B.Sc. ZOOLOGY
(Effective from the academic year 2024 - 2025)

Vision of the Department:

- To co-exist without tampering nature
- Helping the students to understand the formation and functioning of living organisms
- Imparting knowledge about the various technologies in life sciences
- Creating awareness to conserve the environment

Objectives of the Department:

- ❖ Helping the students to understand the diversity, formation and functioning of living organisms.
- ❖ Creating awareness to conserve and coexist with the nature.
- ❖ To know one's position, role and sustenance in environment.
- ❖ To provide a platform for the various interdisciplinary/ research oriented/ advanced higher education in LIFE SCIENCES.
- ❖ Preparing the students for economic independency through self-employment.

Eligibility for admission to B.Sc. Zoology:

- A pass in higher secondary with Mathematics, Physics, Chemistry and Biology (Category I).
- A pass in higher secondary with Physics, Chemistry, Biology and Computer Science (Category II).
- A pass in higher secondary with Physics, Chemistry, Zoology and Botany (Category III).

Allied Subjects:

1. Chemistry
2. Botany

Eligibility to take Allied Subjects:

Students who belong to category I, II and III are eligible for the Allied papers.

Highlights of the Revamped Curriculum:

- ➢ Student-centric, meeting the demands of industry & society, incorporating industrial components, hands-on training, skill enhancement modules, industrial project, project with viva-voce, exposure to entrepreneurial skills, training for competitive examinations, sustaining the quality of the core components and incorporating application-oriented content wherever required.
- ➢ The Core subjects include latest developments in the education and scientific front, practical training, catering to the needs of stakeholders with research aptitude.
- ➢ The curriculum is designed to strengthen the industry-academia interface and provide more job opportunities for the students.
- ➢ The Internship during the second-year vacation will help the students gain valuable work experience, that connects classroom knowledge to real world experience and to narrow down and focus on the career path.
- ➢ Project with viva-voce component in the fifth semester enables the students to apply their conceptual knowledge to practical situations. Such innovative provisions of the industrial training/project/internships will give students an edge over the counterparts in the job market.
- ➢ State-of Art techniques from the streams of multi-disciplinary, cross disciplinary and inter disciplinary nature are incorporated as Elective and Skill Enhancement Courses, covering conventional topics to the application oriented.

Value additions in the Revamped Curriculum:

Semester	Newly introduced Components	Outcome / Benefits
I	**Foundation Course in Zoology** To ease the transition of learning from higher secondary to higher education, providing an overview of the pedagogy of learning Chemistry and its concepts.	• Instil confidence among students • Create interest for the subject
I, II, III & IV	**Skill Enhancement papers** (Discipline centric/ Generic / Entrepreneurial)	• Industry ready graduates • Skilled human resource • Students are equipped with essential skills to make them employable
		• Entrepreneurial skill training will provide an opportunity for independent livelihood • Generates self – employment • Create small scale entrepreneurs • Skill training to girls leads to women empowerment
		• Discipline centric skill will improve the technical knowhow of solving real life problems
I, II, III, IV, V & VI	**Elective papers-** An open choice of topics categorized under Generic and Discipline Centric	• Strengthening the domain knowledge • Introducing the stakeholders to the state-of art techniques from the streams of multi-disciplinary, cross disciplinary and inter disciplinary nature • Emerging topics related to industry are introduced to facilitate advanced learning in the respective domains
II Year Vacation activity	**Internship / Industrial Training**	• Practical training at the Industry/ Chemical Companies/Educational institutions, enable the students gain professional experience and become responsible citizens.
V Semester	**Project with Viva – voce**	• Self-learning is enhanced • Application of the concept to real situation is conceived resulting in tangible outcome
VI Semester	**Introduction of Professional Competency component**	• 'General Awareness for Competitive Examinations' caters to the needs of the aspirants towards most sought - after services of the nation viz, UPSC, ISS, CDS, NDA, Banking Services, CAT, TNPSC group services, etc.
Skills acquired from the Courses		Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill

B.Sc. ZOOLOGY TANSCHE based Programme Structure of the Course and Scheme of Examination: (Effective from the Academic Year 2024 – 2025)

Sem	Part	Category	Paper Code	Title of Subject	Hours	Exam		Credits	Marks
						Th	Pr		
I	I	Language	ULTAA24	Tamil Paper- I	5	3	-	3	40+60
	II	English	UENGA24	English Paper- I	6	3	-	3	40+60
	III	Core 1	UCZOA24	Invertebrata	5	3	-	5	40+60
	III	Core Practical I	UCZOB24	Core Practical-I Invertebrata	3	-	3	3	40+60
	III	Generic Elective 1	UACHA24	Allied I: Chemistry-I	4	3	-	3	40+60
	III	Generic Elective Practical I	UACHB24	Allied Practical: Chemistry	2	3	-	2	40+60
	IV	Skill Enhancement Course SEC 1	USZO124	SEC: Biocomposting for Entrepreneurship	2	2	-	2	40+60
	IV	Foundation course-FC	UFZO24	FC: Foundation Course in Zoology	2	2	-	2	40+60
	IV	Value Education	UVEDA22*	Value Education	1	-	-	-	-
				Total	**30**			**23**	**800**
II	I	Language	ULTAB24	Tamil Paper -II	6	3	-	3	40+60
	II	English	UENGB24	English Paper -II	5	3	-	3	40+60
	III	Core 1I	UCZOC24	Chordata	5	3	-	5	40+60
	III	Core Practical II	UCZOD24	Core Practical-II Chordata	3	-	3	3	40+60
	III	Generic Elective 2	UACHC24	Allied II: Chemistry-II	4	3	-	3	40+60
	III	Generic Elective Practical 2	UACHD24	Allied Practical: Chemistry	2	-	3	2	40+60
	IV	Skill Enhancement Course SEC 2	USZO224	SEC: Ornamental Fish farming and Management	2	2	-	2	40+60
	IV	Skill Enhancement Course –SEC-3	USZO324	SEC: Basic course in Ornithology	2	2	-	2	40+60
	IV	Value Education	UVEDA22**	Value Education	1	-	-	-	-
				Total	**30**			**23**	**800**
III	I	Language	ULTAC24	Tamil Paper -III	5	3	-	3	40+60
	II	English	UENGC24	English Paper -III	6	3	-	3	40+60
	III	Core 1II	UCZOE24	Cell Biology & Genetics	5	3	-	5	40+60
	III	Core Practical III	UCZOF24	Core Practical III Cell Biology and Genetics	3	-	3	3	40+60
	III	Generic Elective 2	UABTA324	Allied III: Botany-I	4	3	-	3	40+60
	III	Generic Elective Practical 2	UABTB324	Allied: Practical: Botany	2	-	3	2	40+60
	IV	Skill Enhancement Course SEC 4	USZO424	SEC: Aquarium Keeping	1	2	-	1	40+60
	IV	Skill Enhancement Course –SEC-5	USZO524	SEC: Bioinstrumentation	2	2	-	2	40+60
	IV	EVS	UNEVS24*	Environmental Studies	1	-	-	-	-
	IV	Value Education	UVEDA22***	Value Education	1	-	-	-	-
				Total	**30**			**22**	**800**

IV	I	Language	ULTAD24	Tamil Paper -IV	6	3	-	3	40+60
	II	English	UENGD24	English Paper -IV	5	3	-	3	40+60
	III	Core 1V	UCZOG24	Developmental Biology	5	3	-	5	40+60
	III	Discipline Specific Elective: 1/2. DSE 1/2	UEZOA24	Elective: Economic Zoology	3	3	-	3	40+60
			UEZOB24	Elective: Human Reproductive Biology					
	III	Generic Elective 3	UABTC24	Allied III: Botany-II	4	3	-	4	40+60
	III	Generic Elective Practical 2	UABTD24	Allied Practical: Botany	2	-	3	2	40+60
	IV	Skill Enhancement Course –SEC-6	USZO624	SEC: Basics in Marine Biology	2	2		2	40+60
	IV	Skill Enhancement Course SEC-7	USZO724	SEC: Food Nutrition & Health	1	2	-	1	40+60
	IV	Environmental Studies	UNEVS24	Environmental Studies	1	2	-	2	40+60
	IV	Value Education	UVEDA22****	Value Education	1	-	-	-	-
				Total	**30**			**25**	**900**
V	III	Core V	UCZOH24	Evolutionary Biology	6	3	-	4	40+60
	III	Core VI	UCZOI24	Animal Physiology	6	3	-	4	40+60
	III	Core VII	UCZOJ24	Environmental Biology	6	3	-	4	40+60
	III	Core Practical IV	UCZOK24	Core Practical -IV: Physiology and Developmental Biology	3	-	3	3	40+60
	III	Core VIII	UCZOL24	Project	5	-	-	4	100
	III	Discipline Specific Elective 3/4-	UEZOC24	Elective: Wildlife Conservation and Management	3	3	-	3	40+60
			UEZOD24	Elective: Agricultural Entomology					
	IV	Summer Internship	UIZO24	Internship	-	-	-	2	100
	IV	Value Education	UVEDA22*****	Value Education	1	-	-	-	-
				Total	**30**			**24**	**700**
VI	III	Core VIII	UCZOM24	Animal Biotechnology	6	3	-	4	40+60
	III	Core IX	UCZON24	Microbiology	6	3	-	4	40+60
	III	Core X	UCZOO24	Immunology	6	3	-	4	40+60
	III	Core Practical - V	UCZOP24	Core Practical -V: Environmental Biology and Toxicology	3	-	3	2	40+60
	III	Core Practical - VI	UCZOQ24	Core Practical VI: Biotechnology, Microbiology and Immunology	3	-	3	2	40+60
	III	Discipline Specific Elective 4/5- DSE 4/5	UEZOE24	Elective: Animal Behaviour	3	3	-	2	40+60
			UEZOF24	Elective: Nanobiology					
	IV	Professional Competency Skill	UPZO24	Professional Competency Skill	2	2	-	2	40+60
	IV	Value Education	UVEDA22	Value Education	1	2	-	2	40+60
	V	Extension Activities	-	Extension Activities (90Hours)	-	-	-	1	-
				Total	**30**	**-**	**-**	**23**	**800**
				Grand Total	**180**	**-**	**-**	**140+2***	**4800**

- Any one course of the following to be completed during III semester (15 hours teaching and 15 hours activities):
  i) Fundamentals of Computer and MS Office (Computer Science & B.C.A)
    - Advanced Excel
    - Multimedia Using Flash
    - Photoshop
  ii) Health and Fitness (Physical Education)

Methods of Evaluation						
S. No.	**Category**	**Assessment Tool**	**Maximum Marks**	**Exam Theory**	**Weightage**	
1	Core Courses/Generic & Discipline Specific Electives	I Continuous Assessment (ICA)	50	1 ½ h	35	40
		II Continuous Assessment (IICA)	50	1 ½ h		
		Innovative Component (IC)	5	-	5	
		End Semester Examination	100	3 h		60
2	Foundation Course/Professional Competency SEC/	I Continuous Assessment (ICA)	30	1 h	35	40
		II Continuous Assessment (IICA)	30	1 h		
		Innovative Component (IC)	5	-	5	
		End Semester Examination	60	2 h		60
3	EVS	Continuous Assessment (IICA)	25	1 h		40
		Innovative Component (IC)	25	-		
		End Semester Examination	60	2 h		60

Activity-based Assessment for Skill Enhancement Courses:

Activity 1 for Unit I: (Nature of Activity) – 20 marks
Activity 2 for Unit II: (Nature of Activity) – 20 marks
Activity 3 for Unit III: (Nature of Activity) – 20 marks
Activity 4 for Unit IV: (Nature of Activity) – 20 marks
Activity 5 for Unit V: (Nature of Activity) – 20 marks

Nature of Activity – Field visit/Industrial visit/Project (individual or group)/Exhibits/Model making/Hands on training/Lab practice/Product making/Extempore/Block and Tackle/Debate/Report writing/Case study/Interpretation of data or results/Transcription/Quiz (LMS)/Problem solving/ Designing/Role play/Start-up proposal/Research proposal/Poster presentation/Oral presentation (live or video recorded)/Survey (Field or Online)/Group discussion/Problem solving/Problem formulation/Interviews/Concept mapping/Mind mapping /Promoting public awareness etc.

Record of Assessment will be maintained by the course instructors and verified by the Head of the department.

Cognitive Levels of Assessment	
Recall (K1)	Simple definitions, MCQ, Recall steps, Concept definitions
Understand/ Comprehend (K2)	MCQ, True/False, Short essays, Concept explanations, short summary or overview
Application (K3)	Suggest idea/concept with examples, suggest formulae, Solve problems, Observe, Explain
Analyze (K4)	Problem-solving questions, finish a procedure in many steps, Differentiate between various ideas, Map knowledge
Evaluate (K5)	Longer essay/Evaluation essay, Critique or justify with pros and cons

Create (K6)	Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations

PROGRAMME OUTCOMES (PO):

On completion of the UG Programme, students will be able to:

PO1: Attain knowledge and understand the principles and concepts in the respective discipline.

PO2: Acquire and apply analytical, critical and creative thinking, and problem-solving skills

PO3: Effectively communicate general and discipline-specific information, ideas and opinions.

PO4: Appreciate biodiversity and enhance eco-consciousness for sustainable development of the society.

PO5: Emulate positive social values and exercise leadership qualities and team work.

PO6: Pursue higher knowledge, qualify professionally, enhance entrepreneurial skills and contribute towards the needs of the society.

PROGRAMME SPECIFIC OUTCOMES (PSO):

As Zoology graduates, students will:

PSO1: Demonstrate comprehensive knowledge on the complexity of life process, their molecular, cellular and physiological process, their genetics, evolution, behaviour and their interrelationship with the environment.

PSO2: Undertake further studies in Zoology or Multidisciplinary areas.

PSO3: Develop skills that are relevant to wage employment, self-employment and entrepreneurship.

PSO4: Technically sound in applying the Information technology and will be Lifelong learners in updating to the current advancements in their respective fields.

PSO5: Exercise leadership qualities and moral values through ethical ways with the concern for the society.

PSO6: Utilize the opportunities to conceptualize, nurture and accomplish the dream to be entrepreneur/leaders.

PSO/PO	**PO**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
PSO1	H	H	M	H	M	H
PSO2	H	H	H	H	M	H
PSO3	H	M	H	M	H	H
PSO4	M	H	H	H	H	H
PSO5	M	H	H	L	H	M
PSO6	M	M	H	L	H	H

H-HIGH (3): M-MODERATE (2): L-LOW-(1)

Consolidated Semester wise and Component wise Credit distribution

Parts	**Sem I**	**Sem II**	**Sem III**	**Sem IV**	**Sem V**	**Sem VI**	**Total Credits**
Part I	3	3	3	3	-	-	**12**
Part II	3	3	3	3	-	-	**12**
Part III	13	13	13	14	22	18	**93**
Part IV	4	4	3	5	2	4	**22**
Part V	-	-	-	-	-	1	**1**
Other	-	-	-	-	-	-	**2**
Total	**23**	**23**	**22**	**25**	**24**	**23**	**142**

*****Part I, II, and Part III components will be separately considered for CGPA calculation and classification for the undergraduate programme and the other components. IV, V must be completed during the duration of the programme as per the norms, to be eligible for obtaining the UG degree.

<table>
<tr><td>Title of the Course</td><td colspan="7">INVERTEBRATA</td></tr>
<tr><td>Paper No.1</td><td colspan="7">Core I</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>I</td><td>Credits</td><td>5</td><td>Course Code</td><td>UCZOA24</td></tr>
<tr><td>Semester</td><td>I</td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>5</td><td></td><td colspan="3">-</td><td colspan="2">5</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">• To understand the systematic and functional morphology of various groups of Invertebrates.
• To study their economic importance, affinities and adaptations.</td></tr>
<tr><td>Course Outline</td><td colspan="7">Unit I (15 Hours) (K1, K2, K3, K4)
1.1. Introduction to Classification, taxonomy and nomenclature.
1.2. General characters and classification of Phylum Protozoa up to classes.
1.3. Type study Plasmodium
1.4. Economic importance- Nutrition in protozoa.
1.5. Host-parasitic interactions in protozoa.
1.6. Locomotion in protozoa.</td></tr>
<tr><td></td><td colspan="7">Unit II: (15 Hours) (K1, K2, K3, K4)
2.1. General characters and classification up to Classes.
2.2.T ype study - Sycon.
2.3. Canal system in sponges.
2.4. Coelenterata General characters and classification up to classes.
2.5. Type study – Obeli.
2.6. Corals and coral reefs.</td></tr>
<tr><td></td><td colspan="7">Unit III: (15 Hours) (K1, K2, K3, K4)
3.1. Platyhelminthes-General characters and classification of up to classes.
3.2. Type study –Taenia solium.
3.3. Aschelminthes : General characters and classification of up to classes .
3.4. Type study - Ascaris lumbricoides.
3.5. Parasitic adaptations- Host-parasitic interactions of Helminth parasites.
3.6. Nematode- Parasitic diseases - Wuchereria bancrofti.</td></tr>
<tr><td></td><td colspan="7">Unit IV: (15 Hours) (K1, K2, K3, K4)
4.1. General characters and classification up to Classes.
4.2. Type study –Nereis.
4.3. Modes of life in Annelids.
4.4. Arthropoda General characters and classification of Phylum Arthropoda up to Classes.
4.5. Detailed study- Penaeus indicus.
4.6. Larval forms in Crustacea.</td></tr>
</table>

	Unit V: (15 Hours) (K1, K2, K3, K4) 5.1. General characters and classification of Phylum Mollusca up to Classes. 5.2. Detailed study: *Pila globosa*.) 5.3. Foot and torsion in Mollusca. 5.4. General characters and classification of Phylum Echinodermata up to Classes. 5.5. Detailed study: *Asterias.* 5.6. Larval forms of Echinoderms.
Extended Professional Component (is a part of internal component only, not to be included in the external examination Question paper)	Questions related to the above topics, from various competitive examinations UPSC/JAM/TNPSC and others to be solved (To be discussed during the Tutorial hours)
Recommended Text	1.Ekambaranatha Iyer, 2000. A Manual of Zoology, 10th edition, Viswanathan, S., Printers & Publishers Pvt Ltd 2.Jordan, E.L. and Verma P.S, 1995. Invertebrate Zoology, 12th edn. S. Chand& Co.3.Kotpal, R.L, 1992. Protozoa, Porifera, Coelenterata, Annelida, Arthropoda.
Reference Books	**(**Latest editions, and the style as given below must be strictly adhered to) 1. Ruppert and Barnes, R.D. (2006). Invertebrate Zoology, VIII Edition. Holt Saunders International Edition. 2.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 3. Barrington, E.J.W. (1979). Invertebrate Structure and Functions. II Edition, E.L.B.S. and Nelson 4.Hyman L.H, 1955. The invertebrates - Vol. I to Vol. VII – Mc Graw Hill Book Co. 5.Parker, J. and Haswell , 1978. A text book of Zoology Vol. I - Williams and Williams. 6.Kotpal, 1992. Protozoa, Porifera, Coelenterata, Annelida, Arthropoda, Mollusca, Echinodermata, R.L- Rastogi Publication
Website and e-learning source	https://www.nationalgeographic.com/animals/invertebrates/ https://bit.ly/3kABzKa https://www.nio.org/ https://greatbarrierreef.org/ https://www.nationalgeographic.com/animals/invertebrates/ https://bit.ly/3kABzKa https://www.nio.org/ https://bit.ly/3lJdUX0

Course Outcomes:

On completion of the course, the students should be able to

CO1: Understand the basic concepts of invertebrate animals and recall its structure and functions. (K1, K2, K3,K4)

CO2: Illustrate and examine the systemic and functional morphology of various groups of Invertebrata. (K1, K2, K3,K4)

CO3: Infer and integrate the parasitic and economic importance of invertebrate animals. (K1, K2, K3,K4)

CO4: Analyze, compare and distinguish the developmental stages and describe the important biological process. (K1, K2, K3,K4)

CO5: To distinguish the various physiological processes and organ systems in lower animals. (K1, K2, K3,K4)

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

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

H-HIGH (3): M-MODERATE (2): L-LOW-(1)

<table>
<tr><td>Title of the Course</td><td colspan="7">INVERTEBRATA PRACTICAL</td></tr>
<tr><td>Paper No.2</td><td colspan="7">Core Practical I</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>I</td><td>Credits</td><td>3</td><td>Course Code</td><td>UCZOB24</td></tr>
<tr><td>Semester</td><td>I</td><td colspan="4"></td></tr>
<tr><td>Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="2">Lab Practice</td><td colspan="3">Total</td></tr>
<tr><td></td><td>-</td><td>-</td><td colspan="2">3</td><td colspan="3">3</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">• To obtain practical skills in dissection and display of the systems.
• To learn about adaptation, biological significance of animals.
• To understand the evolutionary significance and skeletal structures of animals.</td></tr>
<tr><td>Course Outline</td><td colspan="7">1. Dissections:
a) Major: Cockroach – Digestive and Nervous system.
b) Prawn: Digestive and Nervous system.
2. Minor: Mouth parts - Mosquito, House fly.
Prawn - Cephalic Appendages.
Thoracic Appendages.
Abdominal Appendages.
3. Study of museum specimen/ slides relevant to the types studied in theory:
a) Biological significance
b) Descriptive notes
c) Structure and function
d) Evolutionary significance

Spotters List: Invertebrata
1. ENTAMOEBA
2. VOLVOX
3. PLASMODIUM
4. TRYPANOSOMA
5. VORTICELLA
6. SYCON
7. SPONGE GEMMULE
8. EUPLECTELLA
9. HYALONEMA
10. OBELIA COLONY
11. OBELIA MEDUSA
12. ADAMSIA
13. ZOANTHUS
14. PHYSALIA
15. VELLELA
16. TAENIA SOLIUM
17. SCOLEX OF TAENIA SOLIUM
18. BLADDERWORM
19. ASCARIS MALE AND FEMALE
20. SCHISTOSOMA
21. WUCHERERIA
22. NEREIS ENTIRE
23. NEREIS PARAPODIUM
24. CHAETOPTERUS
25. ARENICOLA
26. TROCHOPHORE LARVA
27. PRAWN ENTIRE
28. PRAWN – DIGESTIVE SYSTEM</td></tr>
</table>

	29. PRAWN – NERVOUS SYSTEM 30. PRAWN- APPENDAGES 31. NAUPLIUS LARVA 32. ZOEA LARVA 33. MEGALOPA LARVA 34. PERIPATUS 35. LIMULUS 36. COCKROACH- DIGESTIVE SYSTEM 37. COCKROACH- NERVOUS SYSTEM 38. HOUSEFLY MOUTH PARTS 39. MOSQUITO MOUTH PARTS 40. UNIO ENTIRE 41. GLOCHIDIUM LARVA 42. RADULA OF PILA 43. CHITON 44. MYTILUS 45. OCTOPUS 46. SEA STAR ENTIRE 47. PEDICELLARIA OF SEA STAR 48. BIPINNARIA LARVA 49. HOLOTHURIA 50. SEA LILY
Extended Professional Component (is a part of internal component only, not to be included in the external examination Question paper)	Questions related to the above topics, from various competitive examinations UPSC/JAM/TNPSC and others to be solved (To be discussed during the Tutorial hours)
Recommended Text	1. 1. Ekambaranatha Iyyar and T. N. Ananthakrishnan, 1995 A manual of Zoology Vol.I (Part 1, 2) S. Viswanathan, Chennai 2. Ganguly, Sinha an d A dhikari , 2 0 11 . Biology of Animals: Volume I, New Central Book Agency; 3rd revised edition. 1008 pp. 3. Sinha, Chatterjee and Chattopadhyay, 2 0 1 4. Advanced Practical Zoology, Books & Allied Ltd; 3rd Revised edition, 1 07 0 pp. 4. Lal ,S. S, 2016 . Practical Zoology Invertebrate, Rastogi Publications. 5. Verma, P. S. 2010. A Manual of Practical Zoology: Invertebates, S Chand, 4 97pp.
Reference Books	**(**Latest editions, and the style as given below must be strictly adhered to) 1. 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 Internationa 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 o Students*. Asia Publishing Home. 5. Lal, S.S. 2005. A text Book of Practical Zoology: Invertebrate, Rastogi, Meerut

Website and e-learning source	https://nbb.gov.in/ http://www.agshoney.com/training.htm https://icar.org.in/ http://www.csrtimys.res.in/ http://csb.gov.in/ https://iinrg.icar.gov.in/ https://www.nationalgeographic.com/animals/invertebrates/

Course Outcomes:

On completion of the course, the students should be able to

CO1: Acquire knowledge about the digestive, and nervous system of arthropods. (K1, K2, K3,K4)

CO2: Prepare mounting of the mouth parts of insects. (K1, K2, K3,K4)

CO3: Analyze the biological significance of invertebrates. (K1, K2, K3,K4)

CO4: Distinguish structure and function of invertebrates .(K1, K2, K3,K4)

CO5: Justify the importance of evolutionary significance of animals. (K1, K2, K3,K4)

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

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

H-HIGH (3): M-MODERATE (2): L-LOW-(1)

<table>
<tr><td>Title of the Course</td><td colspan="7">SKILL ENHANCEMENT COURSE: BIOCOMPOSTING FOR ENTREPRENEURSHIP</td></tr>
<tr><td>Paper No.16</td><td colspan="7">Skill Enhancement Course I</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">SEC</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">2</td><td>Course Code</td><td>USZO124</td></tr>
<tr><td>Semester</td><td>I</td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td colspan="2">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>2</td><td colspan="2"></td><td colspan="2">-</td><td colspan="2">2</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">• To highlight the importance of Biocomposting for entrepreneurship
• To enable students for setting up Biocompost units and bins for waste reduction.</td></tr>
<tr><td>Course Outline</td><td colspan="7">Unit I (6 hours) (K1, K2, K3 & K4)
1.1: Biocomposting – Definition and Types.
1.2: Ecological importance.
1.3: Compost and Vermicompost – Definition.
1.4: Compost and Vermicompost- Differences.
1.5: Role of Earthworms in Agriculture, Fishing and Medicine.</td></tr>
<tr><td></td><td colspan="7">Unit – II (6 hours) (K1, K2, K3 & K4)
2.1: Types of Biocomposting technology.
2.2: Field pits and Ground heaps.
2.3: Tank/large-scale
2.4: Batch and Continuous methods.
2.5: Preparation of Biocompost pit and bed using different amendments.</td></tr>
<tr><td></td><td colspan="7">Unit – III (6 hours) (K1, K2, K3 & K4)
3.1: Introduction and Scope of Vermiculture.
3.2: Ecological groups of earthworms.
3.3: Physical and Biological effects of earthworm on soil.
3.4: Factors affecting Vermicompost: pH, Moisture, Temperature, Light.
3.5: Natural enemies of earthworms and Collection of compost and separation of earthworms.</td></tr>
<tr><td></td><td colspan="7">Unit – IV (6 hours) (K1, K2, K3 & K4)
4.1: Applications of Biocompost
4.2: Soil fertility maintenance
4.3: Promotion of plant growth
4.4: Value added products
4.5: Vermi wash and Waste reduction.</td></tr>
<tr><td></td><td colspan="7">Unit – V (6 hours) (K1, K2, K3 & K4)
5.1: Economics of establishment of a small biocompost unit
5.2: Project report proposal for Self Help Group (Income and employment generation)
5.3: Schemes and Project available for the promotion of Vermiculture
54: Packing and Marketing of Bio-Compost
5.5: Applications of biocompost in pollution management.
Practical
➢ Preparation procedures for Biocompost pit.
➢ Selection of Biocompost material, separation of Compostable and Non-compostable materials.
➢ Packing and marketing of Biocompost.
➢ Field visit to Biocomposting unit.</td></tr>
</table>

Extended Professional Component (is a part of internal component only, not to beincluded in the external examination question paper)	Questions related to the above topics, from various competitive examinationsUPSC/JAM /TNPSC and others to be solved (To be discussed during the Tutorial hours)

Recommended Text	1. Ranganathan L.S. 2006. Vermibiotechnology from Soil Health to Human Health.
ReferenceBooks	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. Handbook for Composting and Compost Use in Organic Horticulture. BioGreenhouse COST Action FA 1105.
Website and e-learning source	www.biogreenhouse.org.

Course Outcomes:

On completion of the course, the students should be able to

CO1: Distinguish between compost and vermicompost. (K1, K2, K3, K4)

CO2: Demonstrate Biocomposting techniques. (K1, K2, K3, K4)

CO3: Explain the process of Biocomposting. (K1, K2, K3, K4)

CO4: Discuss the applications of Biocomposting. (K1, K2, K3, K4)

CO5: Analyze the economic cost of establishing small Biocompost units as a cottage industry. (K1, K2, K3, K4)

<table>
<tr><td>Title of the Course</td><td colspan="8">FOUNDATION COURSE IN ZOOLOGY</td></tr>
<tr><td>Paper No.28</td><td colspan="8">BASICS IN ZOOLOGY</td></tr>
<tr><td rowspan="2">Category</td><td>Foundation course</td><td>Year</td><td>I</td><td>Credits</td><td>2</td><td>Course Code</td><td colspan="2">UFZO24</td></tr>
<tr><td></td><td>Semester</td><td>I</td><td></td><td></td><td></td><td colspan="2"></td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td colspan="2">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>2</td><td colspan="2">-</td><td colspan="2">-</td><td colspan="2">2</td></tr>
<tr><td>Objectives of the course</td><td colspan="8">• To Instill confidence among students
• To Create interest for the subject</td></tr>
<tr><td>Course Outline</td><td colspan="8">Unit I : (6 hrs) (K1, K2, K3 & K4)
1.1 Introduction to Zoology & Animal Kingdom.
1.2 Branches of Zoology.
1.3 Scope of Zoology/ Opportunities for Zoologist.
1.4 Eminent Scientists of Zoology.
1.5 Importance of studying Zoology.</td></tr>
<tr><td></td><td colspan="8">Unit II : (6 hrs) (K1, K2, K3 & K4)
2.1 Systematics and Binomial system of Nomenclature.
2.2 Meaning of the terms Taxonomy, Systematics, Classification and Nomenclature.
2.3 Need for classification.
2.4 Prokaryotes and Eukaryotes.
2.5 Unicellular and multicellular organization.</td></tr>
<tr><td></td><td colspan="8">Unit III: (6 hrs) (K1, K2, K3 & K4)
3.1 Introduction to Invertebrate.
3.2 Classification of Invertebrate up to class.
3.3 Introduction to different Phyla: Protozoa, Porifera, Coelenterata, Platyhelminthes, Aschelminthes,
3.4 Annelida, Arthropoda, Mollusca, Echinodermata.
3.5 Introduction to Chordata and Classification of Chordata upto class</td></tr>
<tr><td></td><td colspan="8">Unit IV: (6 hrs) (K1, K2, K3 & K4)
4.1 Levels of organization.
4.2 Symmetry and its types – Asymmetry, Radial, Bilateral and Spherical symmetry.
4.3 Coelom- - Acoelomate, Pseudocoelomate and Eucoelomate organization.
4.4 Nutrition, Locomotion, Polymorphism, Metamorphosis.
4.5 Parasites, Parasitic adaptations, Adaptive radiation, Social life</td></tr>
<tr><td></td><td colspan="8">Unit V: (6 hrs) (K1, K2, K3 & K4)
5.1 Fundamentals of organ and organ systems.
5.2 Digestive system.
5.3 Circulatory system, Reproductive system.
5.4 Respiratory system, Excretory system.
5.5 Nervous system, Sense Organs.</td></tr>
<tr><td>Recommended Text</td><td colspan="8">1. Ekambaranatha Ayyar M, and T.N. Ananathakrishnan- Manual of Zoology Vol. I [Invertebrata], Parts I and II – S. Viswanathan (Printers and publishers) Pvt. Ltd; Madras, 1992.
2. Kotpal, R.L. – Protozoa, Porifera, Coelenterata, Helminthes, Arthropoda, Mollusca, Echinodermata- Rastogi Publications, Meerut, 1992.
3. Ekambaranatha Ayyar M, and T.N. Ananathakrishnan- Manual of Zoology Vol. II [Chordata] – S. Viswanathan (Printers and publishers) Pvt. Ltd; Madras, 1992.
4. Kotpal R.L. – Moderrn Text book of Zoology, Vertebrates, 4th edition. Rastogi Publication., Meerut, 2015-16.</td></tr>
</table>

ReferenceBooks	1. Barnes, R.S.K., Calow, P., Olive, P.J.W., Golding, D.W. & J.I., Spicer (2002) The Invertebrates: A New Synthesis. Iii Edition. Blackwell Science. 2. Barrington, E.J.W. (1979) Invertebrate Structure And Functions. Ii Edition. E.L.B.S. And Nelson. 3. Boradale, L.A. And Potts, E.A. (1961) Invertebrates: A manual for the use of students. Asia Publishing Home. 4. Bushbaum, R. (1964) Animals without Backbones. University Of Chicago Press. 5. T.C .Majpuria. 1990- Invertebrate Zoology. Pradeep Pub. Kitab Mahal. 6. Jordan, E.L and P.S Verma – Chordate Zoology and Elements of Animal Physiology, 10th Edition – S. Chand and Co. Ltd, Ram Nagar, New Delhi, 1995.
Website and e-learning source	1. http://www.encyclopedia.com/topic/Invertebrates.aspx 2. http://en.wikipedia.org/wiki/Invertebrate 3. www.notesonzoology.com 4. Animal Diversity Web - Database with information and photos on the animal kingdom

Course Outcomes:

On completion of the course, the students should be able to

CO1: Develop interest in the core subject Zoology. (K1, K2, K3, K4)
CO2: Explain Classification. (K1, K2, K3, K4)
CO3: Appreciate different phyla. (K1, K2, K3, K4)
CO4: Define the structures, forms and adaptations. (K1, K2, K3, K4)
CO5: Name the organs and organ system. (K1, K2, K3, K4)

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

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

H-HIGH (3): M-MODERATE (2): L-LOW-(1)

<table>
<tr><td>Title of the Course</td><td colspan="7">CHORDATA</td></tr>
<tr><td>Paper No.3</td><td colspan="7">Core II</td></tr>
<tr><td>Category</td><td>Core</td><td>Year</td><td>I</td><td>Credits</td><td>5</td><td>Course Code</td><td>UCZOC24</td></tr>
<tr><td></td><td></td><td>Semester</td><td>II</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td>Total</td></tr>
<tr><td></td><td>4</td><td>1</td><td colspan="3"></td><td>5</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">• To understand the systematic and functional morphology of various groups of Chordates.
• To study their affinities and adaptations to different modes of life.</td></tr>
<tr><td>Course Outline</td><td colspan="7">Unit I. (15 Hours) (K1, K2, K3, K4)
1.1. General Characters and Classification of Phylum.
1.2. Chordata- Origin of Chordata
1.3. Difference between non-chordates and chordates
1.4. Type study – Amphioxus.
1.5. Affinities and Systematic position of Amphioxus.
1.6. General Characteristics of Agnatha- Petromyzon.</td></tr>
<tr><td></td><td colspan="7">Unit II (15 Hours) (K1, K2, K3, K4)
2.1 General characters and classification of fishes.
2.2. Type study - Pisces (Scoliodon sorrakowah) .
2.3. Accessory respiratory organs.
2.4. Migration in fishes.
2.5. Parental care in fishes.
2.6. Economic importance of fishes.</td></tr>
<tr><td></td><td colspan="7">Unit III (15 Hours) (K1, K2, K3, K4)
3.1. 3.1. General characters and classification of Amphibia.
3.2. Type study- Frog.
3.3. General essay. Parental care in Amphibians, Adaptive radiations in Amphibians.
3.3. General characters and classification of Reptilia
3.4. Type study- Calotes.
3.5. General essay-Poison apparatus and biting mechanism in snakes.
3.6. Identification of poisonous and non-poisonous snakes.</td></tr>
<tr><td></td><td colspan="7">Unit IV (15 Hours) (K1, K2, K3, K4)
4.1. 4.1. General characters and classification of Aves.
4.2. Type study- Pigeon.
4.3. General essay- Flight adaptations and Migration in birds.
4.4. Flightless birds.
4.5. Beaks in birds.
4.6. Feet in birds.</td></tr>
</table>

	Unit V (15 Hours) (K1, K2, K3, K4) 5.1. General characters and classification of mammals. 5.2. Type study- Rabbit. 5.3. General essay- Dentition in mammals, Adaptive radiations in mammals. 5.4. Characteristics of Prototheria with examples. 5.5. Characteristics of Eutheria with examples. 5.6. Characteristics of Metatheria with examples.
Extended Professional Component (is a part of internal component only, not to be included in the external examination Question paper)	Questions related to the above topics, from various competitive examinations UPSC/JAM/TNPSC and others to be solved (To be discussed during the Tutorial hours)
Recommended Text	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.
Reference 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.
Website and e-learning source	http.//tolweb.org/Chordata/2499 https.//www.nhm.ac.uk/ https.//bit.ly/3Av1Ejg https.//bit.ly/3kqTfYz https.//biologyeducare.com/aves/ https.//www.vedantu.com/biology/mammalian

Course Outcomes:

On completion of the course, the students should be able to

CO1. Acquire knowledge on taxonomic status of vertebrates and its origin. (K1, K2, K3,K4)

CO2. Understand the anatomy and functions of systems in vertebrates. (K1, K2, K3,K4)

CO3. Correlate the different modes of life and parental care among different vertebrates. (K1, K2, K3,K4)

CO4. Analyze the origin, structural organization and evolutionary aspects of vertebrates. (K1, K2, K3,K4)

CO5. Distinguish the various physiological processes and organ systems in lower animals. (K1, K2, K3,K4)

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

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

H-HIGH (3): M-MODERATE (2): L-LOW-(1)

<table>
<tr><td>Title of the Course</td><td colspan="8">CHORDATA PRACTICAL</td></tr>
<tr><td>Paper No.4</td><td colspan="8">Core Practical II</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">3</td><td rowspan="2">Course Code</td><td colspan="2" rowspan="2">UCZOD24</td></tr>
<tr><td>Semester</td><td>II</td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="3">Total</td></tr>
<tr><td>-</td><td>-</td><td colspan="3">3</td><td colspan="3">3</td></tr>
<tr><td>Objectives of the course</td><td colspan="8">• To obtain practical skills in dissection and display of the systems.
• To learn about adaptation, biological significance of animals.
• To understand the evolutionary significance and skeletal structures of animals.</td></tr>
<tr><td>Course Outline</td><td colspan="8">1. Dissections:
a) Major: Frog (Model) - Digestive, Arterial, Venous, Urinogenital system.
b) Fish - Digestive, Arterial, Urinogenital system

2. Minor: a) Shark -Placoid scales.
c) Frog (Model) – Brain, Hyoid

3. Study of museum specimen/ slides relevant to the types studied in theory:
a) Biological significance.
b) Descriptive notes.
c) Structure and function.
d) Skeletal structure / Dentition.

Spotters List: Chordata
1. AMPHIOXUS ENTIRE
2. ASCIDIA ENITIRE
3. ASCIDIAN TADPOLE
4. BALANOGLOSSUS ENTIRE
5. TORNARIA LARVA
6. PETROMYZON ENTIRE
7. AMMOCETES LARVA
8. BUCCAL FUNNEL OF PETROMYZON
9. SALPA
10. SHARK ENTIRE
11. SCALES- PLACOID, CTENOID
12. NARCINE
13. SACCOBRANCHUS
14. EXOCOETUS
15. ECHENEIS
16. HIPPOCAMPUS
17. FROG ENTIRE
18. FROG-DIGESTIVE SYSTEM
19. FROG-VENOUS SYSTEM
20. FROG- ARTERIAL SYSTEM
21. FROG-BRAIN
22. FROG-HYOID
23. FROG-PECTORAL AND PELVIC GIRDLE
24. ICHTHYOPHIS
25. SALAMANDER
26. AXOLOTL LARVA</td></tr>
</table>

	27. NECTURUS 28. ALYTES 29. RHACOPHORUS 30. CALOTES ENTIRE 31. CALOTES- HYOID 32. CALOTES-PECTORAL AND PELVIC GIRDLE 33. DRACO 34. CHAMAELEON 35. PYTHON 36. KRAIT 37. COBRA 38. COBRA-POISON APPARATUS 39. PIGEON ENTIRE 40. PECTEN OF BIRD 41. PIGEON FORE AND HIND LIMBS 42. SYNSACRUM OF BIRD 43. OSTRICH 44. PROTOTHERIA- PLATYPUS 45. METATHERIA - OPOSSUM 46. EUTHERIA – BAT 47. RABBIT ENTIRE 48. RABBIT – PECTORAL AND PELVIC GIRDLE 49. SKULL OF RABBIT 50. SKULL OF DOG

Extended Professional Component (is a part of internal component only, not to be included in the external examination Question paper)	Questions related to the above topics, from various competitive examinations UPSC/JAM/TNPSC and others to be solved (To be discussed during the Tutorial hours)

Recommended Text	1. Lal S S, 2009. Practical Zoology Vertebrate, Rajpal and Sons Publishing, 484pp. 2. VermaP.S,2000.AManual of Practical Zoology :Chordates ,S. Chand Limited, 627pp.
Reference Books	**(**Latest editions, and the style as given below must be strictly adhered to) 1. Robert William Hegner, 2015. Practical Zoology, BiblioLife, 522pp. 2. Young, J,Z., 1972. The life of vertebrates. OxfordUni. London.
Website and e -learning source	https://www.youtube.com/watch?v=b04hc_kOY10 https://bit.ly/3CzTEy8 http://tolweb.org/Chordata/2499 https://www.nhm.ac.uk/ https://bit.ly/3Av1Ejg

Course Outcomes:

On completion of the course, the students should be able to

CO1: Acquire knowledge about the digestive, circulatory and Urinogenital system of vertebrates. (K1, K2, K3,K4)

CO2: Prepare mounting of the placoid scales.(K1, K2, K3,K4)

CO3: Analyze the biological significance of vertebrates. (K1, K2, K3,K4)

CO4: Distinguish structure and function of vertebrates .(K1, K2, K3,K4)

CO5: Justify the importance Oesteology and dentition in mammals. (K1, K2, K3,K4)

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

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

H-HIGH (3): M-MODERATE (2): L-LOW-(1)

<table>
<tr><td>Title of the Course</td><td colspan="7">SKILL ENHANCEMENT COURSE: ORNAMENTAL FISH FARMING & MANAGEMENT</td></tr>
<tr><td>Paper No.17</td><td colspan="7">Skill Enhancement Course II</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">SEC</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">2</td><td rowspan="2">Course Code</td><td rowspan="2">USZO224</td></tr>
<tr><td>Semester</td><td>II</td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>2</td><td></td><td colspan="3">-</td><td colspan="2">2</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">• To highlight the importance of ornamental fish culture in relation to entrepreneurship development.
• To enable the identification, culture and maintenance of commercially important ornamental fishes.
• To provide the knowledge on the techniques of ornamental fish breeding, rearing, disease control and economics of ornamental fish farming.</td></tr>
<tr><td>Course Outline</td><td colspan="7">Unit I (6 Hours) (K1,K2,K3,K4)
1.1 Introduction to ornamental fish keeping.
1.2 Scope and importance of ornamental fish culture.
1.3 Domestic and global scenario of ornamental fish trade and export potential.
1.4 Commercially important ornamental fishes - Indigenous varieties.
1.5 Exotic varieties.</td></tr>
<tr><td></td><td colspan="7">Unit II (6 Hours) (K1,K2,K3,K4)
1.1 Biology of egg layers and live bearers.
2.2 Food and feeding in ornamental fishes.
2.3 Formulated feed and Live feed; Live feed culture.
2.4 Breeding, hatchery and nursery management of egg layers.
2.5 Egg Layer Goldfish and Live bearer Guppy.</td></tr>
<tr><td></td><td colspan="7">Unit III (6 Hours) (K1,K2,K3,K4)
3.1 Aquarium design and construction.
3.2 Accessories - aerators, filters and lighting.
3.3 Aquarium plants and their propagation.
3.4 Maintenance of aquarium and water quality management.
3.5 Ornamental fish diseases, their prevention, control and treatment methods.</td></tr>
<tr><td></td><td colspan="7">Unit IV: (6 Hours) (K1,K2,K3,K4)
4.1: Aquarium plants.
4.2: Nutritional requirements.
4.3: Kinds of feed - live feeds - artificial feed.
4.4: Feed formulation - balanced diet.
4.5: Culture of live food organisms - Chironomous, mosquito larva, tubifex</td></tr>
<tr><td></td><td colspan="7">Unit V (6 Hours) (K1,K2,K3,K4)
5.1. Conditioning process.
5.2 Packing process.
5.3. Transport and quarantine methods.
5.4. Economics and trade regulations.
5.5. Domestic and export marketing strategies.</td></tr>
</table>

	Practical 1) Identification of locally available ornamental fishes - Egg layers and live bearers. 2) Identification of locally available live feed organisms.
Extended Professional Component (isa part of internal component only, not to beincluded in the external examination question paper)	Questions related to the above topics, from various competitive examinationsUPSC/JAM /TNPSC and others to be solved (To be discussed during the Tutorial hours)
Recommended Text	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. JingranV.G., 1991: Fish and Fisheries in India – Hindustan Publ.co. New Delhi 5. Mill Dick, 1993: Aquarium Fish, Daya Pub.co., New Delhi
ReferenceBooks	1. Swain SK., Sarangi N. and Ayyappan S. 2010. Ornamental fish farming. ICAR, New Delhi. 2. Living Jewels – A handbook on freshwater ornamental fish, MPEDA, Kochi. 3. Dey V.K.A. 1997. A handbook on aquafarming ornamental fishes. MPEDA, Kochi. 4. Ahilan, B., Felix N. and Santhanam R. 2008. Text book of aquariculture. Daya Publishing House, New Delhi.
Website and e-learning source	http://ecoursesonline.iasri.res.in/course/view.php?id=297 https://www.ofish.org/ https://krishijagran.com/agripedia/income-generation-by-ornamental-fish-culture/ https://99businessideas.com/ornamental-fish-farming/

Course Outcomes:

On completion of the course, the students should be able to

CO 1: Obtain knowledge on importance and global scenario of commercially important fishes. (K1,K2,K3,K4)

CO 2: Acquire knowledge about the Egg laying and live fishes in an aquarium. (K1,K2,K3,K4)

CO 3: Gain understanding on design, accessories used and aquarium plants. (K1,K2,K3,K4)

CO 4: Acquire knowledge about trade and export strategies that enhances entrepreneurship .(K1,K2,K3,K4)

CO 5: Attain understanding on locally available ornamental fishes and feeds.(K1,K2,K3,K4)

<table>
<tr><td>Title of the Course</td><td colspan="7">SKILL ENHANCEMENT COURSE: BASIC COURSE IN ORNITHOLOGY</td></tr>
<tr><td>Paper No.18</td><td colspan="7">Skill Enhancement Course III</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">SEC</td><td>Year</td><td>I</td><td>Credits</td><td>2</td><td>Course Code</td><td>USZO324</td></tr>
<tr><td>Semester</td><td>II</td><td colspan="4"></td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>2</td><td></td><td colspan="3">-</td><td colspan="2">2</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">• To understand the taxonomic position and role of birds in ecosystem.
• To study bird behaviour, bird conservation.</td></tr>
<tr><td>Course Outline</td><td colspan="7">Unit I (6 Hours) (K1,K2,K3,K4)
1.1: Introduction to Ornithology, Bird Lore .
1.2: Birds and Humans.
1.3: Classification of Birds.
1.4: Bird Evolution and Speciation.
1.5: Endemism.</td></tr>
<tr><td></td><td colspan="7">Unit 2: (6 Hours) (K1,K2,K3,K4)
2.1: External Morphology of the Bird.
2.2: Structure of bird feather.
2.3: Types of feathers
2.4: Internal Structure of the Bird.
2.5: Adaptations to Flight.</td></tr>
<tr><td></td><td colspan="7">Unit 3: (6 Hours) (K1,K2,K3,K4)
3.1: Bird Behaviour: Foraging, Roosting, Vocalization.
3.2: Imprinting, Feather care.
3.3: Bird Intelligence.
3.4: Social Behaviour.
3.5: Mixed Species Flocks, Migration.</td></tr>
<tr><td></td><td colspan="7">Unit 4: (6 Hours) (K1,K2,K3,K4)
4.1: Breeding Biology: Differential investment of sexes; territoriality.
4.2: Courtship and Display behaviour.
4.3: Nesting, eggs.
4.4: Incubation and care of young.
4.5: Brood parasitism.</td></tr>
<tr><td></td><td colspan="7">Unit 5: (6 Hours) (K1,K2,K3,K4)
5.1; Studying bird populations and communities.
5.2: Avian Disease.
5:3 Threats faced by birds.
5.4: Migration
5.5: Bird Conservation.</td></tr>
<tr><td colspan="4">Extended Professional Component (isa part of internal component only, not to beincluded in the external examination
question paper)</td><td colspan="4">Questions related to the above topics, from various competitive examinationsUPSC/JAM /TNPSC and others to be solved
(To be discussed during the Tutorial hours)</td></tr>
</table>

Recommended Text	1.Lovette, I.J and Fitzpatrick, J.W. (2016). *Handbook of Bird Biology*, 3rd ed. Wiley. 2.Birkhead, T. (2013). *Bird Sense: What it's like to be a bird?* Bloomsbury, NY. 3.Birkhead, T., Wimpenny, J., and Montgomerie, B. (2014). Ten Thousand Birds 4.*Ornithology since Darwin*. Princeton University Press, Princeton, NJ. 5.Gill, F.B, and Prum, R.O. (2019). *Ornithology*, 4th ed. Macmillan.
Reference Books	1.Ornithology, Third ed. Frank B. Gill, W.H. Freeman (2006) 2.Basic course in Orinthology DR.Rajah Jayapal and Salim 3.The Book of Indian Birds 13/E: Salim Ali 4.The Nests and Eggs of Indian Birds, Vol.1 by Allan Octavia Hume
Website and e-learning source	http://acl.digimat.in https://archive.org https://www.scribd.com https://batrachos.com

Course Outcomes:

On completion of the course, the students should be able to

CO1: Discuss taxonomic position and role played by birds in the ecosystem, their importance to humans and their evolution (K1,K2,K3,K4)

CO2: Explain biological evolution of birds and their structural adaptations (K1,K2,K3,K4)

CO3: Explain bird behaviour (K1,K2,K3,K4)

CO4: Discuss breeding biology of birds (K1,K2,K3,K4)

CO5: Explain macroecology of birds, bird populations and communities, bird diseases, bird conservation and on the role of citizen science in ornithology (K1,K2,K3,K4)

<table>
<tr><td>Title of the Course</td><td colspan="7">CELL BIOLOGY AND GENETICS</td></tr>
<tr><td>Paper No.5</td><td colspan="7">Core III</td></tr>
<tr><td>Category</td><td>Core</td><td>Year</td><td>II</td><td>Credits</td><td>5</td><td>Course Code</td><td>UCZOE24</td></tr>
<tr><td></td><td></td><td>Semester</td><td>III</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td>Total</td></tr>
<tr><td></td><td>4</td><td>1</td><td colspan="3">-</td><td>5</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">• To learn the structure and function of various cellular components.
• To learn the basics of genes, heredity and variations.</td></tr>
<tr><td>Course Outline</td><td colspan="7">Unit I. (15 Hours) (K1, K2, K3, K4)
1.1: Introduction to cell biology.
1.2: Brief account on cell theory.
1.3: Prokaryotes - PPLO
1.4: Eukaryotes - Ultra structure of Animal Cell.
1.5: Cell Cycle and Cell division- Amitosis, Mitosis and Meiosis.
1.6: Ageing of Cells – Apoptosis.</td></tr>
<tr><td></td><td colspan="7">Unit II (15 Hours) (K1, K2, K3, K4)
2.1: Structure and functions of Cell organelles - Cell Membrane
2.2: Structure and functions of Cell organelles- Mitochondria, Golgi complex.
2.3: Structure and functions of Cell organelles - Endoplasmic Reticulum, Ribosomes.
2.4: Structure and functions of Cell organelles - Lysosome and Centriole.
2.5: Structure and functions of Cell organelles - Nucleus and Nucleolus.
2.6: Structure and functions of Cell organelles - Chromosomes - Giant Chromosomes.</td></tr>
<tr><td></td><td colspan="7">Unit III (15 Hours) (K1, K2, K3, K4)
3.1: Nucleic acids: DNA - Ultra structure
3.2: DNA - Replication.
3.3: RNA – Structure and types.
3.4: Genetic Code - Protein synthesis.
3.5: Gene Regulation - Lac operon.
3.6: Cancer Biology – Characteristics of cancer cells, types, theories on Carcinogenesis.</td></tr>
<tr><td></td><td colspan="7">Unit IV (15 Hours) (K1, K2, K3, K4)
4.1 : Mendelian genetics: Mendelian experiments, laws of Mendel, Monohybrid cross and modification of the ratio.
4.2 Dihybrid cross and modification of ratio.
4.3: Interaction of genes - Epistasis
4.4: Polygenic inheritance - Skin colour and ABO blood groups in man
4.5: Extra chromosomal inheritance- shell coiling, kappa particles
4.6: Sex linked inheritance – Eye colour in Drosophila, Colour blindness and Hemophilia in man</td></tr>
<tr><td></td><td colspan="7">Unit V (15 Hours) (K1, K2, K3, K4)
5.1 : Linkage and Crossing Over
5.2: Gene mutation, Chromosomal aberrations, Genetic disorder – Autosomal and Sex Chromosomal
5.3: Human genetics: Karyotype Pedigree analysis
5.4: Sex determination in animals
5.5: Population genetics: gene pool, gene frequency
5.6: Hardy-Weinberg law of equilibrium.</td></tr>
</table>

Extended Professional Component (is a part of internal component only, not to be included in the external examination Question paper)	Questions related to the above topics, from various competitive examinations UPSC/JAM/TNPSC and others to be solved (To be discussed during the Tutorial hours)

Recommended Text	1. Verma P.S. and V.K. Agarwal – Cytology - Chand and Co., New Delhi, Revised Edition, 2015 2. M. Prakash, C.K. Arora - Microscopical Methods - Anmol Publications Pvt. Ltd., First Edition 1998. 3. Verma P.S. and V.K.Agarwal – Genetics - Chand and Co., New Delhi, 2006 4. Gopalakrishnan T.S. - Itta Sambasivaiah and A.P.Kamalakara Rao – Introduction to Genetics - Himalaya Publishing House, Bombay, 1996.
Reference Books	(Latest editions, and the style as given below must be strictly adhered to) 1. Philip Sheeler, Donald E. Bianchi - Cell and Molecular Biology - John Wiley and Sons, Inc, 3rd Edition, 1987. 2. E.D.P.De Robertis, E.M.F.De Robertis Jr. - Cell and Molecular Biology – Indian Edition, B.I. Publications Pvt. Ltd. 8th Ed. 2005 3. Bruce Alberts, Julian Lewis- Molecular Biology of the Cell- Taylor and Francis 5th Edition, 2008 4. Gardner - Principles of Genetics - Wiley Eastern Pvt. Ltd., 8th Edition, 2013. 5. Benjamin Lewin - Genes VII- Oxford University Press, 2000. 6. Philip Sheeler, Donald E. Bianchi - Cell and Molecular Biology - John Wiley and Sons, Inc, 3rd Edition, 1987. 7. Lodish, Harvey, Arnold Berk *et al* .,Molecular cell biology. 6th edition, W. H. Freeman, 2007 8. Strickberger M. W., Genetics, Prentice Hall India Learning Private Limited, 1995.
Website and e-learning source	https://www.britannica.com https://www.microscopemaster.com https://www.ascb.org http://www.ibiblio.org/virtualcell/index.htm https://bit.ly/3tXwDSB https://bit.ly/3tWNpRX https://bit.ly/3AuYR9M https://go.nature.com/2XE8V1q https://bit.ly/3zoTt6B https://bit.ly/2XAm7oa https://bit.ly/2XEbhxi https://bit.ly/3AB4bso https://bit.ly/39pZSE4 https://www.genome.gov/genetics-glossary/Sex-Linked https://www.vedantu.com/biology/mutagens

Course Outcomes:

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

CO1: Recall the cell theory, Distinguish between Prokaryotes and Eukaryotes. (K1, K2, K3, K4)

CO2: Summarize the structure and functions of Cell Organelles. (K1, K2, K3, K4)

CO3: Explain the structure and function of Nucleic acids. (K1, K2, K3, K4)

CO4: Demonstrate the Mendelian inheritance. Understand the genetic interactions. (K1, K2, K3, K4)

CO5: Analyze the types of Gene Mutation and Explain Population Genetics. (K1, K2, K3, K4)

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

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

H-HIGH (3): M-MODERATE (2): L-LOW-(1)

<table>
<tr><td>Title of the Course</td><td colspan="8">CELL BIOLOGY AND GENETICS PRACTICAL</td></tr>
<tr><td>Paper No.6</td><td colspan="8">Core Practical III</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">3</td><td rowspan="2">Course Code</td><td colspan="2" rowspan="2">UCZOF24</td></tr>
<tr><td>Semester</td><td>III</td></tr>
<tr><td>Instructional hours per week</td><td>Lecture
-</td><td colspan="2">Tutorial
-</td><td colspan="2">Lab Practice
3</td><td colspan="3">Total
3</td></tr>
<tr><td>Objectives of the course</td><td colspan="8">• To obtain practical skills in preparation of slides and basic haematological techniques.
• To learn about cell organelles and nucleic acid.
• To understand the principles in genetics.</td></tr>
<tr><td>Course Outline</td><td colspan="8">CELL BIOLOGY
1. Spotters: Tissue slides – T. S. of bone, striated, non – striated and cardiac muscles, Neuron, ciliated epithelium, columnar epithelium, germinal epithelium-Human sperm and ovum.
2. Mitosis: Squash preparation of Onion root tip.
3. Meiosis: Slides
4. Buccal epithelium - smear preparation.
5. Micrometry.
6. Camera Lucida.
7. Total Count of RBC.
8. Total Count of WBC.
9. Differential Count of WBC.
10. Structure of DNA – Model.
11. Structure of rRNA, mRNA, tRNA- Charts.
12. Structure and function of cell organells- 80s Ribosome, Golgi Body, Centriole, Mitochondria- Chart.
13. Light Microscope, TEM, SEM.
14. Homogenizer, Centrifuge, Gel Electrophoresis,

GENETICS
15. Study of Simple Mendelian traits in Human – Any 2 traits.
16. Karyotypic study of Syndromes: Klinefeiter’s syndrome, Turners syndrome and Down syndrome- Chart.
17. Giant chromosome of Chironomous larva- Permanent Slide.
18. Drosophila mutants - vestigial wing, white eye, yellow body.
19. Drosophila medium preparation and observation of life cycle.
20. Drosophila male and female.</td></tr>
<tr><td colspan="4">Extended Professional Component (is a part of internal component only, not to be included in the external examination
Question paper)</td><td colspan="5">Questions related to the above topics, from various competitive examinations UPSC/JAM/TNPSC and others to be solved (To be discussed during the Tutorial hours)</td></tr>
</table>

Recommended Text	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.
Reference Books	**(**Latest editions, and the style as given below must be strictly adhered to) 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 Pubilshing 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). Lippincoat 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.
Website and e -learning source	https://www.jove.com/ https://vlab.amrita.edu/?sub=3&brch=77 http://cbii-au.vlabs.ac.in/ https://media.hhmi.org/biointeractive/vlabs/transgenic_fly/index.html https://www.ibiology.org/biology-techniques/

Course Outcomes:

On completion of the course, the students should be able to

CO1: Observe the structure of different types of tissue and the stages of cell division. (K1, K2, K3,K4)

CO2: Demonstrate preparation of buccal smear and squash preparation of onion root tip. (K1, K2, K3,K4)

CO3: Demonstrate the skill of focusing, calibrating a microscope and learn the principle, working of laboratory instruments. (K1, K2, K3,K4)

CO4: Enumerate the Differential count of WBC, total count of WBC and RBC. Identify simple Mendelian traits and syndromes. (K1, K2, K3,K4)

CO5: Observe and study the life cycle of drosophila, polytene giant chromosome and the common mutants.(K1, K2, K3,K4)

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

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

H-HIGH (3): M-MODERATE (2): L-LOW-(1)

<table>
<tr><td>Title of the Course</td><td colspan="7">SKILL ENHANCEMENT COURSE: AQUARIUM KEEPING</td></tr>
<tr><td>Paper No.19</td><td colspan="7">Skill Enhancement Course IV</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">SEC</td><td>Year</td><td>II</td><td>Credits</td><td>1</td><td>Course Code</td><td>USZO424</td></tr>
<tr><td>Semester</td><td>III</td><td colspan="4"></td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td colspan="2">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>1</td><td colspan="2">-</td><td colspan="2">-</td><td colspan="2">1</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">• To create knowledge on self-employment opportunity of ornamental fishes
• To provide the knowledge of ornamental fishes and their equipment
• To understand the different breeding techniques of ornamental fishes</td></tr>
<tr><td>Course Outline</td><td colspan="7">Unit I (3 Hours) (K1,K2,K3,K4)
1.1 Introduction and scope - Aquarium fish keeping.
1.2 Aquarium keeping as hobby and cottage industry.
1.3 Commercial aspects National market.
1.4 Commercial aspects International market.
1.5 To create knowledge on self-employment opportunity.</td></tr>
<tr><td></td><td colspan="7">Unit II (3 Hours) (K1,K2,K3,K4)
2.1 External morphology of a typical Exotic fish.
2.2 Angel Fish.
2.3 Endemic varieties of ornamental fishes.
2.4 Butterfly fish.
2.5 Other marine organisms.</td></tr>
<tr><td></td><td colspan="7">Unit III (3 Hours) (K1,K2,K3,K4)
3.1 Aquarium preparation and maintenance.
3.2 Kinds of tanks, tank setting.
3.3 Biological filter and aeration.
3.4 Water management, planting, lighting and feeds.
3.5 Budget for setting up an Aquarium Fish Farm as a Cottage Industry.</td></tr>
<tr><td></td><td colspan="7">Unit IV (3 Hours) (K1,K2,K3,K4)
4.1 Live fish transport.
4.2 Handling of fish.
4.3 Feeding and forwarding techniques of fish.
4.4 Fish Diseases and their control.
4.5 Over Feeding and its impact.</td></tr>
<tr><td></td><td colspan="7">Unit V(3 Hours) (K1,K2,K3,K4)
5.1 Breeding – Common characters and sexual dimorphism of Fresh water fish.
5.2 Marine aquarium ornamental fish varieties such as Guppies, Mollies.
5.3 Sword tails, Platy, Siamese fighters.
5.4 Gold fish, Butterfly fish.
5.5 Blue morph, Anemone fish.</td></tr>
</table>

Extended Professional Component (isa part of internal component only, not to beincluded in the external examination question paper)	Questions related to the above topics, from various competitive examinationsUPSC/JAM /TNPSC and others to be solved (To be discussed during the Tutorial hours)

Recommended Text	1. Swain SK., Sarangi N. and Ayyappan S. 2010. Ornamental fish farming. ICAR, New Delhi. 2. Living Jewels – A handbook on freshwater ornamental fish, MPEDA, Kochi. 3. Dey V.K.A. 1997. A handbook on aquafarming ornamental fishes. MPEDA, Kochi. 4. Ahilan, B., Felix N. and Santhanam R. 2008. Text book of aquariculture. Daya Publishing House, New Delhi.
ReferenceBooks	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. JingranV.G., 1991: Fish and Fisheries in India – Hindustan Publ.co. New Delhi 5. Mill Dick, 1993: Aquarium Fish, Daya Pub.co., New Delhi
Website and e-learning source	http://ecoursesonline.iasri.res.in/course/view.php?id=297 https://www.ofish.org/ https://krishijagran.com/agripedia/income-generation-by-ornamental-fish-culture/ https://99businessideas.com/ornamental-fish-farming/

Course Outcomes:
On completion of the course, the students should be able to

CO 1: Acquire knowledge to establish aquarium cottage industry as entrepreneurs.(K1,K2,K3,K4)

CO 2: Acquire knowledge about exotic and endemic ornamental fishes. (K1,K2,K3,K4)

CO 3: Gain understanding on budgeting and design of aquarium. (K1,K2,K3,K4)

CO 4: Attain understanding on handling, feeding and health of live ornamental fishes.(K1,K2,K3,K4)

CO 5: Obtain knowledge on important ornamental fishes and their common characteristics. (K1,K2,K3,K4)

<table>
<tr><td>Title of the Course</td><td colspan="7">SKILL ENHANCEMENT COURSE: BIOINSTRUMENTATION</td></tr>
<tr><td>Paper No.20</td><td colspan="7">Skill Enhancement Course V</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">SEC</td><td>Year</td><td>II</td><td>Credits</td><td>2</td><td>Course Code</td><td>USZO524</td></tr>
<tr><td>Semester</td><td>III</td><td colspan="4"></td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>2</td><td></td><td colspan="3">-</td><td colspan="2">2</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">• To induce interest in the use of various biological instrumentation and employ them for the study of cells, tissues and genetic material.
• To help students to map the use of specific bioinstrumentation for specific biological experiments and infer the results of such experiments.
• To study the working principle of different bioinstrumentation and their applications.
• To enable students to design experiments and justify them with the underlying principles of bioinstrumentation.</td></tr>
<tr><td>Course Outline</td><td colspan="7">Unit I: Good Laboratory Practices: (6 Hours) (K1,K2,K3,K4)
1.1 Guide lines, Laboratory symbols; Cleaning and sterilization of lab ware and reagents
1.2 Handling and care of laboratory animals; Laminar flow hood: types and use
1.3 Concepts of molecular weight, atomic weight, preparation of solutions of a particular molarity and percentage
1.4 Buffers: definition and preparation of buffers, pH meter
1.5 Safety and ethical issues in laboratory settings</td></tr>
<tr><td></td><td colspan="7">Unit II: Microscopy (6 Hours) (K1,K2,K3,K4)
2.1 Light microscope, SEM
2.2 TEM, Atomic force microscope
2.3 Cryopreservation - principle and procedure
2.4 Fluorescence activated cell sorting
2.5 X-ray crystallography.</td></tr>
<tr><td></td><td colspan="7">Unit III: Centrifugation (6 Hours) (K1,K2,K3,K4)
3.1 Working principle and types of centrifugation
3.2 Spectrophotometry
3.3 Mass spectrometry
3.4 Chromatography - principle
3.5 Types of chromatography</td></tr>
<tr><td></td><td colspan="7">Unit IV: Biomedical Instrumentation (6 Hours) (K1,K2,K3,K4)
4.1 ESR measurement, haemoglobin measurement,
4.2 Blood pressure, blood flow, ECG, cardiac pacemakers
4.3 X- ray imaging, CT scan and NMR imaging
4.4 Ultrasound imaging; medical applications of laser
4.5 Biosensors - glucose biosensor, alcohol biosensor, artificial retina, environmental biosensors, cantilever-based biosensors, DNA biosensor.</td></tr>
<tr><td></td><td colspan="7">Unit V: Molecular Techniques (6 Hours) (K1,K2,K3,K4)
5.1 Isolation of DNA, RNA and proteins
5.2 Electrophoresis of DNA and proteins
5.3 Polymerase chain reaction; ELISA;
5.4 Immunofluorescence, Fluorescent in situ hybridization
5.5 Southern and Western blotting.</td></tr>
<tr><td colspan="4">Extended Professional Component (isa part of internal component only, not to beincluded in the external examination question paper)</td><td colspan="4">Questions related to the above topics, from various competitive examinationsUPSC/JAM /TNPSC and others to be solved
(To be discussed during the Tutorial hours)</td></tr>
</table>

Recommended Text	1. Sabari Ghosal and Anupama Sharma Avasthi, 2018. Fundamentals of Bioanalytical Techniques and Instrumentation, 2nd Ed., Phi Learning Pvt. Ltd., New Delhi, India. 2. Veerakumari L., 2015. Bioinstrumentation, MJP Publishers, Chennai, India. 3. Prakash Singh Bisen, Anjana Sharma, 2012. Introduction to Instrumentation in Life Sciences, CRC Press, Taylor & Francis Group, New York, USA. 4. Gupta P.C., 2010. Biological Instrumentation and Methodology (Tools & Techniques), S. Chand & Company Limited, New Delhi, India. 5. Ghatak K. L., 2010. Techniques and Methods in Biology, Phi Learning Pvt. Ltd., New Delhi, India.
ReferenceBooks	1. Sue Carson, Heather Miller, Melissa Srougi and Scott Witherow, 2019. Molecular Biology Techniques: A Classroom Laboratory Manual, Academic Press, New York, USA. 2. Aysha Divan, Janice Royds, 2013. Tools and Techniques in Biomolecular Science, Oxford Univeristy Press, UK. 3. Gordon M.H., Macrae R., 2012. Instrumental Analysis in the Biological Sciences, Blackie & Son Ltd., UK 4. Leonard Davis, Mark Dibner and James Battey, 2012. Basic Methods in Molecular Biology, Elsevier Science Publishing Co., New York, USA. 5. Wilson, K.M. and Walker, J.M., 2010. Principles and Techniques of Biochemistry and Molecular Biology, Cambridge University Press, UK.
Website and e-learning source	https://bit.ly/3i5flym https://pbiol.rsb.org.uk https://www.nature.com/subjects/biological-techniques https://www.ibiology.org

Course Outcomes:

On completion of the course, the students should be able to

CO 1: Acquire knowledge about the laboratory practice of various biological instruments. (K1,K2,K3,K4)

CO 2: Obtain understanding on principle and applications of microscope and biological techniques for the study of cells, tissues and genetic material. (K1,K2,K3,K4)

CO 3: Correlate and appraise the use of centrifuge, Spectrophotometry and chromatography.(K1,K2,K3,K4)

CO 4: Obtain understanding on working principle of different bioinstrumentation and to Summarize their applications. (K1,K2,K3,K4)

CO 5: Acquire understanding of the principles of analysis of protein and detection of gene Sequences.(K1,K2,K3,K4)

<table>
<tr><td>Title of the Course</td><td colspan="7">DEVELOPMENTAL BIOLOGY</td></tr>
<tr><td>Paper No.7</td><td colspan="7">Core IV</td></tr>
<tr><td>Category</td><td>Core</td><td>Year
Semester</td><td>II
IV</td><td>Credits</td><td>5</td><td>Course Code</td><td>UCZOG24</td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>4</td><td>1</td><td colspan="3">-</td><td colspan="2">5</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">• To study the process of development from germ cell to individual.
• To study the recent advancements in the reproductive biology.</td></tr>
<tr><td>Course Outline</td><td colspan="7">Unit I. (15 Hours) (K1, K2, K3, K4)
1.1: Introduction and history of Developmental Biology.
1.2: Spermatogenesis, Structure & types of Spermatozoa
1.3: Oogenesis.
1.4: Eggs-Types of eggs.
1.5: Egg membranes- Extra embryonic membranes in Chick.
1.6: Polarity and symmetry of eggs.</td></tr>
<tr><td></td><td colspan="7">Unit II (15 Hours) (K1, K2, K3, K4)
2.1: Fertilization – mechanism, theories
2.2: Parthenogenesis.
2.3: Cleavage - Planes and Patterns.
2.4: Fate map and its construction.
2.5: Blastulation
2.6: Blastula – Types</td></tr>
<tr><td></td><td colspan="7">Unit III (15 Hours) (K1, K2, K3, K4)
3.1: Morphogenetic movements.
3.2: Gastrulation in Frog
3.3: Gastrulation in Mammal
3.4: Organogenesis in Frog & Mammal - Development of Brain
3.5: Development of Eye in Frog & Mammal
3.6: Development of Heart in Frog & Mammal</td></tr>
<tr><td></td><td colspan="7">Unit IV (15 Hours) (K1, K2, K3, K4)
4.1 : Placentation in Mammals.
4.2: Organizer concept, mechanism of induction and competence
4.3: Nuclear transplantation.
4.4: Teratogenesis.
4.5: Regeneration in Invertebrates and Vertebrates.
4.6: Embryonic stem cells & significance.</td></tr>
<tr><td></td><td colspan="7">Unit V (15 Hours) (K1, K2, K3, K4)
5.1: Human reproduction - Menstrual cycle and Menopause.
5.2: Pregnancy, Hormonal changes in pregnancy, Erythroblastosis foetalis -Twins –Types
5.3: Parturition and Lactation.
5.4: Infertility – causes, Assisted Reproductive Technology.
5.5: Super Ovulation, Artificial insemination, IVF, Test tube baby.
5.6: Embryo transfer, Amniocentesis, Bio ethics.</td></tr>
</table>

Extended Professional Component (is a part of internal component only, not to be included in the external examination Question paper)	Questions related to the above topics, from various competitive examinations UPSC/JAM/TNPSC and others to be solved (To be discussed during the Tutorial hours)

Recommended Text	1. P.S. Verma, V.K. Agarwal and Tyagi - Chordate Embryology, S. Chand and Co. New Delhi 2007. 2. Arumugam N. - Developmental Biology- Saras Publication-15th edition 2014.
Reference Books	(Latest editions, and the style as given below must be strictly adhered to) 1. Balinsky B.L - Introduction to Embryology, 5th Edition. First Indian, Reprint 2012. 2. Mohan P. Arora –Embryology- Himalaya Publishing House, 2011. 3. Veer Bala Rastogi, Jayaraj- Developmental Biology,2nd Edition, Kedar Nath Ram Nath. 1994. 4. Robert S. Mcewen- Vertebrate Embryology, 4th Edition, Oxford & IBH Publishing Co. 1949. 5. Bradley M.Patten, Bruce M. Carlson-Foundations of Embryology, 3rd Edition. Tata McGraw Hill Publishing Company Ltd. 1977. 6. Berril, N.J. Developmental Biology, McGraw Hill, New York, USA. 1971. 7. Carlson, Bruce, M. Human embryology and Developmental Biology, Elsevier, Philadelphia, USA, 2009.
Website and e-learning source	https://www.ncbi.nlm.nih.gov/books/NBK10052/ https://www.cdc.gov/ncbddd/developmentaldisabilities/facts.html https://anatomypubs.onlinelibrary.wiley.com/doi/full/10.1002/dvdy.20468 https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5293490/

Course Outcomes:

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

CO1: Discuss gametogenesis, types of eggs and egg membranes.(K1, K2, K3,K4)

CO2: Explain the mechanism of physiology of fertilization, parthenogenesis and cleavage.(K1, K2, K3,K4)

CO3: Describe gastrulation and organogenesis in Frog and Mammal.(K1, K2, K3,K4)

CO4: Explain Organizer, Nuclear transplantation and Regeneration.(K1, K2, K3,K4)

CO5: Discuss human reproduction and Assisted Reproductive Technologies(K1, K2, K3,K4)

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

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

H-HIGH (3): M-MODERATE (2): L-LOW-(1)

<table>
<tr><td>Title of the Course</td><td colspan="7">ELECTIVE: ECONOMIC ZOOLOGY</td></tr>
<tr><td>Paper No.23</td><td colspan="7">Discipline Specific Elective Course - I</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">DSE</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">3</td><td rowspan="2">Course Code</td><td rowspan="2">UEZOA24</td></tr>
<tr><td>Semester</td><td>IV</td></tr>
<tr><td>Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td></td><td>3</td><td>-</td><td colspan="3">-</td><td colspan="2">3</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">• To learn the economic importance of animals
• To motivate the students to become entrepreneurs</td></tr>
<tr><td>Course Outline
.</td><td colspan="7">Unit I: (9 hours) (K1,K2,K3,K4)
1.1 Economic Entomology: Apiculture: Species of honey bees
1.2 Social organization of honey bee selection of bees and location for apiary
1.3 Newton’s bees hive - products of bee keeping - enemies and diseases of honey bees
1.4 Sericulture: Species of silkworm - life history of mulberry silkworm
1.5 Rearing of silkworm-pests and diseases of silkworm
1.6 Lac Culture: Introduction - Life history - Host plants - cultivation of Lac Enemies of lac cultivation - Economic importance of Lac</td></tr>
<tr><td></td><td colspan="7">Unit II: (9 hours) (K1,K2,K3,K4)
2.1 Vermiculture: Introduction- Types of earthworms - ecological classifications of earthworms
2.2 Physical, chemical and biological changes caused by earthworms in the soil
2.3 Natural enemies of earthworms
2.4 Vermicomposting: vermicomposting methods - factors affecting vermicomposting- Vemiculture unit
2.5 Harvesting of vermicompost - vermicast - advantages of vermicompost
2.6 Vermiwash and its applications</td></tr>
<tr><td></td><td colspan="7">Unit III: (9 hours) (K1,K2,K3,K4)
3.1 Aquaculture: Fresh water aquaculture: Carp culture - types of ponds
3.2 Preparation - maintenance - harvesting and management
3.3 Integrated and composite culture
3.4 Prawn culture. Marine Aquaculture: Types
3.5 Pearl oyster culture
3.6 Ornamental fish culture: Aquarium Fishes-Aquarium maintenance in home</td></tr>
<tr><td></td><td colspan="7">Unit IV: (9 hours) (K1,K2,K3,K4)
4.1 Poultry Farming: Poultry for sustainable food production and livelihood
4.2 Commercial poultry farming – Nutritive value of egg and meat
4.3 Types of Breeds
4.4 Broiler management (Definition; Housing and equipment; Brooding, feeding and health cover of broilers; Record keeping; Broiler integration)
4.5 Layer management (Brooder; Grower and layer management; Culling of layers;)
4.6 Diseases of Poultry</td></tr>
</table>

	Unit V: (9 hours) (K1,K2,K3,K4) 5.1 Dairy Farming: Dairy farming - advantages of dairying 5.2 Classification of breeds of cattle - Indigenous and exotic breeds - Selection of dairy cattle 5.3 Breeding - artificial insemination - Dairy cattle management - housing - water supply - cattle nutrition feeding standards 5.4 Common contagious diseases. 5.5 Milk - Composition of milk - milk spoilage - pasteurization -Role of milk and milk products in human nutrition 5.5 Dairying as a source of additional income and employment
Extended Professional Component(isapart of internal component only, not to be included in the external examination Question paper)	Questions related to the above topics, from various competitive examinations UPSC/JAM/TNPSC and others to be solved. (To be discussed during the Tutorial hours)
Recommended Text	1. Ahsan J., and Sinha SP- Handbook of Economic zoology, S. Chand and Co., New Delhi, 2009. 2. Shukla GS, amd Upadhyay SP- Economic Zoology, Ratogi Publication, Meerut, 1994.
Reference Books	1. Mary Violet Christy A-Vermitechnology, MJP Publication Chennai,1976. 2. Ayyar TVT- Handbook of Economic Entomology for South India, Govt press, Madras, 1963. 3. Jhinghran VG- Fish and fisheries of India, Hindustan Publishing Corpn, New Delhi, 1982. 4. Jawaid Ahgan, Subhas Prasad Sinha- A Hand book on Economic Zoology, S. Chand & Co. Ltd., New Delhi, 2000. 5. Jagadish Prasad - Principles and practices of Dairy Farm Management, 3rd Ed. Kalyani Publishers, Ludhiana. 2002. 6. Prabakaran, R.. Commercial Chicken production. Published by P. Saranya, Chennai, 1998. 7. Hafez, E. S. E. Reproduction in Farm Animals, Lea &Fabiger Publisher, 1962.
Website and e-learning source	http://csb.gov.in http://www.fao.org http://nfdb.gov.in

Course Outcomes:

On completion of the course, the students should be able to

CO1: Demonstrate culture techniques of apiculture, sericulture. (K1, K2, K3,K4)

CO2: Illustrate the preparation and management of vermiculture (K1, K2, K3,K4)

CO3: To assess and integrate the available tools and techniques to increase the productivity in aquaculture, prawn culture. (K1, K2, K3,K4)

CO4: Understand the basic aspect of poultry management. (K1, K2, K3,K4)

CO5: Acquire knowledge about dairy farming. (K1, K2, K3,K4)

CO/PSO	PSO					
	PSO1	PSO2	PSO 3	PSO 4	PSO5	PSO6
CO1	H	H	H	H	H	H
CO2	H	H	H	H	H	H
CO3	H	H	H	H	H	H
CO4	H	H	H	M	H	H
CO5	H	H	H	H	H	H

CO/PO	PO					
	PO1	PO2	PO 3	PO 4	PO5	PO6
CO1	H	H	H	H	H	H
CO2	H	H	H	H	H	H
CO3	H	H	M	H	H	H
CO4	H	H	M	H	H	H
CO5	H	M	H	H	H	H

H-HIGH (3): M-MODERATE (2): L-LOW-(1)

<table>
<tr><td>Title of the Course</td><td colspan="7">ELECTIVE: HUMAN REPRODUCTIVE BIOLOGY</td></tr>
<tr><td>Paper No. 24</td><td colspan="7">Discipline Specific Elective Course - II</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">DSE</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">3</td><td>Course Code</td><td>UEZOB24</td></tr>
<tr><td>Semester</td><td>IV</td></tr>
<tr><td>Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td></td><td>3</td><td></td><td colspan="3">-</td><td colspan="2">3</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">• Acquire knowledge about the reproductive systems, fertilization, pregnancy, parturition, lactation, infertility, reproductive health, assisted reproductive technology and associated ethical issues.
• To enable the students to understand the endocrine structures and hormones associated with the physiology of reproductive system.</td></tr>
<tr><td>Course Outline</td><td colspan="7">Unit I (9 hours) (K1,K2,K3,K4)
1.1: Gonadal hormones and mechanism of hormone action.
1.2: Steroids, glycoprotein hormones, and prostaglandins.
1.3: Hypothalamo – hypophyseal – gonadal axis.
1.4: Regulation of gonadotrophin secretion in male and female; Reproductive System.
1.5: Development and differentiation of gonads, genital ducts, external genitalia.
1.6: Mechanism of sex differentiation; Puberty.</td></tr>
<tr><td></td><td colspan="7">Unit II (9 hours) (K1,K2,K3,K4)
2.1: Outline and histoarchitecture of male reproductive system.
2.2: Testis: Cellular functions; Spermatogenesis and its hormonal regulation.
2.3: Androgen synthesis and metabolism.
2.4: Epididymal function and sperm maturation.
2.5: Accessory glands function.
2.6 : Sperm transportation in male tract; Andropause.</td></tr>
<tr><td></td><td colspan="7">Unit III (9 hours) (K1,K2,K3,K4)
3.1: Outline and histoarchitecture of female reproductive system.
3.2: Ovary: oogenesis and its hormonal regulation.
3.3: Steroidogenes
3.4: Secretion of ovarian hormones.
3.5: Reproductive cycles and their regulation, changes in the female tract.
3.6: Menopause.</td></tr>
<tr><td></td><td colspan="7">Unit IV (9 hours) (K1,K2,K3,K4)
4.1: Ovum transport in the fallopian tubes.
4.2: Sperm transport in the female tract.
4.3: Fertilization; Hormonal control of implantation.
4.4: Hormonal regulation of gestation, pregnancy diagnosis.
4.5: Foeto -maternal relationship; Mechanism of parturition and its hormonal regulation.
4.6: Lactation and its regulation.</td></tr>
<tr><td></td><td colspan="7">Unit V (9 hours) (K1,K2,K3,K4)
5.1: Reproductive Technology: sex selection, sperm banks, frozen embryos.
5.2: Stem Cell banks, in vitro fertilization, ET, EFT, IUT, ZIFT.
5.3: GIFT, ICSI, PROST.
5.4: Ethical issues related to ART.
5.5: Surrogate motherhood; ethical issues; Consanguinity.
5.6: Fetal Loss and Birth Defects; Adoption.</td></tr>
</table>

Extended Professional Component (is a part of internal component only, not to be included in the external examination Question paper)	Questions related to the above topics, fromvariouscompetitiveexaminationsUPSC/JAM/TNPSCandotherstobesolved (To be discussed during the Tutorial hours)
Recommended Text	1. Cassan, A. (2005). *Human reproduction and Development (Inside the Human Body)*.NewYork: ChelseaClubhouse. 2. Field,M.A.(1990).*SurrogateMotherhood*.Massachusetts:Harvard University. 3. Gardner, D. K.(2001). *Textbook of Assisted Reproductive Techniques: Laboratory andClinicalPerspectives.*London: MartinDunitz.
Reference Books	1. Gardner, D. K.(2006). In vitro Fertilization: A Practical Approach. CRC Press. 2. Johnson, M. H. (2018). *Essential Reproduction*. New Jersey: Wiley-Blackwell. 3. Jones,R.E.(2013).*HumanReproductiveBiology*.Amsterdam:Elsevier. 4. Neill, Jimmy D. ed (2006). Knobil and Neill's Physiology of Reproduction.Volume I. Third edn. Elsevier Academic Press. 5. Pinon, R. (2003).*Biology of Human Reproduction*. California: University Science Books.
Website and e-learning source	https://my.clevelandclinic.org/health/articles/9118-female-reproductive-system https://www.sciencedirect.com/topics/medicine-and-dentistry/reproductive-hormone https://www.eshre.eu/Publications/Journals/Human-Reproduction https://www.britannica.com/science/hormone/Hormones-of-the-reproductive-system https://raf.bioscientifica.com/

Course Outcomes:

On completion of the course, the students should beable to

- **CO1:** Acquire knowledge about the gonadal hormones.(K1,K2,K3,K4)
- **CO2:** Recall the structure and functioning of the male reproductive system.(K1,K2,K3,K4)
- **CO3:** Recall the structure and functioning of the male reproductive system.(K1,K2,K3,K4)
- **CO4:** Describe the fertilization; implantation and Mechanism of parturition and its hormonal regulation.(K1,K2,K3,K4)
- **CO5:** Analyze the different techniques and associated ethical issues related to reproductive technology.(K1,K2,K3,K4)

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

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

H-HIGH (3): M-MODERATE (2): L-LOW-(1)

<table>
<tr><td>Title of the Course</td><td colspan="7">SKILL ENHANCEMENT COURSE: BASICS IN MARINE BIOLOGY</td></tr>
<tr><td>Paper No.21</td><td colspan="7">Skill Enhancement Course VI</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">SEC</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">2</td><td>Course Code</td><td>USZO624</td></tr>
<tr><td>Semester</td><td>IV</td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>2</td><td></td><td colspan="3">-</td><td colspan="2">2</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">• To understand and learn the physical, chemical and biological aspects of marine environment and to gain knowledge about the management of oceans.
• To introduce students to the marine environment and its indigenous organisms.</td></tr>
<tr><td></td><td colspan="7">Unit I (6 Hours) (K1,K2,K3,K4)
1.1 Marine environment- ecological factors- light, temperature, salinity, pressure
1.2 Classification of marine environment; Pelagic environment – Planktonic and Nektonic adaptations
1.3 Benthic environment - intertidal, interstitial and deep sea adaptations
1.4 Distribution and ecological role of other coastal environments - coral reefs, estuaries
1.5 Mangroves, sea grass beds, kelp forests polar seas and hydrothermal vents</td></tr>
<tr><td></td><td colspan="7">Unit II (6 Hours) (K1,K2,K3,K4)
2.1 Physical Properties of Seawater- density, viscosity, surface tension
2.2 Conductivity and their relationship
2.3 Temperature distribution in the sea - heat budget, UV radiation; El Nino/La Nina
2.4 Global impact; Dynamics of the ocean
2.5 General surface circulation, Waves, Currents and Tides, Tsunami</td></tr>
<tr><td></td><td colspan="7">Unit III (6 Hours) (K1,K2,K3,K4)
3.1. Chemical composition of seawater- ionic, major and minor constituents
3.2. Constancy- ionic compositions and factors affecting constancy
3.3. Major and minor elements, trace elements- their importance, distribution
3.4. Chemistry of seawater constituents- concept of chlorinity and salinity, methods of measurements, nutrients - biogeochemical cycles</td></tr>
<tr><td></td><td colspan="7">Unit IV (6 Hours) (K1,K2,K3,K4)
4.1 Sea as a biological environment- Plankton- classification based on size, mode of life and habitat
4.2 Phytoplankton and Zooplankton - methods of collection
4.3 Estimation of standing crop-wet and dry weight estimation-plankton volume settling and displacement methods
4.4 Oxidation as carbon (as organic matter)
Primary productivity – estimation and factors affecting primary productivity</td></tr>
<tr><td></td><td colspan="7">Unit V (6 Hours) (K1,K2,K3,K4)
5.1 Ocean pollution- kinds and quantities of pollutants
5.2 Toxic effects and control measures – oil spills, plastics, nuclear waste disposal in marine environment, Eutrophication
5.3 Role of National and international agencies and organizations in ocean management- DOD, WOCE
5.4 IMO INMARSAT- IUCN, SCAR, Marpol, Traffic
5.5 Ocean policy (India) - research and management</td></tr>
</table>

Extended Professional Component(isapart of internal component only, not to be included in the external examination Question paper)	Questions related to the above topics, from various competitive examinations UPSC/JAM/TNPSC and others to be solved. (To be discussed during the Tutorial hours)

Recommended Text	1. Thurman, Harold., 2001 Introduction to Oceanography, Prentice Hall Inc. New Jersey. 506 pp. 2. Bertness, M.D, S. D. Gaines and M.K. Hay 2000. Marine Community Ecology Sinauer Associates. 3. Grant Gross, M., 1993 Oceanography: A view of the earth (sixth edition). Prentice Hall Inc. New Jersey. 4. Fincham A. A, 1984.Basic Marine Biology. Cambridge University Press, England. 157 pp. 5. John Resech Jr.1979, Marine Biology. Reston Publishing Company, Virginia. 257 pp.
Reference Books	1. Barbara E. Curry, 2016. Advances in Marine Biology, Volume 74, Ist Edition. Academic Press ISBN: 9780128036075 2. Peter Castro, Michael E. Huber, 2015. Marine Biology; Series Botany, Zoology, Ecology and Evolution.McGraw-Hill Education. 3. Philip V. Mladenov, 2013 Marine Biology: A very short introduction, Ist Edition. Oxford University Press. 4. Venkataraman K, Raghunathan C, Raghuraman R, Sreeraj C. R, 2012. Marine diversity in India.Zoological Survey of India, Kolkata.178 pp. 5. Amy Hill. 2002. Marine Biology: An Introduction to Ocean Ecosystems (Marine Biology Ser) Walch publishing. 6. Pickard, G.L. and W.J. Emery 1995. Descriptive Physical Oceanography. PergamonPress,London. 7. Gage. J.D. and P.A. Tyler, 1991. Deep Sea Biology, Cambridge University Press,Cambridge 8. Raymont J. E. G., 1980. Plankton and Productivity in the oceans: Volume 1: Phytoplankton, Pergamon Press.
Website and e-learning source	https://www.livescience.com https://www.icriforum.org https://www.cbd.int

Course Outcomes:

On completion of the course, the students should be able to

CO 1: Acquire Knowledge on marine ecosystem, recognize and describe the interrelationship between biology and ocean technology. (K1,K2,K3,K4)

CO 2: Articulate and classify the dynamics and the physical attributes of the ocean (K1,K2,K3,K4)

CO 3: Identify and analyze the physical and biological factors of marine environments, and focus life in the open sea (K1,K2,K3,K4)

CO 4: Evaluate the impact of variations in abiotic factors in marine productivity.(K1,K2,K3,K4)

CO 5: Categorize marine pollutants and develop controlling measures in collaboration with the institutions for ocean management.(K1,K2,K3,K4)

<table>
<tr><td>Title of the Course</td><td colspan="7">SKILL ENHANCEMENT COURSE: FOOD NUTRITION & HEALTH</td></tr>
<tr><td>Paper No.22</td><td colspan="7">SKILL ENHANCEMENT COURSE VII</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">SEC</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">1</td><td rowspan="2">Course Code</td><td rowspan="2">USZO724</td></tr>
<tr><td>Semester</td><td>IV</td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>1</td><td>-</td><td colspan="3">-</td><td colspan="2">1</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">• To highlight the various dimensions of human health with reference to nutrition, environment and disease.
• To gain basic knowledge about health and hygiene</td></tr>
<tr><td>Course Outline</td><td colspan="7">Unit I (3 Hours) (K1,K2,K3,K4)Nutrition and dietary nutrients:
1. 1. Basic concepts of Food.
1.2. Balanced diet.
1.3. Dietary pattern for different groups-pregnant and nursing mothers
1.4. Infants, Young children and complementary feeding
1.5. School children and elderly.</td></tr>
<tr><td></td><td colspan="7">Unit II: (3 Hours) (K1,K2,K3,K4)Macro nutrients and micronutrients:
2.1. Macronutrients-Carbohydrates-Definition, their dietary source and disease.
2.2. Lipids-Definition, their dietary source and disease
2.3. Proteins - Definition, their dietary source and disease.
2.4. Micronutrients-Vitamins- Water-soluble and Fat-soluble vitamins- their sources and importance.
2.5. Important minerals -Calcium, Phosphorus, Iodine, Selenium and Zinc- their biological functions.</td></tr>
<tr><td></td><td colspan="7">Unit III: (3 Hours) (K1,K2,K3,K4)Malnutrition and nutrient deficiency diseases:
3.1. Definition and concept of health
3.2. Common nutritional deficiency diseases- Protein Malnutrition (e.g., Kwashiorkor and Marasmus)
3.3. Vitamin A deficiency- their symptoms, treatment, prevention and government initiatives.
3.4. Iron deficiency - their symptoms, treatment, prevention and government initiatives3.5. Iodine deficiency disorders- their symptoms, treatment, prevention and government initiatives.</td></tr>
<tr><td></td><td colspan="7">Unit IV: (3 Hours) (K1,K2,K3,K4)Life style dependent diseases.
4.1. Hypertension -causes and prevention
4.2. Diabetes mellitus- causes and prevention
4.3. Obesity causes and prevention.
4.4. Social health problems- smoking, alcoholism.
4.5. Narcotics.</td></tr>
<tr><td></td><td colspan="7">Unit V: (3 Hours) (K1,K2,K3,K4) Food and Water-borne disease caused by microorganisms
5.1. Food and Water-borne disease
5.2. Typhoid
5.3. Amoebiasis
5.4. Poliomyelitis
5.5. Hepatitis.</td></tr>
</table>

Extended Professional Component (isapartofinternalcomponentonly,nottobeincludedintheexternalexamination Question paper)	Questionsrelatedtotheabovetopics,fromvariouscompetitiveexaminationsUPSC/JAM/TNPSCandotherstobesolved (To be discussed during the Tutorial hours)

Recommended Text	1. Mudambi, S.R. and Rajagopal, M.V. (2007). Fundamentals of Foods, Nutrition and Diet Therapy; Fifth Ed;; New Age International Publishers. 2. Srilakshmi, B. (2007). Food Science; Fourth Ed; New Age International (P) Ltd. 3. Swaminathan, M. (1986). Handbook of Foods and Nutrition; Fifth Ed; BAPPCO. 4. Bamji, M.S.; Rao, N.P. and Reddy, V. (2009). Text Book of Human Nutrition; Oxford & IBH Publishing Co. Pvt Ltd. 5. Lakra, P. and Singh M.D. (2008). Textbook of Nutrition and Health; First Ed;Academic Excellence. 6. Gibney, M.J. et al. (2004). Public Health Nutrition; Blackwell Publishing.

Course Outcomes:

On completion of the course, the students should be able to

CO1: Understand the role of food and nutrients on health. (K1, K2, K3)
CO2: Acquire knowledge about nutrition and classification of food. (K1, K2, K3)
CO3: Analyze the impact of nutrient deficiency on health. (K1, K2, K3)
CO4: Expand knowledge about non-communicable diseases and its prevention. (K1, K2, K3)
CO5: Improve the quality of life through prevention and treatment of communicable disease. (K1, K2, K3)

<table>
<tr><td>Title of the Course</td><td colspan="7">EVOLUTIONARY BIOLOGY</td></tr>
<tr><td>Paper No.8</td><td colspan="7">Core-V</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>III</td><td>Credits</td><td>4</td><td>Course Code</td><td>UCZOH24</td></tr>
<tr><td>Semester</td><td>V</td><td colspan="4"></td></tr>
<tr><td>Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td></td><td>6</td><td>-</td><td colspan="3"></td><td colspan="2">6</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">• To learn the basics of genes, heredity and variations.
• To learn the evolution of life and speciation.</td></tr>
<tr><td>Course Outline</td><td colspan="7">Unit I (18 Hours) (K1, K2, K3, K4)
1.1. Inorganic and organic evolution.
1.2. Chemical origin of life.
1.3. Synthesis of organic molecules.
1.4. Urey-Miller experiment.
1.5. Origin of prokaryotes.
1.6. Origin of eukaryotes.</td></tr>
<tr><td></td><td colspan="7">Unit II (18 Hours) (K1, K2, K3, K4)
2.1. Lamarckism - Neo Lamarckism .
2.2. Darwinism - Neo Darwinism.
2.3. Modern synthetic theory - Devrie’s Mutation theory.
2.4. Modern concepts of mutation.
2.5. Mutation and their role in evolution.
2.6. Animal colouration and Mimicry.</td></tr>
<tr><td></td><td colspan="7">Unit III (18 Hours) (K1, K2, K3, K4)
3.1 Isolating mechanisms - Modes of speciation.
3.2. Hybridization is an evolutionary catalyst .
3.3. Law of Adaptive Radiation.
3.4. Adaptive radiation in reptiles and mammals.
3.5. Convergence and parallelism.
3.6. Evolutionary constancy.</td></tr>
<tr><td></td><td colspan="7">Unit IV (18 Hours) (K1, K2, K3, K4)
4.1. Morphological, Physiological and Biochemical evidences.
4.2. Embryological Taxonomical Geographical and Palaeontological evidences .
4.3. Evolutionary genomics.
4.4. Geological time scale.
4.5. Dating of fossils.
4.6. Fossil records of man.</td></tr>
<tr><td></td><td colspan="7">Unit V (18 Hours) (K1, K2, K3, K4)
5.1. Evolution of Man.
5.2. Natural selection in action in man-Level of selection.
5.3. Eugenics, Euphenics.
5.4. Euthenics.
5.5. Adaptation-Human Genome Project.
5.6. Evolution and ethics.</td></tr>
</table>

ExtendedProfessionalComponent(isapartofinternalcomponentonly,nottobeincludedintheexternalexamination questionpaper)	Questionsrelatedtotheabovetopics,fromvariouscompetitiveexaminationsUPSC/JAM/TNPSCandotherstobesolved (TobediscussedduringtheTutorialhours)

Recommended Text	(Latest Editions) 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.
Reference Books	(Latest editions, and the style as given below must be strictly adhered to) 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.
Website and e-learning source	https://bit.ly/3nPD09m https://bit.ly/3CHOdgL https://bit.ly/2XvcCXl https://bit.ly/2XAL1Vh https://bit.ly/3zoU9Jl

Course Outcomes:

On completion of the course, the students should be able to

CO1: Understand the Primordial earth and theories on origin of life. (K1, K2, K3, K4)
CO2: Integrate and assess Lamarckism - Neo Lamarckism – Darwinism. (K1, K2, K3, K4)
CO3: Analyze various fossil records of man and fossil records of horse, various types of rocks - Geological time scale. (K1, K2, K3, K4)
CO4: Acquire knowledge on the Nature of fossils- Dating of fossils, evidences of evolution, Adaptive radiation in reptiles and mammals. (K1, K2, K3, K4)
CO5: Construct and compile the role of Human Genome Project, Evolution in the diagnosis, and treatment of diseases. (K1, K2, K3, K4)

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

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

H-HIGH (3): M-MODERATE (2): L-LOW-(1)

Title of the Course	**ANIMAL PHYSIOLOGY**						
Paper No.9	**Core - VI**						
Category	**Core**	**Year**	**III**	**Credits**	**4**	**Course Code**	**UCZOI24**
		Semester	**V**				
Instructional hours per week	**Lecture**	**Tutorial**	**Lab Practice**			**Total**	
	5	**1**	**-**			**6**	
Objectives of the course	To understand and appreciate the structure and function of organ systems. To study the basic physiological processes that supports life.						
Course Outline	**Unit I (18 hours) (K1, K2, K3 & K4)** 1.1: Digestion- digestive system of man. 1.2: Process of digestion –absorption. 1.3: Hormonal control of digestion. 1.4: Types of Respiration. 1.5: Respiratory pigments-structure of Haemoglobin. 1.6: Transportation of gases- Bohr effect- Regulation of respiration						
	Unit II (18 hours) (K1, K2, K3 & K4) 2.1: Circulation - structure and function of heart. 2.2: Cardiac cycle-Cardiac rhythm- factors affecting it. 2.3: Blood- composition and functions – Blood Clotting. 2.4: Nephron structure & mechanism of urine formation, 2.5: Regulation of acid base balance, Excretory products, 2.6: Osmoregulation in fishes.						
	Unit III (18 hours) (K1, K2, K3 & K4) 3.1: Muscles-Types of muscles. 3.2: Ultrastructure of skeletal muscle-composition. 3.3: Contraction – theories of contraction. 3.4: Electric organ in fishes. 3.5: Chromatophores. 3.6: Bioluminescence.						
	Unit IV (18 hours) (K1, K2, K3 & K4) 4.1: Structure of neuron, nerve impulse. 4.2: Synaptic transmission, neurotransmitters. 4.3: Reflex Action. 4.4: Autonomic nervous system. 4.5: Physiology of vision. 4.6: Physiology of hearing.						
	Unit V (18 hours) (K1, K2, K3 & K4) 5.1: Endocrine glands in man. Structure and function of pituitary gland. 5.2: Structure and function of thyroid gland. 5.3: Structure and function of adrenal gland. 5.4: Structure and function of pancreas. 5.5: Sex hormones – estrogen and testosterone. 5.6: Outlines of mechanism of hormonal activity. Feed-back mechanism,						
Extended Professional Component (isa part of internal component only, not to beincluded in the external examination question paper)	Questions related to the above topics, from various competitive examinationsUPSC/JAM /TNPSC and others to be solved (To be discussed during the Tutorial hours)						

Recommended Text	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.
ReferenceBooks	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. 2. Ganong, W.F., 2019. Review of Medical Physiology, McGraw Hill, New Delhi., 340 pp. 3. 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. 4. Hoar, W.S. 1983. General and Comparative Physiology. Prentice Hall of India, New Delhi, 928 pp. 5. Prosser C.L., 1985. Comparative Animal Physiology, Satish Book Enterprise, Agra - 282 003, 966 pp. 6. Sarada Subrahmanyam, Madhavan Kutty, K., & Singh H.D., 2018. Text Book of Human Physiology, S. Chand & Co, New Delhi. 7. Singh, H.R and Kumar, N. 2017. Animal physiology and biochemistry, Vishal publishing company, Jalandhar, 864 pp. 8. Sreekumar, S. 2010. Basic physiology, PHI learning private ltd., New Delhi.210 pp 9. Tortora G.J. & Derrickson B., 2016. Principles of Anatomy and Physiology, John Sons, Inc. 1232 pp. 10. Wood, D.W., 1968. Principles of Animal Physiology, Edward Arnold Ltd, London., 342 pp.
Website and e-learning source	https://microbenotes.com/category/biochemistry/ https://www.stem.org.uk/resources/collection/3931/animal-physiology https://animalphys4e.sinauer.com https://nptel.ac.in/courses/102/104/102104042/ https://biochem.oregonstate.edu

Course Outcomes:

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

CO1: Interpret digestion and respiratory system. (K1, K2, K3 & K4)

CO2: Analyse the interaction between circulatory system and excretory system. (K1, K2, K3 & K4)

CO3: Analyse the function of muscle and the modification in animals. (K1, K2, K3 & K4)

CO4: Illustrate the structure and function of nervous system. (K1, K2, K3 & K4)

CO5: Compare the structure and function of endocrine system. (K1, K2, K3 & K4)

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

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

H-HIGH (3): M-MODERATE (2): L-LOW-(1)

<table>
<tr><td>Title of the Course</td><td colspan="7">ENVIRONMENTAL BIOLOGY</td></tr>
<tr><td>Paper No.10</td><td colspan="7">Core VII</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>III</td><td>Credits</td><td>4</td><td>Course Code</td><td>UCZOJ24</td></tr>
<tr><td>Semester</td><td>V</td><td colspan="4"></td></tr>
<tr><td>Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td></td><td>5</td><td>1</td><td colspan="3">-</td><td colspan="2">6</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">• To understand the Structure and function of ecosystem, Types of ecosystem, Environmental pollution and control, Biodiversity conservation.
• To understand the network of the surrounding and other organism.
• To protect the environment and to use the resources sustainably.</td></tr>
<tr><td>Course Outline</td><td colspan="7">Unit I (18 hours) (K1, K2, K3, K4)
1.1 Ecosystem: Concept of an ecosystem-Structure and function of an ecosystem-Producers, consumers and decomposers.
1.2 Energy flow in the ecosystem-Ecological succession.
1.3 Food chains, food webs .
1.4 Ecological pyramids .
1.5 Introduction, types, characteristic features, structure and function of the following ecosystem : Forest ecosystem-Grassland ecosystem.
1.6 Desert ecosystem-Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries).</td></tr>
<tr><td></td><td colspan="7">Unit II (18 hours) (K1,K2,K3, K4)
2.1 Population - Structure and distribution – Growth curves.
2.2 Natality, Mortality -Density indices. Life study tables Carrying capacity.
2.3. Abiotic Factors and its effects on plants and animals- Temperature
2.4 Abiotic Factors and its effects on plants and animals- Light
2.5 Soil- Soil profile-Pedogenesis
2.6 Biogeochemical cycles- Water, Carbon, Nitrogen, Phosphorus.</td></tr>
<tr><td></td><td colspan="7">Unit III (18 hours) (K1,K2,K3, K4)
3.1 Environmental Stresses And Management :Global warming, ozone depletion.
3.2 Acid and nitrogen deposition.
3.3 Uptake, biotransformation, elimination and accumulation of toxicants. Factors influencing bioaccumulation from food and trophic transfer.
3.4 Biomagnification, Bioconcentration
3.5 Bio indicators
3.6 Biodegradation and bioremediation of chemicals.</td></tr>
<tr><td></td><td colspan="7">Unit IV (18 hours) (K1,K2,K3, K4)
4.1 Environmental Pollution: Definition- cause, effects and control measures of: -Air pollution.
4.2 Water pollution.
4.3 Soil pollution -Marine pollution.
4.4 Noise pollution.
4.5 Thermal pollution.
4.6 Nuclear hazards.</td></tr>
</table>

	Unit V (18 hours)(K1,K2,K3, K4) 5.1 Biodiversity Conservation: Biodiversity crisis – habitat degradation, poaching of wild life. 5.2 Socio economic and political causes of loss of biodiversity. 5.3 In situ and ex situ conservation of biodiversity, Hot spots of Biodiversity. Green peace movement - Chipko Movement. 5.4 Role of government agencies: Central and State Pollution Control Boards - Ministry of Environment and Forests. 5.5 National Biodiversity Authority. Awareness, Programme NGOs, Natural Disaster Management, Legislations for environmental Protection 5.6 Bio villages – sustainable utilization and development, Environmental ethics.
Extended Professional Component (isa part of internal component only, not to beincluded in the external examination question paper)	Questions related to the above topics, from various competitive examinationsUPSC/JAM /TNPSC and others to be solved (To be discussed during the Tutorial hours)
Recommended Text	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
ReferenceBooks	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.
Website and e-learning source	https://bit.ly/2VYWOM5 https://bit.ly/2VZQFiT https://bit.ly/3kqdXYA https://bit.ly/39rvvgt

Course Outcomes:

On completion of the course, the students should be able to

CO1: Explain fundamental structure and functions of the ecosystem. (K1, K2, K3, K4)
CO2: Discuss inter-relationship between organisms and between biotic and abiotic factors in an ecosystem. (K1, K2, K3, K4)
CO3: Discuss factors that cause pollution, climate change, loss of biodiversity and depletion of resources. (K1, K2, K3, K4)
CO4: Explain impact of human population growth and socio-economic development on the structure and function of the ecosystem. (K1, K2, K3, K4)
CO5: Discuss environmental problems using biological tools, technologies and government policies. (K1, K2, K3, K4)

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

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

H-HIGH (3): M-MODERATE (2): L-LOW-(1)

<table>
<tr><td>Title of the Course</td><td colspan="7">PHYSIOLOGY AND DEVELOPMENTAL BIOLOGY</td></tr>
<tr><td>Paper No.11</td><td colspan="7">Core Practical IV</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>III</td><td>Credits</td><td>3</td><td>Course Code</td><td>UCZOK24</td></tr>
<tr><td>Semester</td><td>V</td><td colspan="4"></td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>-</td><td>-</td><td colspan="3">3</td><td colspan="2">3</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">• To obtain practical skills physiology.
• To learn about development of animals.</td></tr>
<tr><td>Course Outline</td><td colspan="7">PHYSIOLOGY:
1. Detection of nitrogenous waste products in Fish Tank Water, Bird’s Excreta and Cow’s Urine.
2. Study of Human Salivary Amylase Activity in relation to pH.
3. Study of Human Salivary Amylase Activity in relation to Temperature.
4. Oxygen Consumption in Fish with reference to Body Weight.
5. Estimation of Clotting Time
6. Estimation of Haemoglobin - Sahli’s Method.
7. Kymograph, Respirometer.

DEVELOPMENTAL BIOLOGY:
1. Frog – 4 cell, 8 cell and 32 celled stages, Blastula, Gastrula.
2. Chick-18, 24, 48hr Embryos.
3. T.S of Testis and Ovary.
4. Human Ovum and Sperm.
5. Placenta - Sheep, Human, Yolk Sac Placenta of Shark.</td></tr>
<tr><td colspan="3">Extended Professional Component (is a part of internal component only, not to be included in the external examination
Question paper)</td><td colspan="5">Questions related to the above topics, from various competitive examinations UPSC/JAM/TNPSC and others to be solved (To be discussed during the Tutorial hours)</td></tr>
<tr><td>Recommended Text</td><td colspan="7">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.</td></tr>
</table>

Reference Books	**(**Latest editions, and the style as given below must be strictly adhered to) 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.
Website and e -learning source	https://bit.ly/3hNyeFN https://www.medicinenet.com/alp_test/article.htm https://vlab.amrita.edu/?sub=3&brch=63 https://www.asbmb.org/education/online-teaching/online-lab-work https://open.umn.edu/opentextbooks/textbooks/687 https://bit.ly/3lO29yP

Course Outcomes:

On completion of the course, the students should be able to

CO1: Demonstrate experiments in Physiology. (K1, K2, K3, K4)

CO2: Recall basic equipment in Physiology. (K1, K2, K3, K4)

CO3: Examine the various parameters of haematology. (K1, K2, K3, K4)

CO4: Identify developmental stages of frog and chick. (K1, K2, K3, K4)

CO5: Discuss the types of placentas and histology in Developmental Biology(K1, K2, K3, K4)

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

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

H-HIGH (3): M-MODERATE (2): L-LOW-(1)

<table>
<tr><td>Title of the Course</td><td colspan="7">PROJECT</td></tr>
<tr><td>Paper No.30</td><td colspan="7">PROJECT WITH VIVA VOCE</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Project</td><td>Year</td><td>III</td><td>Credits</td><td>4</td><td>Course Code</td><td>UCZOL24</td></tr>
<tr><td>Semester</td><td>V</td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>-</td><td>-</td><td colspan="3">-</td><td colspan="2">5</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">• To explore alternatives prior to graduation.
• To integrate theory and practice.
• To develop work habits and attitudes necessary for research environment.
• To build a record of research experience.</td></tr>
<tr><td>Course Outline</td><td colspan="7">Each student shall be required to do a project and prepare the report on the basis of the investigation carried out by her in an institution / research centers or organization.
The student is expected to identify a problem based on her area of interest and provide solutions and suggestions.
The report should demonstrate the capability of the students in analysing and evaluating the problem and to create original approach in providing solutions to the problem. Viva-Voce Examinations will be conducted on the basis of the report and presentation.
Each student shall be required to prepare the report, that demonstrate the capability of the students in studying and performing activities in totality.</td></tr>
<tr><td></td><td colspan="7">EVALUATION PATTERN
• Each student should undergo the training separately.
• The mode of evaluating the student will consist of two parts. One on the basis of the report writing and the other will be through Viva-Voce.
• The valuation of the report writing will be done by the Internal Examiner while for the oral i.e. Viva-Voce Examination an External Examiner will be called for.
• 60 marks will be awarded for the report writing and 40 marks for the Oral (Viva Voce) Examination.</td></tr>
<tr><td colspan="8">Course Outcomes:
On completion of the course, the students should be able to
CO1. Identify work in the Life science field. (K1, K2, K3, K4, K5, K6)
CO 2. Develop communication, interpersonal and other critical skills for employability. (K1, K2, K3, K4, K5, K6)
CO 3. Realize the importance of professionalism in the research institutions. (K1, K2, K3, K4, K5, K6)
CO 4. Gain ethical experience in Research culture. (K1, K2, K3, K4, K5, K6)
CO 5. Ability to identify the diverse needs and global issues for sustainable growth. (K1, K2, K3, K4, K5, K6)</td></tr>
</table>

<table>
<tr><td>Title of the Course</td><td colspan="8">ELECTIVE: WILDLIFE CONSERVATION AND MANAGEMENT</td></tr>
<tr><td>Paper No.25</td><td colspan="8">Discipline Specific Elective Course - III</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">DSE</td><td>Year</td><td>III</td><td>Credits</td><td>3</td><td>Course Code</td><td colspan="2">UEZOC24</td></tr>
<tr><td>Semester</td><td>V</td><td colspan="5"></td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="3">Total</td></tr>
<tr><td>3</td><td></td><td colspan="3">-</td><td colspan="3">3</td></tr>
<tr><td>Objectives of the course</td><td colspan="8">• To understand the importance of wildlife. To study conservation policies, wildlife management.</td></tr>
<tr><td>Course Outline</td><td colspan="8">Unit 1:(9 Hours)Biodiversity extinction and Conservation Approaches:(K1, K2, K3 & K4)
1.1: Perspectives and Expressions.
1.2: Identification of Ecologically sensitive area (ESA).
1.3: Prioritization of Ecologically sensitive area (ESA).
1.4: Coarse filter and fine filter approaches.
1.5: Regional approaches for biodiversity conservation.
1.6: National approaches for biodiversity conservation.</td></tr>
<tr><td></td><td colspan="8">Unit 2: (9 Hours) Theory and Analysis of Conservation Approaches:(K1, K2, K3 & K4)
2.1: Stochastic perturbations - Environmental, Demographic, spatial and genetic stochasticity)
2.2: Population viability analysis-conceptual foundation.
2.3: Uses of PVA models. Management.
2.4: Management Decisions for small populations using PVA models.
2.5: Minimum viable populations .
2.6: Recovery strategies for threatened species.</td></tr>
<tr><td></td><td colspan="8">Unit 3: (9 Hours)National and International Efforts for Conservation(K1, K2, K3 & K4)
3.1: International agreements for conserving marine life
3.2: Convention on wetlands of International Importance (Ramsar convention),Conservation of Natural Resources
3.3: Overview of conservation of Forest &Grassland resources.
3.4: CITES, IUCN, CBD National Forest Policy, 1988, National Wildlife Action Plan 2017-2031, Wildlife Protection Act 1972.
3.5: National and State Biodiversity Action Plans.
3.6: Other Forests and Environmental Acts.</td></tr>
<tr><td></td><td colspan="8">Unit 4: (9 Hours) Wildlife in India.: (K1, K2, K3 & K4)
4.1: Wildlife wealth of India & threatened wildlife.
4.2: Reasons for wildlife depletion in India.
4.3: Wildlife conservation approaches and limitations.
4.4: Wild life Habitat: Characteristic, Fauna and Adaptation with special reference to Tropical forest.
4.5: Protected Area concept: National Parks, Sanctuaries and Biosphere Reserves, cores and Buffers, Nodes and corridors. Community
4.6: Reserve and conservation Reserves.</td></tr>
</table>

	Unit 5: (9 Hours) Management of wildlife : **(K1, K2, K3 & K4)** 5.1 Distribution, status. Habitat utilization pattern. 5.2 threats to survival of Slender Loris, Musk deer, Great Indian Bustard, Olive Ridley turtle. 5.3: Wild life Trade & legislation. 5.4: Assessment, documentation, Prevention of trade. 5.5: Prevention of trade. 5.6: Wild life laws and ethics.
Extended Professional Component (isa part of internal component only, not to beincluded in the external examination question paper)	Questions related to the above topics, from various competitive examinationsUPSC/JAM /TNPSC and others to be solved (To be discussed during the Tutorial hours)
Recommended Text	1. Robinson W L and Eric G Bolen, 1984. Wildlife Ecology and Management, Maxmillan Publishing Company, New York, p 478. 2. Aaron, N.M.1973 Wildlife ecology, W.H. Freeman Co. San Francisco, U.S.A. 3. Dasmann R F, 1964. Wildlife Biology, John Wiley & Sons, New York, p 231. 4. Justice Kuldip Singh 1998. Handbook of Environment, Forest and Wildlife Protection Laws in India, Natraj Publishers, Dehradun. 5. Hosetti, B.B. 1997 Concepts in Wildlife Management, Daya Publishing House, Delhi. 6. Sutherland, W.J 2000. The conservation handbook: Research, Management and Policy. Blackwell Science. 7. Caughley.G and Sinclaire, A.R.E 1994 Wildlife ecology and management. Blackwell Science. 8. Woodroffe R, Thirgood, S. and Rabinowitz A. 2005.People and Wildlife, Conflict or Co exsistence? Cambridge University. 9. Sinha, P.C. 1998. Wildlife and Forest Conservation, Anmol Publishing Pvt. Ltd., New Delhi. Singh, S.K, 2005. Text Book of Wildlife Management. IBDC, Lucknow
ReferenceBooks	1. Gilas R H Jr.(ed.), 1984. Wildlife Management Techniques, 3rd ed. The Wildlife Society, Washington D.C., Nataraj Publishers, Dehra Dun, p 547. 2. Rodgers W A, 1991. Techniques for Wildlife Census in India - A Field Manual: Technical Manual - T M - 2. WII. 3. Saharia V B, 1982. Wildlife of India, Natraj Publishers, Dehra Dun. 4. Goutam Kumar Saha and SubhenduMazumdar, 2017. Wildlife Biology: An Indian Prospective, PHI Publisher, Delhi. 5. Katwal/Banerjee, 2002. Biodiversity conservation in managed and protected areas, Agrobios, India. 6. Gopal, Rajesh,1992. Fundamentals of Wildlife Management, Justice Home, Allahabad, India. 7. Sharma, B.D, 1999. Indian Wildlife Resources Ecology and Development, Daya Publishing House, Delhi. 8. Stephen, H.B. and V.B. Saharia,1995. Wildlife research and management. Asian and American Approaches, Oxford University Press, Delhi. 9. Negi, S.S. 1993. Biodiversity and its conservation in India, Indus Publishing Co., New Delhi.

	10. Moulton, M. P. & J. Sanderson, 1997. Wildlife Issues in a Changing World. St. Lucie Press.
Website and e-learning source	https://bit.ly/39oPj44 https://bit.ly/3lHdEYJ https://bit.ly/3CwBCfY https://bit.ly/3EDYr3a https://bit.ly/3tVtG4U

Course Outcomes:

On completion of the course, the students should be able to

CO1: Discuss the importance of wildlife, its values, modern concepts in wildlife management, and relevant conservation policies (K1,K2,K3,K4)

CO2: Explain wildlife policies laws and regulations.. (K1,K2,K3,K4)

CO3: Discuss the human dimensions of human-wildlife interactions(K1,K2,K3,K4)

CO4: Explain Fundamentals in Ecology, Forestry, Natural Resource Conservation approaches and develop the role PVA models for protection of Endangered species (K1,K2,K3,K4)

CO5: Explain the advanced scientific basis for wildlife management and National and International Efforts for successful wildlife conservation.(K1,K2,K3,K4)

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

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

H-HIGH (3): M-MODERATE (2): L-LOW-(1)

<table>
<tr><td>Title of the Course</td><td colspan="7">ELECTIVE: AGRICULTURAL ENTOMOLOGY</td></tr>
<tr><td>Paper No. 26</td><td colspan="7">Discipline Specific Elective Course - IV</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">DSE</td><td>Year</td><td>III</td><td rowspan="2">Credits</td><td rowspan="2">3</td><td rowspan="2">Course Code</td><td rowspan="2">UEZOD24</td></tr>
<tr><td>Semester</td><td>V</td></tr>
<tr><td>Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td></td><td>3</td><td>-</td><td colspan="3">-</td><td colspan="2">3</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">• To explain the basic concepts of entomology and observe the pest status of agriculture.
• To understand the systemic and functional morphology of various group of agricultural insect pests.
• To compare and distinguish the general and specific characteristics integrated pest management.</td></tr>
<tr><td>Course Outline</td><td colspan="7">Unit I: (9 hours) (K1, K2, K3, K4)
1.1. Outline classification of insects
1.2. Causes for insect assuming pest status
1.3. Methods of collection
1.4. Mounting
1.5. Preservation of insect pests.</td></tr>
<tr><td></td><td colspan="7">Unit II: (9 hours) (K1, K2, K3, K4)
2.1. Insect vectors of plant diseases
2.2. Insect pests of stored grains their preventive and curative methods
2.3. Most common insect pests of Sugarcane, Groundnut and their control measures.
2.4. Most common insect pests of Paddy, Coconut and Cotton and their control measures:
2.5. Locust and its control
2.6. Insect pollinators and scavenger.</td></tr>
<tr><td></td><td colspan="7">Unit III: (9 hours) (K1, K2, K3, K4)
3.1. Apiculture: Introduction, types of honey bees, hive, apiary, selection of bees for apiary.
3.2. Enemies and diseases of honey bees
3.3. Sericulture: Introduction, types of silk worms, silk worm races, life history of mulberry silk worm.
3.4. Pests and diseases of silk worm
3.5. Lac Culture.
3.6. Enemies of Lac.</td></tr>
<tr><td></td><td colspan="7">Unit IV: (9 hours) (K1, K2, K3, K4)
4.1. Introduction to IPM
4.2. Steps towards IPM
4.3. Physical and mechanical control methods
4.4. Chemical control methods
4.5. Biological control methods
4.6. Pesticide application equipment.</td></tr>
</table>

	Unit V: (9 hours) (K1, K2, K3, K4) 5.1. Biopesticide. 5.2. Pheromones 5.3. Antifeedents 5.4. Repellents 5.5. Economic importance of agricultural insect species.
ExtendedProfessionalComponent(isapartofinternal componentonly,nottobeincludedintheexternalexamination questionpaper)	Questionsrelatedtotheabovetopics,fromvariouscompetitiveexaminationsUPSC/JAM/TNPSCandothers tobesolved (TobediscussedduringtheTutorialhours)
Recommended Text	1. David,BandAnanthakrishnan,T.N.2006.Generaland AppliedEntomology, Second edition, Tata McGraw hill publishing company Ltd.,New Delhi, India. 2. Vasanthraj David, B. and Ramamurthy, VV. 2012. Elements ofEconomic Entomology, Seventh edition, Namruthapublications, Chennai. 3. Pruthi,H.S.1969.TextbookonAgriculturalEntomology,I.C.A.R.Publication,New Delhi. 4. Awasthi, V.B. 2012. Introduction toGeneral and Applied Entomology, third edition, Scientific publishers.
Reference Books	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.
Website and e-learning source	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

<table>
<tr><td>Title of the Course</td><td colspan="8">INTERNSHIP</td></tr>
<tr><td>Paper No.29</td><td colspan="8">SUMMER INTERNSHIP (Carried out in II Year Summer Vacation)</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Internship</td><td>Year</td><td>III</td><td rowspan="2">Credits</td><td rowspan="2">2</td><td rowspan="2">Course Code</td><td colspan="2" rowspan="2">UIZO24</td></tr>
<tr><td>Semester</td><td>V</td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="3">Total</td></tr>
<tr><td>-</td><td>-</td><td colspan="3">-</td><td colspan="3">-</td></tr>
<tr><td>Objectives of the course</td><td colspan="8">• To explore alternatives prior to graduation.
• To integrate theory and practice.
• To develop work habits and attitudes necessary for work environment.
• To build a record of work experience.</td></tr>
<tr><td>Course Outline</td><td colspan="8">Each student shall be required to prepare the report based on training undergone by her. The report should demonstrate the capability of the students in studying and performing activities in totality.</td></tr>
<tr><td></td><td colspan="8">Evaluation Pattern
● Each student should undergo the training separately.
● The mode of evaluating the student will consist of two parts. One on the basis of report writing and the other will be through Viva Voce. The valuation will be by the internal examiner
● 60 marks will be awarded for report writing and 40 marks for overall review
● Each student should find a reputed place to carry out her investigation with the approval of the department.
● After completing her training, the student should get an Attendance Certificate from the institution.</td></tr>
<tr><td colspan="9">Course Outcomes:

On completion of the course, the students should be able to

CO1. Identify work in the Life science field. (K1, K2, K3, K4, K5, K6)
CO 2. Develop communication, interpersonal and other critical skills for employability. (K1, K2, K3, K4, K5, K6)
CO 3. Realize the importance of professionalism in the workplace. (K1, K2, K3, K4, K5, K6)
CO 4. Gain ethical experience in organizational culture. (K1, K2, K3, K4, K5, K6)
CO 5. Ability to identify the diverse needs and global issues for sustainable growth.(K1, K2, K3, K4, K5, K6)</td></tr>
</table>

<table>
<tr><td>Title of the Course</td><td colspan="7">ANIMAL BIOTECHNOLOGY</td></tr>
<tr><td>Paper No.11</td><td colspan="7">Core - VIII</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>III</td><td>Credits</td><td>4</td><td>Course Code</td><td>UCZOM24</td></tr>
<tr><td>Semester</td><td>VI</td><td colspan="4"></td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>5</td><td>1</td><td colspan="3">-</td><td colspan="2">6</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">• To learn the basics of biotechnology, the integration of biology and technology.
• To study the application of the subject in various fields.</td></tr>
<tr><td>Course Outline</td><td colspan="7">Unit I (18 hours) (K1, K2, K3 & K4)
1.1: Biotechnology – Introduction, Scope and importance.
1.2: Definition and Branches of Biotechnology.
1.3: DNA Structure and Composition.
1.4: Introduction to Gene.
1.5: Introduction to Genetic Engineering.
1.6: Methodology of Genetic Engineering.</td></tr>
<tr><td></td><td colspan="7">Unit II (18 hours) (K1, K2, K3 & K4)
2.1: Gene cloning – Cloning Strategies. Restriction Endonucleases.
2.2: Cloning Vectors Plasmids – pBR322.
2.3: Bacteriophages Lambda Phage.
2.4: Cosmids – YAC, HAC, BAC.
2.5: Ligases, Linkers and Adaptors.
2.6: rDNA Technology – Construction of rDNA.</td></tr>
<tr><td></td><td colspan="7">Unit III (18 hours) (K1, K2, K3 & K4)
3.1: Gene Transfer Mechanism- Transformation, Transfection, Liposomal, Microinjection, Electroporation, Biolistics. Colony Hybridization, Plaque Hybridization.
3.2: Expression of Cloned Genes.
3.3: DNA Sequencing - Sanger’s Method, DNA Chips, Microarray
3.4: Genomic Library; cDNA Library.
3.5: Blotting Techniques Southern, Western, Northern Techniques.
3.6: PCR and its Applications.</td></tr>
<tr><td></td><td colspan="7">Unit IV (18 hours) (K1, K2, K3 & K4)
4.1: Animal Cell Culture – Basic Requirements and techniques of Cell Culture.
4.2: Culture Media – Natural and Synthetic.
4.3: Tissue Disaggregation; Primary and Secondary Cell Culture.
4.4: Establishment of Cell Line –Monolayer Culture, Suspension Culture.
4.5: Methods of Culture – Petridish, Test Tube, Flask Culture.
4.6: Applications of Cell Culture and Stem Cells.</td></tr>
<tr><td></td><td colspan="7">Unit V (18 hours) (K1, K2, K3 & K4)
5.1: Applications of Genetic Engineering in Medicine.
5.2: Gene therapy, DNA Fingerprinting and applications.
5.3: Applications of Genetic Engineering in Agriculture.
5.4: Applications of Genetic Engineering in Industry.
5.5: Transgenesis: Animal models- Knock out Mice, Transgenic Fish and Sheep, Molecular farming and Animals as Bioreactors.
5.6: Ethics: Socio ethical problems.</td></tr>
</table>

Extended Professional Component (isa part of internal component only, not to beincluded in the external examination question paper)	Questions related to the above topics, from various competitive examinationsUPSC/JAM /TNPSC and others to be solved (To be discussed during the Tutorial hours)

Recommended Text	1. Gupta P.K. Elements of Biotechnology Rastogi Publications, Meerut, 2001. 2. Dubey, R.C. Textbook of Biotechnology S. Chand and Co., New Delhi, 1993.
ReferenceBooks	1. James D. Watson, Gilman- Recombinant DNA- Scientific American Books, 2001 2. Dubey R.C.- Advanced Biotechnology, S.Chand and Company Pvt. Ltd. New Delhi, 2014. 3. Prakash S. Lohar - Textbook of Biotechnology- MJP Publishers, 2012. 4. Nicholl S.T. An Introduction to Genetic Engineering Cambridge University Press, London, 2005. 5. Satyanarayana-Biotechnology-New Delhi, Book and Allied Private Ltd. 6. Sasidhara, R., Animal biotechnology, MJP publishers, 2015. 7. Purohit S.S., Mathur S.K. Fundamentals of Biotechnology Agrobotanical Publishers, Bikaner, India, 1990.
Website ande-learning source	https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3612824/ https://www.isaaa.org/resources/publications/pocketk/40/default.asp https://www.ncbi.nlm.nih.gov/books/NBK207574/ https://iopscience.iop.org/article/10.1088/1755-1315/492/1/012035/pdf https://go.nature.com/3zAZmO9

On completion of the course, the students should be able to

CO1: Explain the scope and branches of Biotechnology and summarize Genetic Engineering. (K1, K2, K3, K4)

CO2: Describe Cloning Strategies. (K1, K2, K3, K4)

CO3: Explain Gene transfer mechanism and Blotting Techniques. (K1, K2, K3, K4)

CO4: Demonstrate Animal Cell Culture and explain the applications of cell culture. (K1, K2, K3, K4)

CO5: Discuss the applications of Genetic Engineering in various fields. (K1, K2, K3, K4)

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

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

H-HIGH (3): M-MODERATE (2): L-LOW-(1)

<table>
<tr><td>Title of the Course</td><td colspan="8">MICROBIOLOGY</td></tr>
<tr><td>Paper No.12</td><td colspan="8">Core IX</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>III</td><td rowspan="2">Credits</td><td rowspan="2">4</td><td rowspan="2">Course Code</td><td colspan="2" rowspan="2">UCZON24</td></tr>
<tr><td>Semester</td><td>VI</td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td>Total</td><td colspan="2"></td></tr>
<tr><td>5</td><td>1</td><td colspan="3">-</td><td>6</td><td colspan="2"></td></tr>
<tr><td>Objectives ofthe course</td><td colspan="8">• To study about the hidden world of microbes.
• To learn about the beneficial and harmful microbes.</td></tr>
<tr><td>Course Outline</td><td colspan="8">Unit I (18 hours) (K1, K2, K3 & K4)
Introduction to Microbiology
1.1. History of microbiology.
1.2. Scope of microbiology.
1.3. Contributions of eminent microbiologists.
1.4. Concepts of microbiology.
1.5. Systematic position: 5 kingdom classification of Whittaker;
3 kingdom classification of Carl Woese.
1.6. Comparison of Bacteria, Archaea, Eukarya.</td></tr>
<tr><td></td><td colspan="8">Unit 2: (18 hours) (K1, K2, K3 & K4)
Bacteriology
2.1. Classification of bacteria.
2.2. Morphology of bacteria.
2.3. Structure of bacteria – cell wall; cytoplasmic membrane; capsule; mesosome;
2.4. Structure of bacteria – Flagella; pilli; cytoplasm; nucleoid; ribosome;
plasmid; magnetosome.
2.5. Nutrition, Respiration and Reproduction of bacteria.
2.6. Simple staining; Differential staining – Gram Staining.</td></tr>
<tr><td></td><td colspan="8">Unit 3: (18 hours) (K1, K2, K3 & K4)
Bacterial culture and control of microbes
3.1. Culture medium and types of culture medium.
3.2. Bacterial culture methods.
3.3. Isolation of Pure culture.
3.4. Maintenance of Bacterial Culture.
3.5. Control of Microorganisms – Physical methods.
3.6. Control of Microorganisms – Chemical methods.</td></tr>
<tr><td></td><td colspan="8">Unit 4: (18 hours) (K1, K2, K3 & K4)
Virology and Mycology
4.1. Classification of virus.
4.2. Fine structure of virus - T_4 Bacteriophage.
4.3. Multiplication of bacteriophage.
4.4. General characteristics and classification of Fungi.
4.5. General characteristic and life cycle of Yeast.
4.6. General characteristics and structure of Lichens.</td></tr>
</table>

	Unit 5: (18 hours) (K1, K2, K3 & K4) **Applied Microbiology** 5.1. Role of microbes in food production. 5.2. Food poisoning and preservation. 5.3. Production of ethanol and vinegar. 5.4. Production of vaccine. 5.5. Microorganisms, pathogenesis and prophylaxis. 5.6. *Salmonella typhi*, *Mycobacterium tuberculosis*, Hepatitis B, Coronavirus, *Candida albicans*.
Extended Professional Component (isa part of internal component only, not to beincluded in the external examination question paper)	Questions related to the above topics, from various competitive examinationsUPSC/JAM /TNPSC and others to be solved (To be discussed during the Tutorial hours)
Recommended Text	1. Powar C.B., Daginwala H.F. General Microbiology. Himalaya Publishing House. 2015. 2. Sharma P.D. - Microbiology - Rastogi Publication, 1998: 5th reprint, 2005-2006.
ReferenceBooks	1. Pelczar Jr. M. J. Chan E.C.S and Kreig N.R. - Microbiology - McGraw Hill Inc. New York, 2001. 2. Stainer R.Y., Ingraham J.L., Wheelis M.L. and Painter P.R. - General Microbiology - Macmillan Education Ltd, London, 1999. 3. Prescott L.M. Harley J.O Klein D.A. – Microbiology - WCB Publishers Sydney, 1990. 4. Ananthanaryanan T., Paniker J.C.K. - Textbook of Microbiology - Orient Longman Ltd., Madras, 2000. 5. Dubey, R.C., and Maheswari, D.K. - A text book of Microbiology. S.Chand and Co., New Delhi, 2007.
Website and e-learning source	https://microbe.net https://asm.org https://mvi-au.vlabs.ac.in/ https://www.merlot.org/merlot/viewMaterial.htm?id=79694 https://vlab.amrita.edu/?sub=3&brch=73 https://learn.chm.msu.edu/vibl/ https://virtuallab.tlc.ontariotechu.ca/intro.php https://medicine.uiowa.edu

Course Outcomes:
On completion of the course, the students should be able to

CO1: Discuss the history, scope and classification of microbiology. (K1, K2, K3, K4)
CO2: Explain the structure of bacteria. (K1, K2, K3, K4)
CO3: Discuss the methods of bacterial culture and control of microbes. (K1, K2, K3, K4)
CO4: Describe the structure and characteristics of virus and fungi. (K1, K2, K3, K4)
CO5: Discuss the applications of microbes and explain microbial diseases. (K1, K2, K3, K4)

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

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

H-HIGH (3): M-MODERATE (2): L-LOW-(1)

<table>
<tr><td>Title of the Course</td><td colspan="8">IMMUNOLOGY</td></tr>
<tr><td>Paper No.13</td><td colspan="8">Core - X</td></tr>
<tr><td>Category</td><td>Core</td><td>Year</td><td>III</td><td>Credits</td><td>4</td><td>Course Code</td><td colspan="2">UCZOO24</td></tr>
<tr><td></td><td></td><td>Semester</td><td>VI</td><td></td><td></td><td></td><td colspan="2"></td></tr>
<tr><td>Instructional hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td></td><td>5</td><td colspan="2">1</td><td colspan="3">-</td><td colspan="2">6</td></tr>
<tr><td>Objectives of the course</td><td colspan="8">• To study the structure and function of immune system
• To understand the application of immunology in medical field</td></tr>
<tr><td>Course Outline</td><td colspan="8">Unit I (18 hours) (K1, K2, K3 & K4)
1.1: Overview of Immune System - General concepts and Haematopoeisis.
1.2: Lymphoid organs. - Primary and secondary.
1.3: Structure and role - Bone marrow – Thymus.
1.4: Structure and role - Lymph node.
1.5: Structure and role - Spleen.
1.6: Structure and role - Payer’s patches, Kuffer cells and MALT, GALT and CALT.</td></tr>
<tr><td></td><td colspan="8">Unit II (18 hours) (K1, K2, K3 & K4)
2.1: Immunity types - Innate Active and Passive.
2.2: Acquired Active and Passive.
2.3: Characteristics of Immune response.
2.4: Humoral and Cell mediated immunity.
2.5: Cells involved in immune response – T, B Cells and Macrophages.
2.6: Structure and cellular distribution of HLA antigens.</td></tr>
<tr><td></td><td colspan="8">Unit III (18 hours) (K1, K2, K3 & K4)
3.1: Antibodies: Immunoglobulin - structure and functions.
3.2: Human Immunoglobulin Classes.
3.3: Antigens- Types.
3.4: Epitopes, Paratopes and Adjuvants.
3.5: Hybridoma technology - production of monoclonal antibodies.
3.6: Production of catalytic antibodies (abzymes).</td></tr>
<tr><td></td><td colspan="8">Unit IV (18 hours) (K1, K2, K3 & K4)
4.1: Antigen Antibody Reactions-Precipitation.
4.2: Agglutination, Cytolysis, Opsonization.
4.3: Transplantations and Graft rejections.
4.4: Hypersensitivity.
4.5: Autoimmunity.
4.6: AIDS/HIV.</td></tr>
<tr><td></td><td colspan="8">Unit V (18 hours) (K1, K2, K3 & K4)
5.1: Immunity against Viral and parasitic infections.
5.2: Types of vaccines used in humans. Immunization schedule for children.
5.3: Immunity and tumors- tumor antigens (TSTA and TAA).
5.4: Immune response to tumors.
5.5: Tumor evasion of the immune system.
5.6: Immunotherapy for tumors.</td></tr>
<tr><td colspan="4">Extended Professional Component (isa part of internal component only, not to beincluded in the external examination question paper)</td><td colspan="5">Questions related to the above topics, from various competitive examinationsUPSC/JAM /TNPSC and others to be solved
(To be discussed during the Tutorial hours)</td></tr>
</table>

Recommended Text	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.
ReferenceBooks	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. 5. Tizard I.R. – Immunology: An Introduction, IV Ed. - Saunders College, Publication, Philadelphia, 1995. 6. Janis Kuby, Thomas J. Kindt, Richard A. Goldsby, Barbara A. Osborne, W.H. Freeman and company - Immunology - sixth edition, 2007. 7. Paul W.E.M. - Fundamental Immunology - Raven Press, New York, 1998.
Website and e-learning source	https://www.aaaai.org/ https://www.bsaci.org/ https://www.immunology.org/ https://nptel.ac.in/courses/102/103/102103038/ https://microbenotes.com/category/immunology/

Course Outcomes:

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

CO1: Describe the primary and secondary lymphoid organs. **(K1, K2, K3, K4)**

CO2: Categorize types of immunity and the cells involved in immunity. **(K1, K2, K3, K4)**

CO3: Analyse the structure and function of antigens and antibodies. **(K1, K2, K3, K4)**

CO4: Examine the antigen antibody reaction and its role in transplantation, hypersensitivity, autoimmunity and AIDS. **(K1, K2, K3, K4)**

CO5: Analyse immunization and its importance in prevention of diseases. **(K1, K2, K3, K4)**

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

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

H-HIGH (3): M-MODERATE (2): L-LOW-(1)

<table>
<tr><td>Title of the Course</td><td colspan="7">ENVIRONMENTAL BIOLOGY AND TOXICOLOGY</td></tr>
<tr><td>Paper No.14</td><td colspan="7">Core Practical V</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>III</td><td rowspan="2">Credits</td><td rowspan="2">2</td><td rowspan="2">Course Code</td><td rowspan="2">UCZOP24</td></tr>
<tr><td>Semester</td><td>VI</td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>-</td><td>-</td><td colspan="3">3</td><td colspan="2">3</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">• To obtain practical skills Ecology and Toxicology.
• To learn about adaptation of animals to their ecosystem.</td></tr>
<tr><td>Course Outline</td><td colspan="7">ENVIRONMENTAL BIOLOGY:
1. Instruments - Rain gauge, Max-Min thermometer, Hygrometer, Luxmeter, Anemometer, Aneroid barometer.
2. Estimations - Oxygen, Carbon-dioxide, Salinity, Carbonate and Bicarbonate and pH in different water samples.
3. Study of museum specimen based on Benthic, Sandy shore, Rocky shore and Flying adaptations.
4. Planktons: Fresh water and Marine Planktons five each (Spotters).

TOXICOLOGY:
1. Estimation of Nitrites.
2. Study of Vermicompost Plant.
3. Visit to Water treatment plant.
4. Instruments – Incubator, Centrifuge, Colorimeter, Spectrophotometer, pH meter.</td></tr>
<tr><td colspan="4">Extended Professional Component (is a part of internal component only, not to be included in the external examination Question paper)</td><td colspan="4">Questions related to the above topics, from various competitive examinations UPSC/JAM/TNPSC and others to be solved (To be discussed during the Tutorial hours)</td></tr>
<tr><td>Recommended Text</td><td colspan="7">1. Abhijit Dutta, 2009. Experimental biology: A Laboratory Science, Narosa, New Delhi.
2. Michael, P, 1984. Ecological Methods for field visit and laboratory investigation. Tata McGraw Hill, New Delhi.
3. APHA, 1992. Standard Methods for the examination of water and waste water, American Public Health association, Washington D.C.</td></tr>
<tr><td>Reference Books</td><td colspan="7">1. Eugenia, 2008. Environmental Biotechnology and cleavers Bioprocesses, London.
2. Ramesh, R & M, Anbu 1996. Chemical methods for environmental Analysis of water and sediment. Macmillan India Limited, Chennai.</td></tr>
<tr><td>Website and e -learning source</td><td colspan="7">https://www.asbmb.org/education/online-teaching/online-lab-work
https://open.umn.edu/opentextbooks/textbooks/687
https://bit.ly/3lO29yP</td></tr>
<tr><td colspan="8">Course Outcomes:
On completion of the course, the students should be able to
CO1: Demonstrate procedures in Ecology. (K1, K2, K3, K4)
CO2: Identify the adaptation of animals in the ecosystem. (K1, K2, K3, K4)
CO3: Apply the principle, working and application of instruments. (K1, K2, K3, K4)
CO4: Demonstrate procedures in Toxicology. (K1, K2, K3, K4)
CO5: Discuss water treatment and vermicomposting through field visits. (K1, K2, K3, K4)</td></tr>
</table>

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

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

H-HIGH (3): M-MODERATE (2): L-LOW-(1)

<table>
<tr><td>Title of the Course</td><td colspan="7">BIOTECHNOLOGY, MICROBIOLOGY AND IMMUNOLOGY</td></tr>
<tr><td>Paper No.15</td><td colspan="7">Core Practical VI</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>III</td><td rowspan="2">Credits</td><td rowspan="2">2</td><td rowspan="2">Course Code</td><td rowspan="2">UCZOQ24</td></tr>
<tr><td>Semester</td><td>VI</td></tr>
<tr><td rowspan="2">Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>-</td><td>-</td><td colspan="3">3</td><td colspan="2">3</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">• To obtain practical skills in Biotechnology, Microbiology and Immunology.
• To understand the basic interpretations in medical field.</td></tr>
<tr><td>Course Outline</td><td colspan="7">BIOTECHNOLOGY:
1. Isolation of DNA
2. Isolation of RNA
3. Electrophoresis - Agarose Gel – SDS PAGE (Demo)
4. Plasmids pBR322
5. PCR
6. DNA sequencing- Sanger Method
7. Blotting techniques-Southern, Northern and Western
8. Lab visit

MICROBIOLOGY:
1. Gram Staining.
2. Streaking Technique (Demo)
3. Mycobacterium tuberculosis,
4. Salmonella typhi,
5. Clostridium tetani,
6. Vibrio cholerae,
7. Haemophilus influenzae.

IMMUNOLOGY:
1. Blood grouping and Rh typing - Antigen and Antibody Reaction
2. Estimation of Haemoglobin
3. Observation of polymorphic forms of leucocytes in human blood sample.
4. Differential count of WBC.
5. Ig A, Ig G
6. Organs of immune system: TS of – Spleen, Thymus and Bone marrow.</td></tr>
<tr><td colspan="4">Extended Professional Component (is a part of internal component only, not to be included in the external examination Question paper)</td><td colspan="4">Questions related to the above topics, from various competitive examinations UPSC/JAM/TNPSC and others to be solved (To be discussed during the Tutorial hours)</td></tr>
</table>

Recommended Text	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.
Reference Books	1. Andreas Hofmann, Samuel Clokie, 2018. Wilson and Walker's Principles and Techniques of Biochemistry and Molecular Biology, Cambridge University Press, UK. 2. Sarah Stauffer, Aaron Gardner, Wilko Duprez, Dewi Ayu Kencana Ungu, Philip Wismer, 2018. Labster Virtual Lab Experiments: Basic Genetics, Springer Publishers, NY, USA. 3. Leonard Davis, Mark Dibner, James Battey, 2012. Basic Methods in Molecular Biology, Elsevier Science Pubilshing Co., NY, USA. 4. Robert F. Schleif, Pieter C. Wensink, 2012. Practical Methods in Molecular Biology, Springer-Verlag, NY, USA. 5. Ian Freshney R., 2010. Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications, John Wiley & Sons, USA.
Website and e -learning source	https://www.jove.com/ https://vlab.amrita.edu/?sub=3&brch=77 http://cbii-au.vlabs.ac.in/ https://media.hhmi.org/biointeractive/vlabs/transgenic_fly/index.html https://www.ibiology.org/biology-techniques/

Course Outcomes:

On completion of the course, the students should be able to

CO1: Demonstrate procedures in Biotechnology, Microbiology and Immunology. (K1, K2, K3, K4)

CO2: Apply the principle, working and application of instruments used Biotechnology. (K1, K2, K3, K4)

CO3: Discuss microbes and the disease caused by them. (K1, K2, K3, K4)

CO4: Describe Lymphoid organs and immunoglobulins (K1, K2, K3, K4)

CO5: Discuss the instruments and procedures used in Biotechnology Lab. (K1, K2, K3, K4)

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

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

H-HIGH (3): M-MODERATE (2): L-LOW-(1)

<table>
<tr><td>Title of the Course</td><td colspan="8">ELECTIVE: ANIMAL BEHAVIOUR</td></tr>
<tr><td>Paper No.27</td><td colspan="8">Discipline Specific Elective Course - V</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">DSE</td><td>Year</td><td>III</td><td>Credits</td><td>2</td><td>Course Code</td><td colspan="2">UEZOE24</td></tr>
<tr><td>Semester</td><td>VI</td><td colspan="4"></td></tr>
<tr><td>Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td></td><td>3</td><td></td><td colspan="3">-</td><td colspan="2">3</td></tr>
<tr><td>Objectives of the course</td><td colspan="8">• To learn the origin and development of animal behaviour and to understand the influence of genetics, environment on animal behaviours.
• To understand the biological properties of animal behaviour, with an evolutionary and ecological emphasis.
• To Compare innate and learned behaviour and differentiate between various mating system.
• To impart the knowledge about visual and auditory communication; courtship, mate choice, and mating systems; social behaviour and social systems; and animal personality.
• To discuss how movement and migration behaviours are a result of natural selection</td></tr>
<tr><td>Course Outline</td><td colspan="8">Unit I: (9 Hours) Genetics and Behaviour (K1, K2, K3 & K4)
1.1 Genetic material, Genes and chromosomes.
1.2 Genetic variation, Single and Polygenic inheritance of behaviour.
1.3 Heritability of behaviour, Natural selection and behaviour.
1.4 Frequency distribution of phenotypes.
1.5 Darwinian fitness,
1.6:Evolution of adaptive strategies.</td></tr>
<tr><td></td><td colspan="8">Unit II: (9 Hours) Evolution and Social Behaviour (K1, K2, K3 & K4)
2.1 Sexual selection, Altruism, Sexual strategy.
2.2 Social organization.
2.3 Social Life of Honey bees
2.4 Animal perception, Neural control of behaviour.
2.5 Sensory processes and perception.
2.6 Visual adaptations to unfavourable environments</td></tr>
<tr><td></td><td colspan="8">Unit III: (9 Hours) Animal and the Environment (K1, K2, K3 & K4)
3.1 Coordination and Orientation.
3.2 Homeostasis and Behaviour.
3.3 Physiology and Behaviour in changing environments.
3.4 Animal Learning, Conditioning and Learning.
3.5 Biological aspects of learning,
3.6 Cognitive aspects of learning.</td></tr>
<tr><td></td><td colspan="8">Unit IV: (9 Hours) Understanding Complex Behaviour(K1, K2, K3 & K4)
4.1 Instinct and learning, Displacement activities, Ritualization and Communication.
4.2 Decision making behaviour in Animals, Complex behaviour of honey bees.
4.3 Evolutionary optimality, Mechanism of Decision making.
4.4 The mentality of Animals: Languages and mental representation,
4.5 Non-verbal communication in human, mental images, Intelligence, tool use and culture.
4.6 Animal awareness and Emotion.</td></tr>
</table>

	Unit V: (9 Hours) Chronobiology (K1, K2, K3 & K4) 5.1 Organization of circadian system in multicellular animals, Concept of central and peripheral clock system. 5.2 Circadian pacemaker system in invertebrates with particular reference to Drosophila. 5.3 Photoreception and photo- transduction, the physiological clock and measurement of day length. 5.4 Molecular bases of seasonality. 5.5 The relevance of biological clocks for human welfare 5.6 Clock function (dysfunction).
Extended Professional Component (isa part of internal component only, not to beincluded in the external examination question paper)	Questions related to the above topics, from various competitive examinationsUPSC/JAM /TNPSC and others to be solved (To be discussed during the Tutorial hours)
Recommended Text	1. David McFarland, 1985.Animal Behaviour, Longman Scientific & Technical, UK.576pp. 2. HarjindraSingh,1990.A TextBook of AnimalBehaviour,AnomolPublication,293pp. 3. HoshangS.GundeviaandHareGovingSingh,1996.AnimalBehaviour,S.Chand&Co, 280pp. 4. Shukla, J. P 2010, Fundamentals of Animal Behaviour, Atlantic, 587pp. 5. Vinod Kumar, 2002. Biological Rhythms. NarosaPublishingHouse, Delhi.
ReferenceBooks	1. Michael D. Breed and Janice Moore, 2012. Animal Behaviour, Academic Press, USA, 359pp. 2. Aubrey Manning and Martin Stamp Dawkins, 2012. An Introduction to Animal Behaviour, 6th Edition, Cambridge University Press, UK. 458pp. 3. Davis E.Davis, 1970. Integral Animal Behaviour, Mac Millan Company,London, 118pp. 4. Jay, C. Dunlap, Jennifer, J. Loros, Patricia J. De Coursey (ed). 2004. Chronobiology Biological time Keeping, Sinauer Associates Inc, Publishers, Sunderland, MA.
Website and e-learning source	https://www.ncbs.res.in/content/animal-behaviour https://bit.ly/3i6wUxR https://www.behaviour.univie.ac.at/ https://www.ru.nl/bsi/

Course Outcomes:

On completion of the course, the students should be able to

CO 1: Acquire understanding on genetic basis and evolutionary history of behaviour.(K1,K2,K3,K4)

CO 2: Classify movement and migration behaviours and the environmental influence upon behaviour.(K1,K2,K3,K4)

CO 3: Analyze and differentiate the innate, learned, cognitive behavior, and various mating systems. (K1,K2,K3,K4)

CO 4: Obtain understanding about communication, decision making and language of animals. (K1,K2,K3,K4)

CO 5: Gain knowledge about the molecular basis of rhythm, biological clock.(K1,K2,K3,K4)

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

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

H-HIGH (3): M-MODERATE (2): L-LOW-(1)

<table>
<tr><td>Title of the Course</td><td colspan="7">ELECTIVE: NANOBIOLOGY</td></tr>
<tr><td>Paper No.28</td><td colspan="7">Discipline Specific Elective Course - VI</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">DSE</td><td>Year</td><td>III</td><td rowspan="2">Credits</td><td rowspan="2">3</td><td>Course Code</td><td>UEZOF24</td></tr>
<tr><td>Semester</td><td>VI</td></tr>
<tr><td>Instructional hours per week</td><td>Lecture</td><td>Tutorial</td><td colspan="3">Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td></td><td>3</td><td>-</td><td colspan="3">-</td><td colspan="2">3</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">• To provide knowledge about the basic concepts of nanobiology.
• To acquire skills in the assembly, design and types of nanomaterials and nanoparticles.
• To appreciate the applications of nanobiology in diverse fields.</td></tr>
<tr><td>Course Outline</td><td colspan="7">Unit I: (9 hours) (K1, K2, K3, K4)
1.1.Nanobiology- Definition-concepts
1.2.Scope of nanobiology
1.3.History of nanotechnology and nanoscience in Nature
1.4.Structure and Properties of nanomaterials: size, surface charge
1.5.Conductivity, optical properties of nanomaterials
1.6. Biocompatibility of nanomaterials.</td></tr>
<tr><td></td><td colspan="7">Unit II: (9 hours) (K1, K2, K3, K4)
2.1.Synthesis of nanomaterials
2.2.Characterization of nanomaterials
2.3.Fabrication of nanostructures
2.4.Metallic nanoparticles
2.5.Semiconductor
2.6. Biopolymeric nano-structures and nanoparticles.</td></tr>
<tr><td></td><td colspan="7">Unit III: (9 hours) (K1, K2, K3, K4)
3.1.Composition of nanostructures
3.2.Functional properties of nanostructures
3.3.Protein and peptide-based nanostructures
3.4.Carbohydrate based nanomaterials
3.5.Nucleic acid based nanomaterials
3.6. Use of gold, silver and other metallic nanoparticles.</td></tr>
<tr><td></td><td colspan="7">Unit IV: (9 hours) (K1, K2, K3, K4)
4.1.Strategies to design nanostructure
4.2.Biologically active nanostructure
4.3.Nanostructure -based biomaterials
4.4.Interaction of nanoparticles with biomolecules
4.5.Study their conformational and
4.6. Functional properties.</td></tr>
<tr><td></td><td colspan="7">Unit V: (9 hours) (K1, K2, K3, K4)
5.1.Biological Applications of Nanomaterials and nanoparticles
5.2.Therapeutics
5.3.Biomaterials
5.4.Immobilized enzymes
5.5.Drug delivery systems
5.6. Biosensors-Cellular imaging tools and diagnostics.</td></tr>
</table>

ExtendedProfessionalComponent(isapartofinternalcomponentonly,nottobeincludedintheexternalexamination questionpaper)	Questionsrelatedtotheabovetopics,fromvarious competitiveexaminationsUPSC/JAM/TNPSCandotherstobesolved (TobediscussedduringtheTutorialhours)

Recommended Text	1. Springer Handbook of Nanotechnology- Ed. by B. Bhushan, Springer-Verlag 2. The Chemistry of Nanomaterials: Synthesis, Properties and Applications, C.N.R. Rao, A.Muller, A. K. Cheetham (Eds), Wiley-VCH Verlag 3. Nanoparticles And Nanostructured Films Preparation, Characterization And Applications, Janos H. Fendler (Ed) Wiley
Reference Books	1. Pradeep, T. (2017) The Essentials: Understanding Nanoscience and Nanotechnology: McGraw-Hill Education. 2. Phoenix, D.A. and Ahmad, W (2014) Nanobiotechnology. One Central Press Ltd.
Website and e-learning source	1. NPTEL: Nanotechnology, Science and Applications https://nptel.ac.in/courses/113/106/113106093/ 2. https://youtu.be/qUEbxTkPIWI?si=65zjpxRwTRaXVUrc

<table>
<tr><td>Title of the Course</td><td colspan="7">PROFESSIONAL COMPETENCY SKILL</td></tr>
<tr><td>Paper No.27</td><td colspan="7">PCS 1</td></tr>
<tr><td>Category</td><td>Professional competency skill</td><td>Year
Semester</td><td>III
VI</td><td>Credits</td><td>2</td><td>Course Code</td><td>UPZO24</td></tr>
<tr><td>Instructional hours per week</td><td>Lecture
2</td><td>Tutorial
-</td><td colspan="2">Lab Practice
-</td><td colspan="3">Total
2</td></tr>
<tr><td>Objectives of the course</td><td colspan="7">• To broaden the perspective of various career options in Life Science.
• To motivate the students for self-employment.</td></tr>
<tr><td>Course Outline</td><td colspan="7">Unit I (6 hours) (K1, K2, K3 & K4)
Communication skills and Personality development:
1.1. Interpersonal and communication skills.
1.2. Science popularization through internet- Social media, Websites, You tube.
1.3. Self-awareness, Self-development.
1.4. Self-appraisal.
1.5. Presentation skills.</td></tr>
<tr><td></td><td colspan="7">Unit II (6 hours) (K1, K2, K3 & K4)
Opportunities for Zoologist:
2.1. Higher education- Degree courses, Diploma courses, Multidisciplinary Courses.
2.2. Job opportunities.
2.3. Resume Writing.
2.4. Interview Skills.
2.5. Mastering your emotions.</td></tr>
<tr><td></td><td colspan="7">Unit III (6 hours) (K1, K2, K3 & K4)
Entrepreneurship Opportunity through Zoology:
3.1. Bio-fertilizer, Green manuring, Bio-compost, Vermi-compost and Organic fertilizers.
3.2. Bee keeping.
3.3. Sericulture.
3.4. Aquarium and fish keeping.
3.5. Poultry keeping.</td></tr>
<tr><td></td><td colspan="7">Unit IV (6 hours) (K1, K2, K3 & K4)
Research and Competitive Exams:
4.1. Research positions, Ph.D. and Post-Doc.
4.2. Fellowships and funded projects.
4.3. Competitive exams- UPSC, TNPSC Group services.
4.4. SET, CSIR UGC-NET for LS and JRF.
4.5. GATE- LIFE SCIENCE.</td></tr>
<tr><td></td><td colspan="7">Unit V (6 hours) (K1, K2, K3 & K4)
IPR:
5.1. Basic concepts of IPR.
5.2. Need for Intellectual Property.
5.3. Patents, Copyrights, Trademarks.
5.4. IP Laws, Cyber Law.
5.5. Digital Content Protection.</td></tr>
</table>

Recommended Text	1. Velayudhan, A. and Amudhadevi, N. V. Personality Development for College Students. LAP Lambert Academic Publishing. 2012 2. Shukla GS, amd Upadhyay SP- Economic Zoology, Ratogi Publication, Meerut, 1994. 3. Arihant, NTA CSIR UGC NET/SET Book 2024/SET (JRF & Lecturership) Life Sciences 4. Deborah E. Bouchoux, "Intellectual Property: The Law of Trademarks, Copyrights, Patents and Trade Secrets", Cengage Learning, Third Edition, 2012.
ReferenceBooks	1. Sathe, T.V. Vermiculture and Organic Farming. Daya publishers, 2004 2. Subba Rao, N.S. Biofertilizers in Agriculture and Forestry. Fourth Edition. Medtech. 2017. 3. Green, C.J. Leadership and soft skills for students: Empowered to succeed in High School, College and beyond. Dog Ear Publishing, 2015. 4. Prabuddha Ganguli, "Intellectual Property Rights: Unleashing the Knowledge Economy", McGraw Hill Education, 2011. 5. Edited by Derek Bosworth and Elizabeth Webster, The Management of Intellectual Property, Edward Elgar Publishing Ltd., 2013. 6. V. Scople Vinod, Managing Intellectual Property, Prentice Hall of India pvt Ltd, 2012. 7. S.V. Satakar, Intellectual Property Rights and Copy Rights, Ess Publication, New Delhi, 2002.
Website and e-learning source	1. http://csb.gov.in 2. http://www.fao.org 3. http://nfdb.gov.in

Course Outcomes:

On completion of the course, the students should be able to

CO1: Develop communication skills. (K1, K2, K3, K4)

CO2: List the various opportunities in Zoology. (K1, K2, K3, K4)

CO3: Identify the various entrepreneurial opportunities in Zoology. (K1, K2, K3, K4)

CO4: Develop their competence in research and competitive exams. (K1, K2, K3, K4)

CO5: Explain the Intellectual property rights (IPR). (K1, K2, K3, K4)

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

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

H-HIGH (3): M-MODERATE (2): L-LOW-(1)