction Hours: 5

Credits: 5

Exam Hours: 3

Internal Marks: 25

External Marks: 75

### CORE COURSE: IX – DEVELOPMENTAL BIOLOGY

#### OBJECTIVES:

1. To create an awareness to the students about the theories, concepts and basics of Developmental Biology.
2. To provide students about the idea of sex cells, fertilization, cleavage, differentiation and development of organs.
3. To make an awareness of the induction, organizers and development of extra embryonic structures.
4. To provide adequate explanation to students about the late embryonic developments and post embryonic development and ageing
5. To give an idea about teratogenesis, invitro fertilization, stem cells and amniocentesis to the students

#### COURSE OUTCOMES:

1. To describe and illustrate the significance of cellular processes in embryonic development.
2. To relate the factors that contribute to the developmental process, construct fate maps and illustrate the steps in morphogenesis and organogenesis.
3. To correlate the involvement of specific cell types in the formation of specific organs and explain the importance of morphogens.
4. To distinguish between the different types of developmental mechanisms in various organisms and appraise the species-based differences in development.
5. To justify and validate the role of environment and genetics in influencing embryonic development

#### UNIT I

##### Gametogenesis & Fertilization

Basic concepts of developmental biology. Structure & types of Spermatozoa, Mammalian egg - Egg membranes. types of egg - Spermatogenesis – Oogenesis. Fertilization – mechanism, theories and significance – Parthenogenesis.

#### UNIT II

##### Blastulation & Gastrulation

Cleavage - Planes and Patterns, Factors controlling cleavage - Fate map and its construction. Blastulation –types of blastula. Morphogenetic movements - Gastrulation of frog & chick.

#### UNIT III

##### Organogenesis

Development of Brain, Eye and Heart in frog. Development of Nervous system in chick .Foetal membranes in chick..Development of Pro, MesoMetanephric kidneys.Placentation in Mammals.

#### UNIT IV

##### Applied Embryology

Organizer concept –Structure – mechanism of induction and competence. Nuclear transplantation - teratogenesis – Regeneration: types - events and factors. Embryonic stem cells & significance. Methods to culture embryo

## UNIT V

Reproductive organs, Menstrual cycle and menopause - Pregnancy – trimesters – development. Erythroblastosis foetalis -Twins – types. Infertility – causes - Test tube baby and Assisted Reproductive Technology – Embryo transfer – Amniocentesis.

### TEXT BOOKS

- Lewis Wolpert 2007. Principles of development, 3rd edition, Oxford University Press, New Delhi, India
- Subramoniam, T. 2003. Developmental Biology, Narosa Publishing House, New Delhi, India.
- Verma, P.S., Agarwal, V. K.2010.Chordate Embryology: Developmental Biology, S. Chand & Company, New Delhi., India.

### REFERENCES BOOKS

1. Gilbert S.F. 2010. Developmental Biology, Sinauer Associates, Massachusetts, USA.
2. Balinsky, B.I. 1970. Introduction to Embryology, Philadelphia & London, UK.
3. Berril, N.J.1971. Developmental Biology, McGraw Hill, New York, USA.
4. Russ Hodge 2010. Developmental Biology, Facts on File, Inc., New York, USA.
5. Carlson, Bruce, M. 2009. Human embryology and Developmental Biology, Elsevier, Philadelphia, USA

### WEB RESOURCES:

1. <https://www.ncbi.nlm.nih.gov/books/NBK10052/>
2. <https://www.cdc.gov/ncbddd/developmentaldisabilities/facts.html>
3. <https://anatomypubs.onlinelibrary.wiley.com/doi/full/10.1002/dvdy.20468>
4. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5293490/>

Semester	Code	Title of the Course					Hours	Credits				
V	23UZO5CC9	Developmental Biology					5	5				
Course Outcomes (COs)	Programme Outcomes (Pos)					Programme Specific Outcomes (PSOs)						
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5		
CO1	✓	✓	✓	✓	✓	✓				✓		
CO2			✓	✓	✓	✓	✓	✓	✓	✓		
CO3			✓				✓					
CO4	✓	✓	✓	✓	✓	✓		✓	✓	✓		
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
Number of Matches(✓) = 36 Relationship: <b>HIGH</b>												

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

HOD & Chairperson

## SEMESTER -V

Course Code: 23UZO5CC10

Instruction Hours: 5

Credits: 5

Exam Hours: 3

Internal Marks: 25

External Marks: 75

### CORE COURSE: X – ANIMAL PHYSIOLOGY

#### OBJECTIVES:

1. To familiarize students with the principles and basic facts of Animal Physiology
2. To give students an insight about the molecular and cellular basis of physiological functions in animals.
3. To give an idea about the regulation of organ system functions in a whole animal using a conceptual model of feedback to explain homeostasis.
4. To make the students aware about how the structure- function relationships and its synchronization with the molecular signals.

#### COURSE OUTCOMES:

1. On completion of this course, students will;
2. Be able to explain how the various organ systems are coordinated and controlled.
3. Be able to list the functions of various organs in relation ophysiological process.
4. Be able to develop the idea of multilevel controlling and feedback mechanism in relation to various physiological functions.
5. Be able to understand the basic physiological process related to adaptation, metabolism and major requirements.
6. Be able to correlate and understand human physiology

#### UNIT I

##### Nutrition & Respiration

Nutrition: Digestion and absorption of carbohydrates proteins and lipids. Minerals & Vitamins—their deficiency. Hormonal control of digestion. Types of Respiration, Respirat ory pigments - structure of Haemoglobin, Transportation of gases- Bohreffect-Regulation of respiration-bronchitis, asthma – Physiological effects of smoking

#### UNIT II

##### Circulation & Excretion

Blood- composition and functions, Mechanism of clotting. Types of Hearts – Heartbeat and its regulation -pace maker – Cardiac cycle – ECG - Pulse and blood pressure. Nephron structure & mechanism of urine formation, Regulation of acid base balance, Excretory products, Osmoregulation in fishes.

#### UNIT III

##### Muscle & Nerve Physiology

Types of muscles – Ultra structure of striated muscle, Muscle contraction & properties, Neurons—structure&types-Impulse propagation, synaptic tran smission, neurotransmitters - Reflex action, Nerve disorders – epilepsy, Alzheimer’s disease, Parkinson’s disease.

## UNIT IV

### Sense Organs

Structure of eye, physiology of vision, visual elements and pigments, photo chemistry of vision - Eye defects – myopia, hyperopia, presbyopia, astigmatism, cataract - Structure of ear and mechanism of hearing - Hearing impairments – deafness, labyrinthine disease -Olfactory, gustatory and tactile sense organs

## UNIT V

### Reproductive Physiology

Endocrine glands in man - Hormones, action and disorders - Feed-back mechanism, Outlines of mechanism of hormonal activity. Puberty, adolescence, pregnancy, parturition, lactation and birth control

### TEXT BOOKS:

1. Agarwal R A., Anil K Srivastava., Kaushal Kumar.,1978. Animal Physiology and Biochemistry, S. Chand & Co. Ltd., New Delhi Publishing., 377 pp.
2. Ambika Shanmugam, 2001. Fundamentals of Biochemistry for Medical students, Karthik Offset Printers, Chennai, 590pp
3. Berry A.K.1998. A text book of Animal Physiology and Biochemistry. Emkay Publications, New Delhi, 320 pp.
4. Parameswaran, Ananta krishnan and Ananta Subramanian, 1975. Outlines of Animal Physiology, S. Viswanathan (Printers & Publishers) Pvt. Ltd., 329 p p.
5. Verma P.S., Tyagi B.S & Agarwal V.K., 2010. Animal Physiology, S. Chand & Co. Ltd., New Delhi Publishing., 417 pp.

### REFERENCES BOOKS:

1. Guyton, A.C. and Hall, J.B., 2011. Text Book of Medical Physiology, 9th Edition, W.B. Sanders Company, Prism Books (Pvt.) Ltd., Bangalore., 1064 pp.
- Ganong, W.F., 2019. Review of Medical Physiology, McGraw Hill, New Delhi., 340 pp.
- Hill, W.R., Wyse, G.A and Anderson, M. 2016. Animal Physiology (4thedn). Sinauer Associates is an imprint of Oxford University Press; USA, 828 pp.
2. Hoar, W.S. 1983. General and Comparative Physiology. Prentice Hall of India, New Delhi, 928 pp.
3. Prosser C.L., 1985. Comparative Animal Physiology, Satish Book Enterprise, Agra - 282 003, 966 pp.
4. Sarada Subrahmanyam, Madhavan Kutty, K., & Singh H.D., 2018. Text Book of Human Physiology, S. Chand & Co, New Delhi.
5. Singh, H.R and Kumar, N. 2017. Animal physiology and biochemistry, Vishal publishing company, Jalandhar, 864 pp.
6. Sreekumar, S. 2010. Basic physiology, PHI learning private ltd., New Delhi.210 pp
7. Tortora G.J. & Derrickson B., 2016. Principles of Anatomy and Physiology, John Sons, Inc. 1232 pp.
8. Wood, D.W., 1968. Principles of Animal Physiology, Edward Arnold Ltd, London., 342 pp.

### WEB RESOURCES:

1. <https://microbenotes.com/category/biochemistry/>
2. <https://www.stem.org.uk/resources/collection/3931/animal-physiology>
3. <https://animalphys4e.sinauer.com>
4. <https://nptel.ac.in/courses/102/104/102104042/>
5. <https://biochem.oregonstate.edu>

Semester	Code	Title of the Course					Hours	Credits			
V	23UZO5CC10	Animal Physiology					5	5			
Course Outcomes (COs)	Programme Outcomes (Pos)					Programme Specific Outcomes (PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓	✓	✓	✓	✓				✓	
CO2			✓	✓	✓	✓	✓	✓	✓	✓	
CO3			✓				✓				
CO4	✓	✓	✓	✓	✓	✓		✓	✓	✓	
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Number of Matches(✓) = <b>36</b> Relationship: <b>HIGH</b>											

<b>Mapping</b>	1-29%	30-59%	60-69%	70-89%	90-100%
<b>Matches</b>	1-14	15-29	30-34	35-44	45-50
<b>Relationship</b>	Very Poor	Poor	Moderate	High	Very High

HOD & Chairperson



## SEMESTER – V

Course Code: 23UZO5CC11P

Instruction Hours: 5

Credits: 4

Exam Hours: 3

Internal Marks: 40

External Marks: 60

### **CORE COURSE: 9- ANIMAL PHYSIOLOGY & DEVELOPMENTAL BIOLOGY (LAB)**

#### **OBJECTIVES:**

1. To impart an overview of basic physiological functions of various organ system in human.
2. To understand the physiological processes those regulate body functions.
3. To elucidate the segmental changes in pattern, development and organization.
4. The developing embryo and to highlight the interaction of cells and their role in fetal formation

#### **COURSE OUTCOMES:**

1. An understanding of invertebrate and vertebrate animal physiology, emphasising control mechanisms and response strategies used to cope with different external environments.
2. Students will appreciate how physiological plasticity is key to maintaining and adjusting physiological processes in terrestrial and aquatic animals.
3. Be able to list the types of characteristics that make an organism ideal for the study of developmental biology.
4. Be familiar with the events that led up to fertilization.
5. Be able to describe the stages and cellular mechanisms for gastrulation.

#### **ANIMAL PHYSIOLOGY**

1. Human Salivary Amylase activity in relation to Temperature.
2. Identification of Nitrogenous Waste Products.
3. Total count of RBC and WBC and Differential count of WBC.
4. Quantitative tests for Carbohydrates, Proteins, and Lipids.
5. Simple tests for Sugar, Albumin, and Urea in Human Urine.
6. Estimation of Haemoglobin.

#### **Spotters**

ECG, Sphygmomanometer, Haemoglobinometer, Haemocytometer,

#### **DEVELOPMENTAL BIOLOGY**

1. Observation of the structure of live spermatozoa of Bull.

#### **Observation of prepared micro slides to study:**

- a. Egg, cleavage, blastula and yolk plug stage in frog.
- b. Egg, 24 hrs, 36 hrs, 48 hrs, 72 hrs and 96 hrs - Chick developmental stages

#### **TEXT BOOKS:**

1. Agarwal R A., Anil K Srivastava., Kaushal Kumar.,1978. Animal Physiology and Biochemistry, S. Chand & Co. Ltd., New Delhi Publishing., 377 pp.
2. Ambika Shanmugam, 2001. Fundamentals of Biochemistry for Medical students, Karthik Offset Printers, Chennai, 590pp
3. Lewis Wolpert 2007. Principles of development, 3rd edition, Oxford University Press, New Delhi, India

**REFERENCES BOOKS:**

1. Gilbert S.F. 2010. Developmental Biology, Sinauer Associates, Massachusetts, USA.
2. Balinsky, B.I. 1970. Introduction to Embryology, Philadelphia & London, UK.
3. Berril, N.J.1971. Developmental Biology, McGraw Hill, New York, USA.
4. Guyton, A.C. and Hall, J.B., 2011. Text Book of Medical Physiology, 9th Edition, W.B. Sanders Company, Prism Books (Pvt.) Ltd., Bangalore., 1064 pp.
- Ganong, W.F., 2019. Review of Medical Physiology, McGraw Hill, New Delhi., 340 pp.
- Hill, W.R., Wyse, G.A and Anderson, M. 2016. Animal Physiology (4th edn). Sinauer Associates is an imprint of Oxford University Press; USA, 828 pp.
5. Hoar, W.S. 1983. General and Comparative Physiology. Prentice Hall of India, New Delhi, 928 pp.

**WEB RESOURCES:**

1. <https://microbenotes.com/category/biochemistry/>
2. <https://www.ncbi.nlm.nih.gov/books/NBK10052/>

Semester	Code	Title of the Course					Hours	Credits			
V	23UZ05CC12P	Animal Physiology & Developmental Biology – Practical					5	5			
Course Outcomes (COs)	Programme Outcomes (Pos)					Programme Specific Outcomes (PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓	✓	✓	✓	✓				✓	
CO2			✓	✓	✓	✓	✓	✓	✓	✓	
CO3			✓				✓				
CO4	✓	✓	✓	✓	✓	✓		✓	✓	✓	
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Number of Matches(✓) = <b>36</b> Relationship: <b>HIGH</b>											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

HOD &amp; Chairperson

## SEMESTER -V

Course Code: 23UZ05DE1

Instruction Hours: 4

Credits: 4

Exam Hours: 3

Internal Marks: 25

External Marks: 75

### DISCIPLINE SPECIFIC ELECTIVE COURSE-I ECONOMIC ENTOMOLOGY

#### OBJECTIVES:

1. Explain the basic concepts of entomology and observe the pest status of agriculture.
2. Illustrate and examine the systemic and functional morphology of various group of agricultural insect pests.
3. Differentiate and classify the various groups of insect animals and estimate biodiversity.
4. To compare and distinguish the general and specific characteristics integrated pest management.
5. Infer and integrate the economic importance of insect species.

#### COURSE OUTCOMES:

1. Examine and identify the systemic and functional morphology of various group of agricultural insect pests.
2. Differentiate and classify the various groups of insects and estimate the biodiversity.
3. Explain the pest status in agriculture and control measures.
4. To compare the methods and outcomes of integrated pest management.
5. List the economic importance of agricultural insect species.

**UNIT I:** Outline classification of insects - Causes for insect assuming pest status - Methods of collection, mounting and preservation of insect pests.

**UNIT II:** Insect vectors of plant diseases, Insect pests of stored grains their preventive and curative methods, Most common insect pests of the following plants and their control measures: Paddy, Sugarcane, Groundnut, Coconut and Cotton. Locust and its control. Insect pollinators and scavenger.

**UNIT III:** Apiculture: Introduction, types of honey bees, hive, apiary, selection of bees for apiary, Newton's bee hive, enemies and diseases of honey bees. Sericulture: Introduction, types of silk worms, silk worm races, life history of mulberry silk worm, features of sericulture industry, pests and diseases of silk worm. Lac Culture.

**UNIT IV:** IPM, physical, mechanical, chemical and biological control methods, Pesticide application equipment.

**UNIT V:** Introduction and steps towards IPM, Pheromones, antifeedents, repellents and biopesticide.

#### TEXT BOOKS

1. David, Band Ananthkrishnan, T.N. 2006. General and Applied Entomology, Second edition, Tata McGraw Hill publishing company Ltd., New Delhi, India.
2. Vasanthraj David, B. and Ramamurthy, V.V. 2012. Elements of Economic Entomology, Seventh edition, Namrutha publications, Chennai.
3. Pruthi, H.S. 1969. Textbook on Agricultural Entomology, I.C.A.R. Publication, New Delhi.
4. Awasthi, V.B. 2012. Introduction to General and Applied Entomology, third edition, Scientific publishers.

**REFERENCE:**

1. AbishekShukla, D. 2009.A Hand Bookof EconomicEntomology, VedamseBooks,NewDelhi.
2. MinistryofAgriculture,GovernmentofIndia,1995.ManualonIntegratedPest Management in Rice andCotton.
3. John WilliamS. 1995. Management ofNatural Wealth, Loyola College Publications, Chennai.

**WEB RESOURCES**

1. <http://www.fao.org>
2. <http://flybase.bio.indiana.edu/>
3. <http://www.ipm.ucdavis.edu>
4. <http://www.ent.iastate.edu/list/>
5. [www.entsoc.org](http://www.entsoc.org)

Semester	Code	Title of the Course					Hours	Credits				
V	23UZO5DE1	Economic Entomology					4	4				
Course Outcomes (COs)	Programme Outcomes (Pos)					Programme Specific Outcomes (PSOs)						
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5		
CO1	✓	✓	✓	✓	✓	✓				✓		
CO2			✓	✓	✓	✓	✓	✓	✓	✓		
CO3			✓				✓					
CO4	✓	✓	✓	✓	✓	✓		✓	✓	✓		
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
Number of Matches(✓) = 36 Relationship: <b>HIGH</b>												

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

HOD &amp; Chairperson

## SEMESTER -V

Course Code: 23UZO5DE2

Instruction Hours: 4

Credits: 4

Exam Hours: 3

Internal Marks: 25

External Marks: 75

### DISCIPLINE SPECIFIC ELECTIVE COURSE-II IMMUNOLOGY

#### OBJECTIVES:

1. To understand the fundamentals of immunology in protection against disease and also the key principles of antigen- antibody reaction in the immune system.
2. To list basic mechanisms that regulate immune responses, describe the main steps in the generation of cells and organs of the immune system.
3. To describe the basic mechanisms that provide innate immunity and antigen processing and presentation.
4. To differentiate B and T cell receptors, organs, and microenvironments of the Immune System.
5. To promote critical thinking and provide students with knowledge on how the immune system works building on their previous knowledge from biochemistry, genetics and cell biology.

#### COURSE OUTCOMES:

On completion of this course, students will;

1. Understand and recall the basic structural and functional components of the immune system, compare and contrast cells with respect to origin and maturation.
2. Classify and explain types of immunity, state the significance of antigen and examine their relevance to immunizations.
3. Describe and differentiate the biological characteristics of the antibodies, analyze and formulate the procedure for antibody production
4. Compare and rate the mechanism of various types of hypersensitivity reactions, assess and identify the different types of autoimmune diseases.
5. Summarize immune responses against pathogens.

#### UNIT – I

**Immune Cells and Organs:** Overview of Immune System - General concepts and Haematopoeisis. Cells of the immune system - T and B-lymphocytes, NK cells; Monocytes and macrophages; Neutrophils, eosinophils, and basophils -Mast cells and dendritic cells. Organs of the Immune system: Primary lymphoid organs - Thymus and bone marrow; Secondary Lymphoid organs - Lymph nodes and spleen; Lymphatic tissues - Peyer's patches and Kupffer cells, MALT, GALT and CALT.

#### UNIT – II

**Innate and Adaptive Immunity:** Innate and Adaptive Immunity; Anatomical barriers, Inflammatory response, Cells and molecules involved in innate immunity, Adaptive immunity (Cell mediated and humoral). Receptors and Signaling: Cytokines and Chemokines - General Properties of Cytokines and Chemokines. Major Histocompatibility Complex (MHC): Organization and inheritance of the MHC. Structure and cellular distribution of HLA antigens.

### UNIT – III

**Antigen and Antibodies:** Antigens- Antigenicity and immunogenicity: Properties -foreignness, molecular size, heterogeneity. B & T epitopes, T-dependent and T- independent B cell responses. Antibodies: Structure, function and properties of the Immunoglobulins, Different classes of Immunoglobulins; antigenic determinants on antibodies (isotype, allotype and idiotype). Hybridoma technology - production of monoclonal antibodies and catalytic antibodies (abzymes).

### UNIT – IV

**Hypersensitivity and Autoimmune Diseases:** Hypersensitivity: classification and brief description of various types of hypersensitivities. Autoimmunity: cause of autoimmune diseases - classification of autoimmune diseases. Transplantation immunology: Types of grafts, immunologic basis of graft rejection, immunosuppressive therapy and clinical transplantation.

### UNIT – V

**Clinical Immunology:** Immunity and tumors- tumor antigens (TSTA and TAA), immune response to tumors. Tumor evasion of the immune system, Immunotherapy for tumors. Immunity against - viral, bacterial and parasitic infections. Vaccines: Types and uses - Immunization schedule for children.

### TEXT BOOKS

1. Kuby, J, Punt, J, Stranford, S, Jones, Pand Owen, J, 2018. Immunology, 8th Edition, W.H.Freeman Publishing, New York, 944 pp.
2. Roitt, M, Peter J. Delves, Seamus J. Martin and Dennis R. Burton, 2017. Essential Immunology, 13th Edition, Wiley-Blackwell Publishing, USA, 576 pp.
3. Coleman, R.M., 2014. Fundamental Immunology, 2nd Edition, Published by Mc Graw Hill Education India, 357 pp.
4. Raj Khanna, 2011. Immunology, Oxford University press, New Delhi. 428 pp.
5. Rao. C.V. 2011. Immunology, Narosa Publishing House, New Dehli, 426 pp.

### REFERENCES BOOKS

1. Abul A. Andrew, Lichtman. H, Shiv. P, 2014. Cellular and Molecular Immunology, 8th Edition, Published by W.B. Saunders, 544 PP.
2. Chapel. H, Haeney. M, Misbah. S, and Snowden. N, 2006. Essentials of Clinical Immunology, 5th Edition. Blackwell Publishing, 368 PP.
3. William R. Clark, 1985. The Experimental Foundations of Modern Immunology, Published by Johns Hopkins University Press, New York. 326 PP.
4. Kenneth Murphy & Casey Weaver, 2016. Janeway's Immunology, Garland Science publishers, 924 pp.

Semester	Code	Title of the Course					Hours	Credits			
V	23UZO5DE2	Immunology					4	4			
Course Outcomes (COs)	Programme Outcomes (Pos)					Programme Specific Outcomes (PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓	✓	✓	✓	✓				✓	
CO2			✓	✓	✓	✓	✓	✓	✓	✓	
CO3			✓				✓				
CO4	✓	✓	✓	✓	✓	✓		✓	✓	✓	
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Number of Matches(✓) = 36 Relationship: <b>HIGH</b>											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

HOD & Chairperson

## SEMESTER -VI

Course Code: 23UZO6CC13

Instruction Hours: 6

Credits: 5

Exam Hours: 3

Internal Marks: 25

External Marks: 75

### CORE COURSE-XIII : EVOLUTIONARY BIOLOGY

#### OBJECTIVES:

1. Evolutionary biology is a branch of the biological sciences concerned with the origin of life and the diversification and adaptation of life forms over time.
2. This course helps to understand the important processes, principles, and concepts on evolution.
3. To provide adequate information on the Lamarckism - Neo Lamarckism – Darwinism, Neutral Theory of Molecular Evolution, and Human Genome Project.
4. To explain the importance of the fossil records in evolutionary studies, and the role of phylogenetic studies in the wider context of biodiversity and conservation.
5. In this course, we will apply the knowledge of human evolutionary history to simulate how genetic variation within and among human populations affects risk, diagnosis, and treatment of modern diseases.

#### COURSE OUTCOMES:

1. To understand the Primordial earth and theories on origin of life
2. To integrate and assess Lamarckism - Neo Lamarckism – Darwinism
3. To analyse various fossil records of man and fossil records of horse, various types of rocks - Geological time scale.
4. To explain the Nature of fossils- Dating of fossils, evidences of evolution, Adaptive radiation in reptiles and mammals,
5. To construct and compile the role of Human Genome Project, Evolution in the diagnosis, and treatment of diseases.

#### UNIT I

Inorganic and organic evolution-History of evolutionary thought, Primordial earth and primeval atmosphere, Chemical origin of life: Synthesis of organic molecules, Urey-Miller experiment, Origin of prokaryotes and eukaryotes.

#### UNIT II

Lamarckism - Neo Lamarckism - Darwinism - Neo Darwinism and modern synthetic theory - DeVrie's Mutation theory – modern concepts of mutation - Mutation and their role in evolution - Animal colouration and Mimicry

#### UNIT III

Isolating mechanisms - Modes of speciation-Hybridization is an evolutionary catalyst- Law of Adaptive Radiation- Adaptive radiation in reptiles and mammals - Convergence and parallelism - Evolutionary constancy

#### UNIT IV

Morphological, physiological and biochemical, embryological, Taxonomical and geographical evidences -Palaeontological evidences – evolutionary genomics. Types of rocks - Geological time scale – Nature of fossils- Dating of fossils - Fossil records of man and fossil records of horse.

#### UNIT V

Natural selection in action in man- level of selection- Eugenics, Euphenics and Euthenics- Adaptation- Human Genome Project – Evolution and ethics.

#### TEXT BOOKS

1. Ridley, M., 2004. Evolution. III Edition. Blackwell Publishing.
2. Lull, R.S. 2010. Organic evolution, The Macmillan, New York.
3. Minkoff, E. C. (1983). Evolutionary biology. Reading, MA: Addison-Wesley Publishing Company



4. Sober, E. (1994). Conceptual issues in evolutionary biology. Cambridge, MA: MIT Press.
5. Dr. Kishore R. Pawar, Dr. Ashok E. Desai, 2019. A text book of Organic Evolution, Nirali Prakashan,
6. Rastogi VB. 1991. Organic Evolution. Kedar Nath Ram Nath Publications, Meerut, Uttar Pradesh, India.
7. Stricberger, M.W., 1996. Evolution. Jones & Bartlett, USA
8. Colbert, E.H. Morales, M. and Minkoff, E.C. 2011. Colbert's Evolution of The Vertebrates: A History of the Backboned Animals Through Time, Wiley, India.

#### REFERENCES BOOKS

1. Burns GW. 1972. The Science of Genetics. An Introduction to Heredity. Mac Millan Publ. Co.Inc.
2. Gardner EF. 1975. Principles of Genetics. John Wiley & Sons, Inc. New York.
3. Harth and Jones EW. 1998. Genetics – Principles and Analysis. Jones and BarHett Publ. Boston.
4. Levine L. 1969. Biology of the Gene. Toppan.
5. Pedder IJ. 1972. Genetics as a Basic Guide. W. Norton & Company, Inc.
6. Rastogi VB. 1991. A Text Book of Genetics. Kedar Nath Ram Nath Publications, Meerut, Uttar Pradesh, India.
7. White MJD. 1973. Animal Cytology and Evolution. Cambridge Univ.Press.

#### WEB RESOURCES

1. <https://bit.ly/3nPD09m>
2. <https://bit.ly/3CHOdgL>
3. <https://bit.ly/2XvcCXl>
4. <https://bit.ly/2XAL1Vh>
5. <https://bit.ly/3zoU9Jl>

Semester	Code	Title of the Course					Hours	Credits			
VI	23UZO6CC13	Evolutionary Biology					6	5			
Course Outcomes (COs)	Programme Outcomes (Pos)					Programme Specific Outcomes (PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓	✓	✓	✓	✓				✓	
CO2			✓	✓	✓	✓	✓	✓	✓	✓	
CO3			✓				✓				
CO4	✓	✓	✓	✓	✓	✓		✓	✓	✓	
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Number of Matches(✓) = 36 Relationship: <b>HIGH</b>											
Mapping	1-29%		30-59%		60-69%		70-89%		90-100%		
Matches	1-14		15-29		30-34		35-44		45-50		
Relationship	Very Poor		Poor		Moderate		High		Very High		

HOD & Chairperson

## SEMESTER -VI

Course Code: 23UZO6CC14

Instruction Hours: 6

Credits: 5

Exam Hours: 3

Internal Marks: 25

External Marks: 75

### CORE COURSE- XIV: ENVIRONMENTAL BIOLOGY

#### OBJECTIVES:

1. To understand the structure and functions of the ecosystem.
2. To explain the relationship between biotic and abiotic factors in an ecosystem.
3. To know the causes and effects of climate change and habitat loss.
4. To bring awareness about the impact of socio-economic development on the environment and the solutions put forward by the government to reduce environmental damage.

#### COURSE OUTCOMES:

1. Understand the fundamental structure and functions of the ecosystem.
2. Assess the inter-relationship between organisms and between biotic and abiotic factors in an ecosystem.
3. Analyze the factors that cause pollution, climate change, loss of biodiversity and depletion of resources.
4. Evaluate the impact of human population growth and socio-economic development on the structure and function of the ecosystem.
5. Design plans to scientifically solve environmental problems using biological tools, technologies and government policies.

#### UNIT-I

**Ecosystem** : Concept of an ecosystem-Structure and function of an ecosystem- Producers, consumers and decomposers-Energy flow in the ecosystem-Ecological succession-Food chains, food webs and ecological pyramids-Introduction, types, characteristic features, structure and function of the following ecosystem : Forest ecosystem-Grassland ecosystem-Desert ecosystem-Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries).

#### UNIT-II

**Population And Biological Cycles** : Structure and distribution – Growth curves - Groups, natality, Mortality -Density indices, Life study tables - factors affecting population growth -Carrying capacity. Population regulation and human population control. Complete and incomplete biogeochemical cycles - Sedimentary cycle.

#### UNIT-III

**Environmental Stresses And Management** :Global climatic pattern, global warming, atmospheric ozone, acid and nitrogen deposition. Uptake, biotransformation, elimination and accumulation of toxicants. Factors influencing bioaccumulation from food and trophic transfer. Pesticides and other chemical in agriculture, industry and hygiene and their disposal. Bio indicator and biomarkers of environmental health. Biodegradation and bioremediation of chemicals.

#### UNIT-IV

**Environmental Pollution**: Definition- cause, effects and control measures of: -Air pollution - Water pollution -Soil pollution -Marine pollution - Noise pollution - Thermal pollution -Nuclear hazards.

#### UNIT-V

**Biodiversity Conservation:** Biodiversity crisis – habitat degradation, poaching of wild life. - Socio economic and political causes of loss of biodiversity. - In situ and ex situ conservation of biodiversity -Hot spots of Biodiversity. Green peace movement - Chipko Movement - Role of government agencies: Central and State Pollution Control Boards - Ministry of Environment and Forests- National Biodiversity Authority. Awareness, Programme, NGOs, Natural Disaster Management, Legislations for environmental Protection, Bio villages – sustainable utilization and development, Environmental ethics.

### TEXT BOOKS

1. Matthew R. Fisher, 2018. Environmental Biology.Open Oregon Educational Resources. James Madison University.
2. Asthana, D.K. and Meera, A. 2009. A text book of environmental studies, S. Chand, New Delhi.
3. Sanyal, K. Kundu, M. and Rana, s. 2009. Ecology and environment, Books and allied, Kolkata.
4. Grant, W.E. and Swannack, T.M., 2008, Ecological Modelling, Blackwell.

### REFERENCES BOOKS

1. Odum E.P.1983. Basic Ecology, Saunders, New York
2. Wilkinson, D.M., 2007, Fundamental Processes in Ecology: An Earth system Approach, Oxford University Press, UK.
3. Saha, T.K. 2010. Ecology and Environmental biology, Books and Allied, Kolkata.

### WEB RESOURCES

1. <https://bit.ly/2VYWOM5>
2. <https://bit.ly/2VZQFiT>
3. <https://bit.ly/3kqdXYA>
4. <https://bit.ly/39rvvg>

Semester	Code	Title of the Course					Hours	Credits				
VI	23UZO6CC14	Environmental Biology					6	5				
Course Outcomes (COs)	Programme Outcomes(Pos)					Programme Specific Outcomes(PSOs)						
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5		
CO1	✓	✓	✓	✓	✓	✓				✓		
CO2			✓	✓	✓	✓	✓	✓	✓	✓		
CO3			✓				✓					
CO4	✓	✓	✓	✓	✓	✓		✓	✓	✓		
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
Number of Matches(✓) = <b>36</b> Relationship: <b>HIGH</b>												

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

HOD & Chairperson

## SEMESTER – VI

Course Code: 23UZO6CC15P

Instruction Hours: 6

Credits: 5

Exam Hours: 3

Internal Marks: 40

External Marks: 60

### LABORATORY COURSE- VI (EVOLUTION & ENVIRONMENTAL BIOLOGY)

#### OBJECTIVES:

1. To demonstrate an understanding of core ecological principles, and define scientific principles and concepts as related to environmental studies and sustainability.
2. Measure and interpret experimental data and demonstrate laboratory skills in ecology.
3. To make an awareness about various effects of pollution and its management.
4. To provide practical knowledge and hands on tools and techniques for dose-response assessment of hazardous substances.

#### COURSE OUTCOMES:

1. Students to describe the history and development of evolutionary thought list and describe the evidence for evolution and its required corollaries and mechanisms by which evolution occurs.
2. Students to describe the history of life on earth.
3. Students to explain how speciation occurs and reasons for extinction.
4. Students can make knowledge of how major vertebrate forms evolved in the earth.

#### ENVIRONMENTAL BIOLOGY

1. Estimation of dissolved oxygen.
2. Estimation of dissolved CO<sub>2</sub>
3. Determination of alkalinity in water samples
4. Determination of salinity of water samples,
5. Determination of bicarbonate and carbonates.
6. Estimation of Calcium.
7. Mounting and identification of plankton (fresh water / marine).

#### SPOTTERS:

Animal association, Intertidal fauna -Study of sandy shore fauna- Study of rocky shore fauna, Secchidisc, Thermometer, Barometer. Spectrophotometer, Colorimeter, Ultracentrifuge, Incubator, HPLC.

#### EVOLUTION

1. Animals of evolutionary importance: Peripatus, Limulus, Archaeopteryz.
  2. Homologous organs: Fore limbs of Frog.
  3. Analogous organs: Wings of Insects and Birds.
  4. Fossils: Trilobite, Nautilus.
  5. Living fossil Sphenodon.
  6. Mimicry: Leaf insects, Stick insects, Monarch and Viceroy butterfly.
- Colouration: Chameleon, Lycodon.

#### FIELD WORK:

Visit to a local area to document environmental assets river/forest/grassland/hill/mountain. Visit to a local polluted site- Urban/Rural/Industrial/Agricultural. Study of common plants, insects, birds. Study of simple ecosystems-pond, river, hill slopes, etc.

#### TEXT BOOKS:

1. Widmaier, E.P., Raff, H. and Strang, K.T. 2008. Vander's Human Physiology, XI Edition., McGraw Hill., 770 PP.
2. Bishop, ML., Fody, E.P., Schoeff, LE. 2010. Clinical Chemistry: Principles, Procedure,

correlations. Wolters Kluwer, Inida, 298 PP.

3. Burtis, C.A. and Ashwood, E.R. 2008. Tietztext book of Fundamentals of clinical chemistry and molecular diagnostics, Elsevier, Philadelphia.
4. Tortora G.J.&Derrickson B., 2016. Principles of Anatomy and Physiology, John Wiley and Sons, Inc. 1232 PP.
5. Agarwal R A., Anil K Srivastava.,Kaushal Kumar.,1978. Animal Physiology and Biochemistry, S. Chand & Co. Ltd., New Delhi Publishing., 377 PP.
6. Abhijit Dutta, 2009. Experimental biology: A Laboratory Science, Narosa, New Delhi.
7. Michael, P, 1984. Ecological Methods for field visit and laboratory investigation. Tata McGraw Hill, New Delhi.
8. APHA, 1992. Standard Methods for the examination of water and waste water, American Public Health association, Washington D.C.

#### REFERENCES BOOKS:

1. Hoar, W.S. 1983. General and Comparative Physiology. Prentice Hall of India, New Delhi., 928 PP.
2. Prosser C.L., 1985. Comparative Animal Physiology, Satish Book Enterprise, Agra - 282 003, 966 PP.
3. Wood, D.W., 1968. Principles of Animal Physiology, Edward Arnold Ltd, London.,342 PP.
4. Guyton, A.C. and Hall, J.B., 2011. Text Book of Medical Physiology, 9th Edition, W.B. Sanders Company, Prism Books (Pvt.) Ltd., Bangalore., 1064 PP.
5. Wilson, J.A. 1984, Principles of Animal Physiology, Macmillan Publishing., 426 PP.
6. Eugenia, 2008. Environmental Biotechnology and cleavers Bioprocesses, London.
7. Ramesh, R & M, Anbu 1996. Chemical methods for environmental Analysis of water and sediment. Macmillan India Limited, Chennai.

Semester	Code	Title of the Course	Hours	Credits						
VI	23UZ06CC15P	Evolutionary Biology & Environmental Biology - Practical	6	5						
Course Outcomes (COs)	Programme Outcomes (Pos)					Programme Specific Outcomes (PSOs)				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓	✓	✓	✓	✓	✓				✓
CO2			✓	✓	✓	✓	✓	✓	✓	✓
CO3			✓				✓			
CO4	✓	✓	✓	✓	✓	✓		✓	✓	✓
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Number of Matches(✓) = <b>36</b> Relationship: <b>HIGH</b>										

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

HOD & Chairperson

## SEMESTER -VI

Course Code: 23UZO6DE3

Instruction Hours: 6

Credits: 4

Exam Hours: 3

Internal Marks: 25

External Marks: 75

### DISCIPLINE SPECIFIC ELECTIVE COURSE-III ANIMAL BIOTECHNOLOGY

#### OBJECTIVES:

1. To impart the skills required to explain the protocols for genetically manipulating cells and produce transgenic animals.
2. To encourage the use of the apt molecular techniques to evaluate and analyze animal traits and diseases at the genomic level and employ methods for easy taxonomical identification and classification for biodiversity and environmental studies.
3. To study methods of transgenesis and to consider their use in improving animal husbandry and animal health.
4. To motivate students to review the ethics and speculate on the environmental implications of animal biotechnological methods

#### COURSE OUTCOMES:

1. To describe the methodologies for handling animal cells based on their diverse characteristics and identify the correct biotechnological tools to obtain the desired products from the cells.
2. To develop and explain the protocols for genetically manipulating cells and produce transgenic animals
3. To select the apt molecular techniques to evaluate and analyze animal traits and diseases at the genomic level and devise methods for easy taxonomical identification and classification for biodiversity and environmental studies.
4. To choose the correct methods of transgenesis and to consider their use in improving animal husbandry nationally and globally
5. To speculate on the environmental implications of animal biotechnological methods and design responsible, ethical solutions to livestock production and health issues.

#### UNIT – I

**Fundamentals of Biotechnology** : Animal cell culture: Basic requirements and techniques of cell culture, natural and synthetic culture media, primary culture and cell lines; Stem cells: types, culture and applications; r-DNA technology: Enzymes; Vectors – pBR322, Phage lambda, Cosmid, HAC, BAC, YAC; Host cells; Gene cloning: steps in cloning, selection of clones – chromogenic substrate, antibiotics.

#### UNIT – II

**Techniques in Animal Biotechnology** : Isolation and purification: DNA and mRNA; Blotting techniques: Methods of different types of blotting; DNA sequencing: Sanger method, DNA chips, microarray; PCR: principle, types and application; Gene library: screening with probes; Site directed mutagenesis: principle and application; Gene transfer in animal cells: transfection, liposomal, viral mediated, electroporation, biolistic, direct DNA injection.

#### UNIT – III

**Transgenic Animal Technology** : Transgenesis: Concept, transgenes, transgenic animal models - knock out mice, sheep; Applications of transgenesis : Molecular farming, Transgenic fishes, transgenic live stocks, and animals as bioreactors.

## UNIT – IV

**Animal Biotech and Health Care** : Medical biotechnology: Monoclonal antibodies, recombinant vaccines –hepatitis B, hormones – insulin. DNA diagnostic systems: tuberculosis, AIDS, genetic diseases; Gene therapy: Ex vivo and in vivo, role in cancer treatment; CRISPR gene editing. Molecular markers: RFLP, RAPD, DNA fingerprinting and application.

## UNIT – V

**Applications and Ethics** : Human genome project: Mapping of human genome, applications, ethics; Industrial biotechnology: Bioreactors - Basic concepts of fermentation, bioreactor design, production of ethanol and streptomycin; Ethics: Socio ethical problem, recent trends in animal biotechnology, ethical implications.

## TEXT BOOKS:

1. Singh B. D., 2015. Biotechnology: Expanding horizon, Kalyani publishers.
2. Sasidhara, R., 2015. Animal biotechnology, MJP publishers.
3. Dubey R. C., 2014. A text Book of Biotechnology, S. Chand & Co Ltd, Ram Nagar, New Delhi.
4. Dubey S. K., Bandana Ghosh, 2012. Fish biotechnology, Wisdom Press.
5. Dubey R.C., 2014. Advanced Biotechnology, S. Chand Publication.
6. Ruby, R.C., 2012. A text book of biotechnology, S. Chand Company, New Delhi.
7. Sambamurthy K., Ashutosh Kar., 2009. Pharmaceutical Biotechnology, New Age International (P) Ltd.
8. Ramdoss P., 2009. AnimalBiotechnology- Recent concepts and developments, MJP publishers.
9. Sathanarayan U., 2008. Biotechnology, Books and Allied, Kolkata.
10. Ignacimuthu, S., 2008. Basic Biotechnology, Tata McGraw hill, New Delhi.
11. Rastogi S. C., 2007. Biotechnology: Principles and applications, Alpha Science publishers. Ranga, M.M., 2003. Animal biotechnology, Agrobios, New Delhi.

## REFERENCES BOOKS:

1. Veer Bala Rastogi, 2016. Principles of Molecular biology, Medtech, Maine, USA.
2. Michael Crichton, 2014. Essentials of Biotechnology, Medtech, Maine, USA.
3. Godbey W.T., 2014. An Introduction to Biotechnology, Academic press, New York, USA.
4. Peters, P., 2009. Biotechnology – A guide to genetic engineering, WMC brown publisher, UK.
5. Ramawat, K.G and Shailey Goyal, 2009. Comprehensive biotechnology,
6. S.Chand company, New Delhi, India.
7. Primrose S.B., R. M. Twyman and R. W. Old, 2001. Principles of gene manipulation, Wiley-Blackwell, UK.
8. Primrose S. B., 2001. Molecular Biotechnology, Panima Publishing Corporation, New Delhi, India.
9. Hames B.D. and Higgins S.J. 1995. Gene Probes: A Practical Approach, Oxford University Press, UK.

## WEB RESOURCES:

1. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3612824/>
2. <https://www.isaaa.org/resources/publications/pocketk/40/default.asp>
3. <https://www.ncbi.nlm.nih.gov/books/NBK207574/>
4. <https://iopscience.iop.org/article/10.1088/1755-1315/492/1/012035/pdf>
5. <https://go.nature.com/3zAZmO9>

Semester	Code	Title of the Course					Hours	Credits			
III	23UZO3DE3	Animal Biotechnology					6	4			
Course Outcomes (COs)	Programme Outcomes (Pos)					Programme Specific Outcomes (PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓	✓	✓	✓	✓				✓	
CO2			✓	✓	✓	✓	✓	✓	✓	✓	
CO3			✓				✓				
CO4	✓	✓	✓	✓	✓	✓		✓	✓	✓	
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Number of Matches(✓) = <b>36</b> Relationship: <b>HIGH</b>											

<b>Mapping</b>	1-29%	30-59%	60-69%	70-89%	90-100%
<b>Matches</b>	1-14	15-29	30-34	35-44	45-50
<b>Relationship</b>	Very Poor	Poor	Moderate	High	Very High

HOD & Chairperson



## SEMESTER -VI

Course Code: 23UZO6DE4

Instruction Hours: 6

Credits: 4

Exam Hours: 3

Internal Marks: 25

External Marks: 75

### DISCIPLINE SPECIFIC ELECTIVE COURSE-IV MICROBIOLOGY

#### OBJECTIVES :

1. To become familiar with the foundation concepts of history of Microbiology
2. To understand the structure and functions of a typical prokaryotic cell
3. To gain the knowledge of microscopy and staining concepts
4. To understand and implement disposal and safety measures

#### COURSE OUTCOMES

1. To understand history, relevance of microbiology and classification of bacteria
2. To understand the working of various microscopes and their application
3. To gain knowledge of various (physical and chemical) methods of control of microorganisms and safety measures to be followed while handling microbes
4. To understand the structure of bacterial cells, its organelles, physiology and behaviour.
5. To learn different methods of staining bacteria and demonstrate proficiency in handling aseptic bacteriological specimen.

#### UNIT I

History, scope, branches of microbiology. Contribution of Leeuwenhoek, Jenner, Pasteur, Koch, Fleming, Iwanowsky, Waksman, Luria, M. J. Thirumalachar, Subba Rao, Sambhu Nath De. Evolution of Microbial diversity. Systematic position: 5 kingdom classification of Whittaker and 3 kingdom classification of Carl Woese. Comparison of Bacteria, Archaea, Eukarya (tabular and diagrammatic). Controlling microbes.

#### UNIT II

##### Microscopy

Principles of microscopy ii. Compound microscope (Monocular and Binocular microscopes) – construction and function of parts, ray diagram of path of light, objectives, oculars, condensers, sources of illumination and uses iii. Dark field, Phase contrast and Fluorescence microscopes, Confocal microscopes, Atomic Force Microscope - principle, construction, ray diagram and applications iv. Electron microscopy – TEM and SEM – principle, construction, ray diagram and uses.

#### UNIT III

##### Introductory Mycology

General characteristics and outline classification of fungi, Morphology of some common fungi - Mucor, Rhizopus, Aspergillus, Penicillium and Fusarium. Yeasts: General characteristics and outline classification of yeasts 3. General characteristics of Lichens and Mycorrhiza.

#### UNIT IV

##### Introductory Bacteriology

Classification of bacteria. Anoxygenic photosynthetic bacteria: general characteristics of purple bacteria and green bacteria. Oxygenic photosynthetic bacteria: General characteristics of Cyanobacteria – external and internal features, physiology and ecology. Magnetotactic bacteria- General characteristics, Magnetosomes, Enrichment and isolation of Magnetotactic bacteria. Types of staining.

## UNIT V

### Introductory Virology

Virus Structure and Classification. Virus Entry and Viral Pathogenesis. Positive-strand RNA viruses: Picornaviruses, Flaviviruses, Togaviruses, Coronaviruses. Negative-strand and double-strand RNA viruses: Paramyxoviruses, Rhabdoviruses, Filoviruses, Bunyaviruses, Orthomyxoviruses and Reoviruses. DNA viruses: Parvoviruses, Polyomaviruses, Papillomaviruses, Adenoviruses and Baculoviruses, Herpes viruses and Poxviruses.

### TEXT BOOKS:

1. Aneja K.R., Experiments in Microbiology, plant pathology, Tissue culture and Mushroom Cultivation , New Age International, New Delhi.
2. Atlas R.M., Microbiology – fundamentals and applications, Macmillan Publishing Company, New York.
3. Ravindra Nath, Fundamentals of Biology Courses for Biotechnology, - Vol.1, Special Bangalore University edition, Kalayani Publishers.
4. Greenwood D, Richard CD, John S and Peuther F (1992). Medical Microbiology, 16th edition. ELBS, Churchill living stone

### REFERENCE BOOKS:

1. Alexopoulos C.J. and Mims C.W., Introductory Mycology, New Age International, New Delhi.
2. Thomas M. Bell, 1965. An Introduction to General Virology, William Heinemann Medical books, London.
3. Stanier R.Y., Ingraham J.L., General Microbiology, Prentice Hall of India Private Limited, New Delhi.
4. Salle A.J., Fundamental Principles of Bacteriology, Tata McGraw – Hill Publishing Company Limited, New Delhi.
5. Pelczar .J. Chan E.C.S. and Krieg N.R., Microbiology, McGraw Hill Book Company, New York.
6. Benson Harold J, Microbiological Applications, WCB McGraw – Hill, New York.
7. Brock T.D. and Madigan M.T., Biology of Microorganisms, Prentice Hall of India Private Limited.
8. Collins CH, Patricia M, and Lyne JM (1995). Collins and Lynes Microbiological Methods 7th edition. Grange, Butter Worth, Oxford.
9. Cappucino JG and Sherman N (1996). Microbiology, A Laboratory Manual 4th edition. Benjamin Cumings Inc. California.
10. Pelczar MJ, Chan ECS and Krieg NR (1993). Microbiology 5th edition, Tata McGraw Hill.
11. Madigan MT, Martinko JM and Parker J (2012). Brock Biology of Microorganism, 11th edition Prentice Hall International Inc. London.

### WEB RESOURCES

<https://vlab.amrita.edu/?sub=3&brch=73>

<https://learn.chm.msu.edu/vibl/>

<https://mvi-au.vlabs.ac.in/>

<https://virtuallab.tlc.ontariotechu.ca/intro.php>

<https://www.merlot.org/merlot/viewMaterial.htm?id=79694>

Semester	Code	Title of the Course					Hours	Credits			
I	23UZO6DE4	Microbiology					6	4			
Course Outcomes (COs)	Programme Outcomes (Pos)					Programme Specific Outcomes (PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓	✓	✓	✓	✓				✓	
CO2			✓	✓	✓	✓	✓	✓	✓	✓	
CO3			✓				✓				
CO4	✓	✓	✓	✓	✓	✓		✓	✓	✓	
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Number of Matches(✓) = 36 Relationship: <b>HIGH</b>											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

HOD & Chairperson

## SEMESTER – I

Course Code: 23UZO1AC1

Instruction Hours: 5

Credits: 4

Exam Hours: 3

Internal Marks: 25

External Marks: 75

### ALLIED ZOOLOGY-I

#### OBJECTIVES:

1. To acquire a basic knowledge of diversity and organization of Protozoa, Coelenterata, Helminthes and Annelida
2. To acquire a basic knowledge of diversity and organization of Arthropoda, Mollusca and Echinodermata
3. To comprehend the taxonomic position and diversity among Protochordata, Pisces and Amphibia
4. To comprehend the taxonomic position and diversity among Reptilia, Aves and Mammalia
5. To acquire detailed knowledge of select invertebrate and chordate forms

#### COURSE OUTCOMES:

1. Recall the characteristic features invertebrates and chordates.
2. Classify invertebrates up to class level and chordates up to order level
3. Explain and discuss the structural and functional organisation of some invertebrates and chordates
4. Relate the adaptations and habits of animals to their habitat
5. Analyse the taxonomic position of animals.

#### UNIT – I

##### Diversity of Invertebrates–I

Principles of taxonomy. Criteria for classification–Symmetry and Coelom–Binomial nomenclature. Classification of Protozoa, Coelenterata, Helminthes and Annelida upto classes with two examples

#### UNIT – II

##### Diversity of Invertebrates–II

Classification of Arthropoda, Mollusca and Echinodermata upto class level with examples

#### UNIT – III

##### Diversity of Chordates–I

Classification of Prochordata, Pisces and Amphibia upto orders giving two examples

#### UNIT – IV

##### Diversity of Chordates–II

Classification of Reptilia, Aves and Mammalian upto orders giving two examples

#### UNIT – V

##### Animal organization

Structure and organization of (i).Earthworm (ii)Rabbit/Rat and (iii)Prawn/Fish

#### TEXT BOOKS

Ekambaranatha Iyar, - Outlines of Zoology Viswanathan Publication

#### REFERENCES BOOKS

1. Ekambaranatha Iyar and T.N. Ananthkrishnian - A Manual of Zoology Invertebrata–

VolII:Viswanathan Publishers.

2. Ekambaranatha Iyar and T.N.Ananthakrishnan,-A Manual of Zoology-Invertebrata– VolIII:ViswanathanPublishors.
3. Ekambaranatha Iyar and T.N.Ananthakrishnan,-A Manual of Zoology:Chordata Viswanathan Publishers.
4. JordanE.L. and P.S. Verma- Invertebrate Zoology,S.Chand&Co.

### WEB RESOURCES

1. [www.sanctuaryasia.com](http://www.sanctuaryasia.com)
2. [www.iaszoology.com](http://www.iaszoology.com)

Semester	Code	Title of the Course					Hours	Credits			
VI	23UZO1AC1	Allied Zoology-I					5	4			
Course Outcomes (COs)	Programme Outcomes(Pos)					Programme Specific Outcomes(PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓		✓	✓	✓	✓	✓			✓	
CO2			✓		✓	✓	✓	✓	✓	✓	
CO3	✓		✓		✓		✓		✓		
CO4	✓	✓	✓	✓	✓	✓		✓	✓	✓	
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Number of Matches(✓) = 36 Relationship: <b>HIGH</b>											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

HOD & Chairperson

## SEMESTER – II

Course Code: 23UZO2AC2

Instruction Hours: 3

Credits: 3

Exam Hours: 3

Internal Marks: 25

External Marks: 75

### ALLIED ZOOLOGY-II

#### OBJECTIVES:

1. To enable students to learn basic concepts relating to aspects of respiratory, circulatory, excretory nervous and sensory physiology.
2. To enable students to comprehend the processes involved during development
3. To enable students to learn basic concepts of immunity and the working of immune organs and familiarize them with the recommended vaccination schedule
4. To enable students to comprehend the basic concepts of human genetics and patterns of inheritance
5. To enable students to learn about aspects of animal behaviour such as foraging, courtship, nest construction, parental care and learning

#### COURSE OUTCOMES:

1. Recall the parts and working of body organs and developmental stages, name the patterns of inheritance and list different types of animal behaviour
2. Analyse the different developmental stages
3. Analyse the working of body and immune systems
4. Analyse the different patterns of inheritance
5. Relate the behaviour of animals to physiology. Analyse the different types of behavior

#### UNIT – I

Respiration- Respiratory pigments and transport of gases. Mechanism of blood clotting. Types of excretory products – Ornithine cycle. Structure of neuron – Conduction of nerve impulse, Mechanism of vision and hearing.

#### UNIT – II

Fertilization, Cleavage, Gastrulation and Organogenesis of Frog; Placentation in mammals

#### UNIT – III

Innate and Acquired - Active and Passive; Antigens and Antibodies; Immunological organs–responses in humans; Vaccination schedule

#### UNIT – IV

Human Genetics: Human Chromosomes – Sex Determination in Humans; Patterns of Inheritance: Autosomal Dominant, Autosomal Recessive, X-linked, Y-linked, Mitochondrial, Multiple Allelic and Polygenic; Genetic Counselling

#### UNIT – V

Animal Behaviour: Foraging, Courtship Behaviour, Shelter and Nest Construction, Parental Care, Learning Behaviour

#### TEXT BOOKS

1. Verma P.S. & Agarwal - Developmental Biology, Chordata embryology S. Chand & Co.

## REFERENCES BOOKS

1. Owen, J. A., Punt, J. & Stranford, S. A. - Kuby Immunology. New York: W.H. Freeman & Company
2. Klug, W. S., Cummings, M. R. & Spencer, C - Concepts of Genetics. (12th ed.). New Jersey: Pearson Education
3. Mathur, R.- Animal Behaviour. Meerut: Rastogi.
4. Verma P.S.& Agarwal-Developmental Biology,Chordata embryology S.Chand&Co.

Semester	Code	Title of the Course					Hours	Credits			
1	23UZO1AC2	Allied Zoology-II					3	3			
Course Outcomes (COs)	Programme Outcomes(Pos)					Programme Specific Outcomes(PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓	✓		✓	✓				✓	
CO2	✓		✓	✓	✓	✓	✓	✓	✓	✓	
CO3			✓		✓		✓				
CO4	✓	✓	✓	✓	✓	✓		✓	✓	✓	
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Number of Matches(✓) = <b>37</b> Relationship: <b>HIGH</b>											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

HOD & Chairperson

## SEMESTER-II

Course code: 23UZO2AP1

Instruction Hours: 2

Credit: 2

Exam Hours:3

Internal Marks:40

External Marks:60

### ZOOLOGY ALLIED PRACTICAL – I

#### OBJECTIVES:

1. To identify the different groups of invertebrate and chordate animals by observing the external characteristics.
2. Able to dissect and display the internal organ and mount the mouth parts and scales of animals.
3. To elucidate the segmental changes in pattern, development and organization.
4. To understand the importance of multiple alleles in human with blood grouping.

#### COURSE OUTCOMES:

1. Understand the evolution, history of phylum.
2. Understand about the Non Chordate and Chordate animals.
3. Understand the external as well as internal characters of non-chordates and chordates.
4. Be familiar with the events that led up to fertilization.
5. Understand the distinguishing characters of chordates and Invertebrates.

#### Dissection

Earthworm: Nervous system

Cockroach: Digestive system – Nervous system

#### Mounting:

Earth worm: Body seate Cockroach –mouthparts

Shark: Placoid scale

#### SPOTTERS:

##### 1. Classify by giving reasons

Paramecium– Entamoeba–Plasmodium– Ascaris– Fasciola– Wuchereria

Bancrofti– Sycon– Obelia– Taenia solium– Leech– Neries– Prawn– Freshwater mussel–  
Limulus– Seastar– Balanoglossus– Amphioxus– Ascidian– Shark– Calotes– sea snake–  
Pigeon– Bat– Rat– Rabbit.

##### 2. Biological significance:

Paramecium conjugation– physalia– Trochophore Larva– Peripatus– Sea Anemoneon  
HermitCrab– PearlOyster– Bipinnaria Larva– Anabas– Cobra– Russels Viper.

##### 3. Relate structure and function:

Sponge Spicules– Obelia–Polyp– Taenia–Scolex– Nereis – Parapodium– Honey bee  
sting apparatus– Pedicellaria of Sea star– Ctenoid Scale– Quill Feather of pigeon.

##### 4. Draw labelled sketches:

Pectoral girdles of Frog – Pigeon. Pelvic Girdles of Frog – Pigeon. Fore – Hind limbs of  
Frog.

##### 5. Observation of prepared slides to study

- a. Egg, cleavage, blastula and yolk plug stage in frog



## 6. Blood: Bleeding time and clotting time & Blood grouping in human

### REFERENCE BOOKS:

1. Verma.P.S.2011 A Manual of Practical Zoology invertebrates Chand & Co, Ltd, Ram Nagar– New Delhi.
2. Verma.P.S.2011 A Manual of Practical Zoology chordates, Chand & co, Ltd. Ram Nagar– New Delhi.
3. Jayanpa Sinha. 2010 Advanced Practical Zoology, Books & Allied (p) Ltd.No.1.Subham Plaza I Floor, Calcutta.

Semester	Code	Title of the Course					Hours	Credits			
V	23UZ02AP1	<b>Zoology Allied Practical – I</b>					2	2			
Course Outcomes (COs)	Programme Outcomes (Pos)					Programme Specific Outcomes (PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓	✓	✓	✓	✓				✓	
CO2			✓	✓	✓	✓	✓	✓	✓	✓	
CO3			✓				✓				
CO4	✓	✓	✓	✓	✓	✓		✓	✓	✓	
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Number of Matches(✓) = <b>36</b> Relationship: <b>HIGH</b>											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

HOD & Chairperson