

B. SC ZOOLOGY

(based on TANSCHÉ)

SYLLABUS

FROM THE ACADEMIC YEAR

2023-2024



**RAJAH SERFOJI GOVERNMENT COLLEGE (Autonomous)
THANJAVUR 613005**

December 2025

LEARNING OUTCOMES-BASED CURRICULUM FRAMEWORK GUIDELINES BASED REGULATIONS FOR UNDER GRADUATE PROGRAMME	
Programme:	B.Sc. Zoology
Programme Code:	SZOE1/T1
Duration:	UG - 3 Years
Programme Outcomes:	PO1: Disciplinary knowledge: Capable of demonstrating comprehensive knowledge and understanding of one or more disciplines that form a part of an undergraduate Programme of study PO2: Communication Skills: Ability to express thoughts and ideas effectively in writing and orally; Communicate with others using appropriate media; confidently share one's views and express herself/himself; demonstrate the ability to listen carefully, read and write analytically, and present complex information in a clear and concise manner to different groups. PO3: Critical thinking: Capability to apply analytic thought to a body of knowledge; analyze and evaluate evidence, arguments, claims, beliefs on the basis of empirical evidence; identify relevant assumptions or implications; formulate coherent arguments; critically evaluate practices, policies and theories by following scientific approach to knowledge development. PO4: Problem solving: Capacity to extrapolate from what one has learned and apply their competencies to solve different kinds of non-familiar problems, rather than replicate curriculum content knowledge; and apply one's learning to real life situations. PO5: Analytical reasoning: Ability to evaluate the reliability and relevance of evidence; identify logical flaws and holes in the arguments of others; analyze and synthesize data from a variety of sources; draw valid conclusions and support them with evidence and examples, and addressing opposing viewpoints. PO6: Research-related skills: A sense of inquiry and capability for asking relevant/appropriate questions, problem arising, synthesizing and articulating; Ability to recognise cause-and-effect relationships, define problems, formulate hypotheses, test hypotheses, analyze, interpret and draw conclusions from data, establish hypotheses, predict cause-and-effect relationships; ability to plan, execute and report the results of an experiment or investigation PO7: Cooperation/Team work: Ability to work effectively and respectfully with diverse teams; facilitate cooperative or coordinated effort on the part of a group, and act together as a group or a team in the interests of a common cause and work efficiently as a member of a team PO8: Scientific reasoning: Ability to analyse, interpret and draw conclusions from quantitative/qualitative data; and critically evaluate ideas, evidence and experiences from an open-minded and reasoned perspective. PO9: Reflective thinking: Critical sensibility to lived experiences, with self-awareness and reflexivity of both self and society. PO10 Information/digital literacy: Capability to use ICT in a variety

	of learning situations, demonstrate ability to access, evaluate, and use a variety of relevant information sources; and use appropriate software for analysis of data. PO 11 Self-directed learning: Ability to work independently, identify appropriate resources required for a project, and manage a project through to completion. PO 12 Multicultural competence: Possess knowledge of the values and beliefs of multiple cultures and a global perspective; and capability to effectively engage in a multicultural society and interact respectfully with diverse groups. PO 13: Moral and ethical awareness/reasoning: Ability to embrace moral/ethical values in conducting one's life, formulate a position/argument about an ethical issue from multiple perspectives, and use ethical practices in all work. Capable of demonstrating the ability to identify ethical issues related to one's work, avoid unethical behaviour such as fabrication, falsification or misrepresentation of data or committing plagiarism, not adhering to intellectual property rights; appreciating environmental and sustainability issues; and adopting objective, unbiased and truthful actions in all aspects of work. PO 14: Leadership readiness/qualities: Capability for mapping out the tasks of a team or an organization, and setting direction, formulating an inspiring vision, building a team who can help achieve the vision, motivating and inspiring team members to engage with that vision, and using management skills to guide people to the right destination. in a smooth and efficient way. PO 15: Lifelong learning: Ability to acquire knowledge and skills, including „learning how to learn“, that are necessary for participating in learning activities throughout life, through self-paced and self-directed learning aimed at personal development, meeting economic, social and cultural objectives, and adapting to changing trades and demands of work place through knowledge/skill development/ reskilling.
Programme Specific Outcomes:	PSO1 – Placement: To prepare the students who will demonstrate respectful engagement with others' ideas, behaviors, beliefs and apply diverse frames of reference to decisions and actions. PSO 2 - Entrepreneur: To create effective entrepreneurs by enhancing their critical thinking, problem solving, decision making and leadership skill that will facilitate startups and high potential organizations PSO3 – Research and Development: Design and implement HR systems and practices grounded in research that comply with employment laws, leading the organization towards growth and development. PSO4 – Contribution to Business World: To produce employable, ethical and innovative professionals to sustain in the dynamic business world. PSO 5 – Contribution to the Society: To contribute to the development of the society by collaborating with stakeholders for mutual benefit

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B. Sc. ZOOLOGY COURSE STRUCTURE

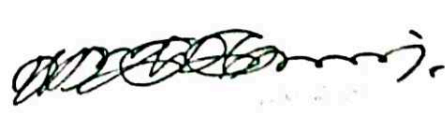
(for the candidates admitted from the academic year 2023-2024 onwards)

Part	Course	Subject Code	List of Courses	Credit	Hours per week (L/T/P)	Exam Hours	Marks		Total
							Int.	Ext.	
First Year Semester-I									
I	LT1	T1T1	Tamil – I	3	6	3	25	75	100
II	LE1	T1E1	English – I (Written Exam)	2	4	2	15	45 60	100
		T1E1P	English Practical	1	2	1	10	30 40	
III	CC1	T1ZO1	Invertebrata	5	5	3	25	75	100
III	CC2	T1ZO2P	Major Practical I: Invertebrata	3	3	3	25	75	100
III	EC1	T1GCH1	Chemistry I	3	4	3	25	75	100
III	EC2	T2GCH2P	Chemistry - Practical	-	2	-	-	-	-
IV	SEC1	T1ZOSE1	Biocomposting for Entrepreneurship	2	2	3	25	75	100
IV	FC	ZOFC	Foundation Course	2	2	3	25	75	100
Total				21	30				700
II Semester									
I	LT2	T2T2	Tamil - II	3	6	3	25	75	100
II	LE2	T2E2	English – I (Written Exam)	2	4	2	15	45 60	100
		T2E2P	English Practical	1	2	1	10	30 40	
III	CC3	T2ZO3	Chordata	5	5	3	25	75	100
III	CC4	T2ZO4P	Major Practical II: Chordata	3	3	3	25	75	100
III	EC2	T2GCH2P	Chemistry Practical	3	2	3	25	75	100
III	EC3	T2GCH3	Chemistry III	4	4	3	25	75	100
IV	SEC2	T2ZOSE2	Wildlife Conservation and Management	2	2	3	25	75	100
IV	SEC3	T2ZOSE3	Aquarium Keeping	2	2	3	25	75	100
Total				25	30				800
Second Year Semester-III									
I	LT3	T3T3	Tamil - III	3	6	3	25	75	100
II	LE3	T3E3	English – I (Written Exam)	2	4	2	15	45 60	100
		T3E3P	English Practical	1	2	1	10	30 40	
III	CC5	T3ZO5	Cell Biology	5	5	3	25	75	100
III	CC6	T3ZO6P	Major Practical III: Cell Biology	3	3	3	25	75	100
III	EC4	T3GBO1	Botany I	3	4	3	25	75	100
III	EC5	T4GBO3P	Botany - Practical	-	2	-	-	-	-
IV	SEC4	T3ZOSE4	Apiculture	2	1	3	25	75	100
IV	SEC5	T3ZOSE5	Ornamental Fish Farming and Management/NM	2	2	3	25	75	100
IV	--	T3NCCI	Introduction to NCC (for NCC Students only)	2	-	-	-	-	-
IV	EVS	T4ES	Environmental Studies	-	1	-	-	-	-

IV	-	T3HW	Health and Wellness	1	-	-	-	-	-
Total				22	30				
Semester-IV									
I	LT4	T4T4	Tamil - IV	3	6	3	25	75	100
II	LE1	T4E4	English – I (Written Exam)	2	4	2	15	45 60	100
		T4E4P	English Practical	1	2	1	10	30 40	
III	CC7	T4ZO7	Environmental Biology	4	4	3	25	75	100
III	CC8	T4ZO8P	Major Practical IV	3	3	3	25	75	100
III	EC5	T4GBO2P	Botany - Practical	3	2	3	25	75	100
III	EC6	T4GBO2	Botany II	4	4	3	25	75	100
IV	SEC6	T4ZOSE6	Sericulture	2	2	3	25	75	100
IV	SEC7	T4ZOSE7	Medical Laboratory Techniques/NM	2	2	3	25	75	100
IV	EVS	T4ES	Environmental Studies	2	1	3	25	75	100
IV	-	T4NCC2	Specialized Subjects-ARMY (for NCC students only)	2	-	-	-	-	-
Total				26	30				900
Third Year Semester-V									
III	CC9	T5ZO9	Evolutionary Biology	4	6	3	25	75	100
III	CC10	T5ZO10	Animal Physiology	4	6	3	25	75	100
III	CC11	T5ZO11	Developmental Biology	4	5	3	25	75	100
III	CC12	T5ZO12P	Major Practical V	3	3	3	25	75	100
III	EC7	TZOECA	Animal Behaviour	3	4	3	25	75	100
III	EC8	TZOECF	Agricultural Entomology	3	4	3	25	75	100
IV	VE	T5VE	Value Education	2	2	2	25	75	100
IV			Internship/Industrial Training	2	-	-	-	-	-
Total				25	30				700
Semester-VI									
III	CC13	T6ZO13	Genetics	5	6	3	25	75	100
III	CC14	T6ZO14	Biotechnology	4	6	3	25	75	100
III	CC15	T6ZO15P	Major Practical VI	4	6	3	25	75	100
III	EC9	TZOECG	Microbiology & Immunology	3	4	3	25	75	100
III	EC10	TZOECH	Aquaculture	3	4	3	25	75	100
IV	PCS	T6PCS	Professional Competency Skill	2	2	2	25	75	100
IV	GS	T6GS	Gender Studies	2	2	2	25	75	100
V			Extension Activity	1	-	-	-	-	-
Total				24	30				700

Total Credits: 143


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RAJAH SERFOJI GOVERNMENT COLLEGE (AUTONOMOUS), THANJAVUR -613005
.B.Sc., ZOOLOGY COURSE STRUCTURE
 (for the candidates admitted from the academic year 2023-2024 onwards)

List of Elective courses
Part -A (Generic)

S.No	Course Code	Title of the Course
1	T1GCH1	General Chemistry –I
2	T2GCH2	General Chemistry - Practical
3	T2GCH3	General Chemistry- II
4	T3GB01	Botany – I
5	T4GB02	Botany - Practical
6	T4GB03	Botany–II

Part -B (Discipline)

S. No	Course Code	Title of the Course
1	T1ZOSE1	Biocomposting and Entrepreneurship
2	T2ZOSE2	Wildlife Conservation and Management
3	T2ZOSE3	Aquarium Keeping
4	T3ZOSE4	Apiculture
5	T3ZOSE5	Ornamental Fish farming and Management
6	T4ZOSE6	Sericulture
7	T4ZOSE7	Medical Laboratory Techniques

Elective

1	TZOECA	Animal Behaviour
2	TZOECB	Nanobiology
3	TZOECC	Radiation Biology
4	TZOECD	Human Reproductive Biology
5	TZOECE	Basics of Marine Biology
6	TZOECF	Agricultural Entomology
7	TZOECG	Microbiology & Immunology
8	TZOECH	Aquaculture
9	TZOECI	Bioinstrumentation
10	TZOECJ	Economic Zoology
11	TZOECK	Basics of Ornithology
12	TZOECL	Biophysics and Biostatistics

Extra Credit Courses

1	TZOECCA	Food, Nutrition and Health
2	TZOECCB	Food Technology
3	TZOECCC	Food Chemistry
4	TZOECCD	Herbal Medicine

Consolidated Semester wise and Component wise Credit distribution

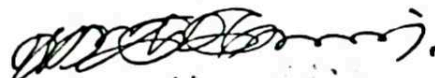
Parts	Sem I	Sem II	Sem III	Sem IV	Sem V	Sem VI	Total Credits
Part I	3	3	3	3	-	-	12
Part II	3	3	3	3	-	-	12
Part III	11	15	11	14	21	19	91
Part IV	4	4	5	6	4	4	27
Part V	-	-	-	-	-	1	1
Total	21	25	22	26	25	24	143

*Part I, II, and Part III components will be separately taken into account for CGPA calculation and classification for the under graduate programme and the other components. IV, V have to be completed during the duration of the programme as per the norms, to be eligible for obtaining the UG degree.



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B. Sc. Zoology (2023-2024)
SEMESTER – I

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	Ext.	Total
TIZO1	INVERTEBRATA	Core	Y	-	-	-	5	5	25	75	100
Learning Objectives											
CO1	To understand the basic concepts of lower animals and observe the structure and functions.										
CO2	To illustrate and examine the systemic and functional morphology of various group of animal modes of life and to estimate the biodiversity.										
CO3	To compare and distinguish the general characteristics of reproduction in lower animals and parasitic adaptation in invertebrates.										
CO4	To infer and integrate the structures and distinct features of invertebrate phyla.										
CO5	To understand and able to distinguish the characteristic feature of phylum and economic importance of invertebrate animals										
UNIT	Details								No. of Hours	Course Objectives	
I	Principles and outline classification of Invertebrates. Binomial nomenclature. Protozoa: General characters and classification up to classes with examples. Type study: <i>Paramecium</i> - external features, nutrition, locomotion and reproduction. General Topics: Parasites of Protozoan- Life cycle of <i>Plasmodium</i> .								15	CO1	
II	Porifera: General characters and classification up to classes with examples. Type study: Sycon sponge (<i>Scypha</i>)- external structure, canal system and reproduction. General Topics: Canal system in sponges. Coelenterate: General characters and classification up to classes with examples - Type study: <i>Obelia</i> - Structure of polyp, medusa and life history of Obelia. General Topics: Corals- Coral reefs and its importance.								15	CO2	
III	Platyhelminthes: General characters and classification up to classes with examples. Type Study: <i>Taenia solium</i> (Tap worm)-external structure, excretion, reproduction and life cycle. General Topics: Parasitic adaptations of Liver fluke. Aschelminths: General characters and classification up to classes with examples - Type Study: <i>Ascaris lumbricoides</i> ; External structure, Digestive system, Reproductive and Life cycle. General Topics: Parasitic adaptations in nematodes.								15	CO3	
IV	Annelida: General characters and classification up to classes with examples -Type study: <i>Nereis</i> -external structure, digestive system, nervous system and reproductive system. General Topics: Adaptive radiation in Annelida. Arthropoda: General characters and classification up to classes with examples - Type Study: <i>Panopeus indicus</i> - external structure, respiratory system, digestive system, circulatory system, reproductive system. General Topics: Crustacean larval forms and their significances								15	CO4	

V	Mollusca: General characters and classification up to classes with examples - Type Study: <i>Pila globosa</i> - external structure, digestive system, respiratory system, nervous system and reproductive system. General Topics: Economic importance of Molluscs. Echinodermata: General characters and classification up to classes with examples. Type Study: <i>Asterias rubens</i> (Star fish)- external structure, water vascular system, circulatory system, and reproductive system. General Topics: Larval forms of Echinoderms.	15	CO5
Total		75	
Course Outcomes			
On completion of this course, students will;			
CO1	Understand the basic concepts of invertebrate animals and recall its structure and functions.	PO1	
CO2	Illustrate and examine the systemic and functional morphology of various groups of animal mode and estimate the biodiversity.	PO1 PO2	
CO3	To compare and distinguish the various physiological processes and organ systems in lower animals.	PO4 PO6	
CO4	Infer and integrate the adaptation in animals and classify, identify and distinct feature of invertebrate animals.	PO4 PO5 PO6	
CO5	To distinguish the structural organization of evolutionary aspects and describe the important biological process.	PO3 PO8	
Text Books (Latest Editions)			
1	Ekambaranatha Iyer, 2000. A Manual of Zoology, 10 th edition, Viswanathan, S., Printers & Publishers Pvt Ltd		
2	Jordan, E.L. and Verma P.S. 2015. Invertebrate Zoology, S. Chand & Co.		
References 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.		
Web Resources			
https://www.nationalgeographic.com/animals/invertebrates/			
https://bit.ly/3kABzKa			
https://www.nio.org/			
https://greatbarrierreef.org/			


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Methods of Evaluation		
Internal Evaluation	Continuous Internal Assessment Test	25 Marks
	Assignments	
	Seminars	
	Attendance and Class Participation	
External Evaluation	End Semester Examination	75 Marks
Total		100 Marks
Methods 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	

Mapping with Programme Outcomes:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO 1	S							
CO 2	M	S						
CO 3				S		S		
CO 4				S	S	M		
CO 5			S					S

S-Strong (3) M-Medium (2)

L-Low (1) B N


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Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	Ext.	Total
T1ZO2P	Major Practical I: INVERTEBRATA	Core	Y	-	-	-	3	3	25	75	100
Learning Objectives											
CO1	To identify the different groups of invertebrate animals by observing their external characteristics.										
CO2	To understand the organs, organ system and their functions in lower animals.										
CO3	To get knowledge about the different modes of life and their adaptation based on the environment.										
CO4	Able to dissect and display the internal organs and mount the mouthparts and scales of invertebrates.										
UNIT	Details								No. of Hours	COs	
I	Major Dissection: Cockroach: Circulatory system, Nervous system and Reproductive system. Leech: Nervous System and Reproductive system. Earthworm: Nervous System and Reproductive system. Prawn: Nervous System Pila globosa: Nervous system.								9	CO1	
II	Minor Dissection: Cockroach: Digestive system. Earthworm: Digestive system. Pila globosa: Digestive system. Freshwater Mussel: Digestive system.								9	CO2	
III	Mounting: Earthworm: Body setae and Pineal setae. Pila globosa: Radula. Freshwater Mussel: Pedal ganglia Prawn: Appendages.								9	CO3	
IV	Mounting: Cockroach: Salivary apparatus and Mouth parts. Honey Bee: Mouth parts. House fly: Mouth parts. Mosquito: Mouth parts.								9	CO4	
V	Spotters: (i). Protozoa: Amoeba, Paramecium, Paramecium -Binary fission and Paramecium -Conjugation, Entamoeba histolytica, Plasmodium. (ii). Porifera: Scypha (Sycon), Spongilla, Euplectella, Hyalonema, Spicules, Gemmule. (iii). Coelenterata: Obelia Colony, Obelia Medusa, Aurelia, Physalia, Velella, Gorgonia, Sea anemone (Meteridium), Meandrina. (iv). Platyhelminthes: Dugesia (Planaria), Fasciola hepatica, Miracidium larva, Redia larva, Cercaria larva, Taenia solium,								9	CO5	

	<i>Taenia solium</i> -scolex, <i>Taenia solium</i> -proglottid. (v). Nemathelminthes: <i>Ascaris lumbricoides</i> (Male & Female), <i>Dracunculus medinensis</i> , <i>Ancylostoma duodenale</i> , <i>Wuchereria bancrofti</i> (vi). Annelida: <i>Nereis</i> , <i>Nereis</i> parapodium, <i>Aphrodite</i> , <i>Chaetopterus</i> , <i>Hirudinaria granulose</i> (Leech), Trochophore larva (vii). Arthropoda: Cockroach, Prawn, <i>Scorpion</i> , <i>Scolopendra</i> , <i>Sacculina</i> , <i>Limulus</i> , <i>Peripatus</i> , Nauplius larva, Mysis larva, Zoea larva, (viii). Mollusca: <i>Pila globosa</i> , Fresh water mussel, <i>Aplysia</i> , <i>Murex</i> , <i>Chiton</i> , <i>Sepia</i> , <i>Loligo</i> , <i>Octopus</i> , <i>Nautilus</i> , Glochidium larva (ix). Echinodermata: <i>Asterias rubens</i> , <i>Sea urchin</i> , <i>Sea cucumber</i> , <i>Sea lily</i> (Antedon), Bipinnaria larva, Auricularia larva.		
	Total	45	
Course Outcomes			
Course Outcomes	On completion of this course, students will;		
CO1	Identify and label the external features of different groups of invertebrate animals.		PO1
CO2	Illustrate and examine the circulatory system, nervous system and reproductive system of invertebrate animals.		PO1, PO2
CO3	Differentiate and compare the structure, function and mode of life of various groups of animals.		PO4, PO6
CO4	To compare and distinguish the dissected internal organs of lower animals.		PO4, PO5, PO6
CO5	Prepare and develop the mounting procedure of economically important invertebrates.		PO3, PO8
Text Books (Latest Editions)			
1.	Ekambaranatha Iyyar and T. N. Ananthakrishnan, 1995 A-manual of Zoology Vol.I (Part 1, 2) S. Viswanathan, Chennai		
2.	Ganguly, Sinha and A shikari, 2011. Biology of Animals: Volume I, New Central Book Agency; 3rd revised edition. 1008 pp.		
3.	Sinha, Chatterjee and Chattopadhyay, 2014. Advanced Practical Zoology, Books & Allied Ltd; 3rd Revised edition, 1070 pp.		
4.	Lal, S. S, 2016. Practical Zoology Invertebrate, Rastogi Publications.		
5.	Verma, P. S. 2010. A Manual of Practical Zoology: Invertebrates, S Chand, 497pp.		
References Books			
(Latest editions, and the style as given below must be strictly adhered to)			
1.	Barnes, R.S.K., Calow, P., Olive, P.J.W., Golding, D.W. and Spicer, J.I. (2002). <i>The Invertebrates: A New Synthesis</i> , III Edition, Blackwell Science.		
2.	Barnes, R.D. (1982). <i>Invertebrate Zoology</i> , V Edition. Holt Saunders International Edition.		

3.	Barrington, E.J.W. (1979). <i>Invertebrate Structure and Functions</i> . II Edition, E.L.B.S. and Nelson	
4.	Boradale, L.A. and Potts, E.A. (1961). <i>Invertebrates: A Manual for the use of Students</i> . Asia Publishing Home.	
5.	Lal, S.S. 2005. A text Book of Practical Zoology: Invertebrate, Rastogi, Meerut	
Web Resources		
1.	https://nbb.gov.in/	
2.	http://www.agshoney.com/training.htm	
3.	https://icar.org.in/	
4.	http://www.csrtimys.res.in/	
5.	http://csb.gov.in/	
Methods of Evaluation		
Internal Evaluation	Continuous Internal Assessment Test	25
	Assignments	
	Seminars	
	Attendance and Class Participation	
External Evaluation	End Semester Examination	75
	Total	100
Methods 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	
Field/Institute Visit		

Mapping with Programme Outcomes:

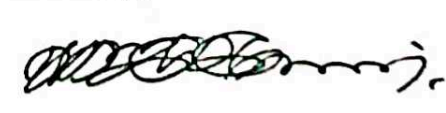
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO 1	S							
CO 2	M	S						
CO 3				S		S		
CO 4				S	S	M		
CO 5			S					S

S-Strong (3)

M-Medium (2)

L-Low (1)


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 RAJAH SERFOJI GOVERNMENT COLLEGE (AUTONOMOUS)
 THANJAVUR-613 005.

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	Ext.	Total
T1ZOSE1	BIOCOMPOSTING FOR ENTREPRENEURSHIP	SEC	Y	-	-	-	2	2	25	75	100

Learning Objectives:

- To highlight the importance of biocomposting for entrepreneurship in waste management.
- To enable students for setting up biocompost units and bins for waste reduction.

Course outcomes:

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

Unit – I

Biocomposting – Definition, types and ecological importance.

Unit – II

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

Unit – III

Preparation of Biocompost pit and bed using different amendments.

Unit – IV

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

Unit – V

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

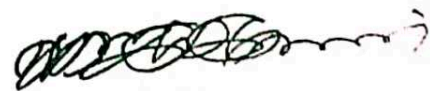
Practical

- 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.

References

Bikas R. Pati & Santi M. Mandal. 2016. Recent trends in composting technology.
 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, www.biogreenhouse.org.


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SEMESTER – I – FOUNDATION COURSE ON ZOOLOGY

SEMESTER – I – FOUNDATION COURSE ON ZOOLOGY												
Course Code FC	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks			
									CIA	External	Total	
ZOFC	FOUNDATION COURSE ON ZOOLOGY	FC	Y	-	-	-	2	2	25	75	100	
Learning Objectives												
CO1	To understand the basic concepts of lower animals and observe the structure and functions.											
CO2	To illustrate and examine the systemic and functional morphology of various group of animal modes of life and to estimate the biodiversity.											
CO3	To compare and distinguish the general characteristics of reproduction in lower animals and parasitic adaptation in invertebrates.											
CO4	To infer and integrate the structures and distinct features of invertebrate phyla.											
CO5	To understand and able to distinguish the characteristic feature of phylum and economic importance of invertebrate animals											
UNIT	Details							No. of Hours	Course Objectives			
I	Animal Kingdom-Systematics. Definition and Kinds. Taxonomy-Stages of Taxonomy (alpha, beta and gamma). Biological Classification: History, theories –artificial classification-natural system of classification. Phylogenetic System of Classification Taxonomy							6	CO1			
II	Hierarchy Categories: Species, Genus, Family, Order, Class, Phylum, Kingdom, Domain. Concept of Species. Species Types							6	CO2			
III	Specimen Collection: Collection methods, cleaning and preservation methods, curation process. skeleton preparations. Dry and wet preservation of specimen							6	CO3			
IV	Alcoholic Preservation, Formalin Preservation. Advantages and disadvantages. Taxidermy							6	CO4			
V	Introduction to Zoology Laboratory: Microscope, slide preparation, Museum and Museum Specimen types and preparation. Role of Zoological Museum in teaching							6	CO5			
Total							30					
Course Outcomes												
COs	On completion of this course, students will;											
CO1	Understand the basic concepts of invertebrate animals and recall its structure and functions.							PO1				
CO2	Illustrate and examine the systemic and functional morphology of various groups of animal model and estimate the biodiversity.							PO1, PO2				
CO3	To compare and distinguish the various physiological processes and organ systems in lower animals.							PO4, PO6				
CO4	Infer and integrate the adaptations in animals and classify, identify and distinct feature of invertebrate animals.							PO4, PO5, PO6				
CO5	To distinguish the structural organization of evolutionary aspects and describe the important							PO3, PO8				

	biological process.	
Text Books		
1.	Ekambaranatha Iyer, 2000. A Manual of Zoology, 10 th edition, Viswanathan, S., Printers & Publishers Pvt Ltd	
2.	Jordan, E.L. and Verma P.S. 1995. Invertebrate Zoology, 12 th edn. S. Chand & Co.	
3.	Kotpal, R.L. 1992. Protozoa, Porifera, Coelenterata, Annelida, Arthropoda.	
References Books		
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	
Web Resources		
1.	https://www.nationalgeographic.com/animals/invertebrates/	
2.	https://bit.ly/3kABzKa	
3.	https://www.nio.org/	
Methods of Evaluation		
Internal Evaluation	Continuous Internal Assessment Test	25 Marks
	Assignments	
	Seminars	
	Attendance and Class Participation	
External Evaluation	End Semester Examination	75 Marks
	Total	100 Marks
Methods 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	

Mapping with Programme Outcomes:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO 1	S							
CO 2	M	S						
CO 3				S		S		
CO 4				S	S	M		
CO 5			S					S

S-Strong (3) M-Medium (2) L-Low (1) B


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SEMESTER - II

Course Code CC3	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
T2ZO3	CHORDATA	Core	Y	-	-	-	5	5	25	75	100
Learning Objectives											
CO1	To understand the structures and distinct features of Phylum Chordata.										
CO2	To understand and able to distinguish the characteristic features of each subphylum and class.										
CO3	To understand the economic importance of vertebrates										
CO4	To know about the adaptations of vertebrates										
CO5	To understand the evolutionary position of different groups of vertebrates										
UNIT	Details							No. of Hours	Course Objectives		
I	General Characters and Classification of Phylum Chordata: Origin of Chordata, Differences between non-chordates and chordates, General characters, Affinities and Systematic position of Hemichordata (<i>Balanoglossus</i>), Urochordata (<i>Ascidia</i>), Cephalochordata (<i>Amphioxus</i>).							12	CO1 CO2		
II	Prochordate and Agnatha: Characteristics of subphylum vertebrata, Classification of Vertebrata upto Class level, Agnatha (<i>Petromyzon</i>), - Pisces (<i>Scoliodon sorrakowah</i>) General characters and classification, Origin of fishes, Affinities of Dipnoi - Types of scales and fins - Accessory respiratory organs - Air bladder - Parental care - Migration - Economic importance.							12	CO1 CO2 CO4 CO5		
III	Amphibia: General characters and classification - Origin of Amphibia - Type study - <i>Rana hexadactyla</i> - Adaptive features of Anura, Urodela and Apoda - Neoteny in Urodela - Parental care in Amphibia.							12	CO1 CO2 CO3 CO4, CO5		
IV	Reptilia: General characters and classification - Type study - (<i>Calotes versicolor</i> (<i>endoskeleton of Varanus</i>)) - Origin of reptiles and effects of terrestrialisation, Extinct reptiles. Snakes of India. Poison apparatus and biting mechanism of poisonous snakes - Skull in reptiles as basis of classification							12	CO1 CO2 CO4 CO5		

V	Aves and Mammalia: Ayes: General characters and classification – Type study - <i>Columba livia</i> - Origin of birds, Flight adaptations, Migration. Mammalia: General characters and classification - Type study - Rabbit - Adaptive radiation in mammals - Egg laying mammals, Marsupials, Flying mammals, Aquatic mammals, Dentition in mammals.	12	CO1 CO2 CO4 CO5
Total		60	
Course Outcomes			
CO	On completion of this course, students will:		
CO1	Classify, Identify and recall the name and distinct features of different subphylum belonging to phylum Chordata.		PO1
CO2	Explain, and relate the origin, structural organization and evolutionary aspects of vertebrates.		PO1 PO2
CO3	Analyze, compare and distinguish the developmental stages and describe the important biological process.		PO3, PO4, PO5
CO4	Correlate the different modes of life and parental care among different vertebrates.		PO3, PO5, PO6
CO5	Summarise the morphology and ecological adaptations in vertebrates and list out the economic importance.		PO2, PO3, PO5, PO8
Text Books (Latest Editions)			
1.	Ayyar, E.K. and T.N. Ananthakrishnan, 1992. Manual of Zoology Vol. II, (Chordata), S. Viswanathan (Printers and Publishers) Pvt Ltd., Madras, 891p.		
2.	Jordan, E.K. and P.S. Verma, 1995. Chordate Zoology and Elements of Animal Physiology, 10th edition, S. Chand & Co Ltd., Ram Nagar, New Delhi, 1151 pp.		
3.	Nigam, H.C., 1983. Zoology of Chordates, Vishal Publications, Jalandhar - 144008, 942.		
4.	Ganguly, Sinha, Bharati Goswami and Adhikari, 2004. Biology of animals Vol.II - New central book Agency (p) Ltd.		
5.	Kotpal. R.L. A, Modern text book of Zoology Vertebrates- Rastogi publications. 2009		
References Books			
(Latest editions, and the style as given below must be strictly adhered to)			
1.	Darlington P.J. The Geographical Distribution of Animals, R.E. Krieger Pub. Co.		
2.	Hall B.K. and Hallgrimsson B. (2008). Strickberger's Evolution. IV Edition. Jones and Bartlett Publishers Inc.		
3.	Hickman, C.P. Jr., F.M.Hickman and L.S. Roberts, 1984. Integrated Principles of Zoology, 7th Edition, Times Merror/Mosby College Publication. St. Louis. 1065 pp.		
4.	Newman, H.H., 1981. The Phylum Chordata, Satish Book Enterprise, Agra – 282 003; 477		
5.	Parker and Haswell, 1964. Text Book of Zoology, Vol II (Chordata), A.Z.T, B.S. Publishers and Distributors, New Delhi - 110 051, 952 pp.		
6.	Pough H. Vertebrate life, VIII Edition, Pearson International.		
7.	Waterman, Allyn J. et al., 1971. Chordate Structure and Function, Mac Millan &Co.,		

	New York, 587 pp.	
8.	Young, J. Z. (2004). The Life of Vertebrates. III Edition. Oxford university press.	
Web Resources		
1.	http://tolweb.org/Chordata/2499	
2.	https://www.nhm.ac.uk/	
3.	https://bit.ly/3Av1Ejg	
4.	https://bit.ly/3kqTFYz	
5.	https://biologyeducare.com/aves/	
6.	https://www.vedantu.com/biology/mammalia	
Methods of Evaluation		
Internal Evaluation	Continuous Internal Assessment Test	25 Marks
	Assignments	
	Seminars	
	Attendance and Class Participation	
External Evaluation	End Semester Examination	75 Marks
Total		100 Marks
Methods 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	

Mapping with Programme Outcomes:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO 1	S							
CO 2	M	S						
CO 3		S	S	S	S	S		S
CO 4			S	S	S	M		
CO 5			S		S			S

S-Strong (3) M-Medium (2) L-Low (1)


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Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
T2ZO4	Major Practical II: CHORDATA	Core	Y	-	-	-	3	3	25	75	100
Learning Objectives											
CO1	To understand the structures and distinct features of phylum chordata										
CO2	To understand and able to distinguish the characteristic features of each subphylum and class										
CO3	To understand and compare the structure of various internal organs in different classes of vertebrates										
CO4	To know about the classification, adaptations and affinities of chordate animals										
UNIT	Details							No. of Hours	Course Objectives		
I	Dissections: Frog (Demo)/Fish: External features, Digestive system, Arterial system, Venous system, 5 th Cranial nerve, 9 th and 10 th cranial nerves, Male and female urinogenital system.							12	CO1		
II	Mounting: Fish: Placoid and Ctenoid scales, Frog: Hyoid apparatus and Brain (Demo).							12	CO2		
III	Osteology: Frog: Skull and lower jaw, Vertebral column, Pectoral girdle, Pelvicgirdle, Forelimb, Hindlimb. Chelonia-Anapsid skull, Pigeon - skull and lower jaw, synsacrum.							12	CO3		
IV	Specimen and Slides: i) Hemichordata: <i>Balanoglossus</i> , <i>Tornaria</i> larva ii). Protochordata: <i>Amphioxus</i> , <i>Amphioxus</i> T.S. through pharynx iii). Cyclostomata: <i>Petromyzon</i> , <i>Myxine</i> , <i>Ammocoetus</i> larva iv). Pisces: <i>Sphyrna Pristis</i> , <i>Torpedo</i> , <i>Channa</i> , <i>Pleuronectes</i> , <i>Hippocampus</i> , <i>Exocoetus</i> , <i>Echieneis</i> , <i>Labeo</i> , <i>Catla</i> , <i>Clarius</i> , <i>Auguilla</i> , <i>Protopterus</i> , Scales: Placoid, Cycloid, Ctenoid v). Amphibia: <i>Ichthyophis</i> , <i>Amblystoma</i> , <i>Siren</i> , <i>Hyla</i> , <i>Rachophous</i> , <i>Bufo</i> , <i>Rana</i> , <i>Axolotal</i> larva vi). Reptilia: <i>Draco</i> , <i>Chamaeleon</i> , <i>Gecko</i> , <i>Uromastix</i> , <i>Vipera russelli</i> , <i>Naja</i> , <i>Bungarus</i> , <i>Enhydrina</i> , <i>Typhlops</i> , <i>Testudo</i> , <i>Trionyx</i> , <i>Crocodylus</i> , <i>Ptyas</i> . vii). Aves: <i>Archaeopteryx</i> , <i>Passer</i> , <i>Psittacula</i> , <i>Bubo</i> , <i>Alcedo</i> , <i>Columba</i> , <i>Corvus</i> , <i>Pavo</i> ; Collection and study of different types of feathers: Quill, Contour, Filoplume, down viii). Mammalia: <i>Ornithorhynchus</i> , <i>Tachyglossus</i> , <i>Pteropus</i> , <i>Funambulus</i> , <i>Manis</i> , <i>Loris</i> , <i>Hedgehog</i>							12	CO4		
V	Embryology: Stages in the development of <i>Amphioxus</i> , Frog and Chick- Placenta in shark and mammals.							12	CO5		
Total								60			
Course Outcomes											

COs	On completion of this course, students will;	
CO1	Identify and recall the name and distinct external and internal features of animals belonging to phylum Chordata.	PO1
CO2	Explain the structural organization of various organs and systems in different classes of vertebrates.	PO1, PO2
CO3	Analyse, compare and distinguish the morphological features and developmental stages of chordates	PO4, PO6
CO4	Dissect and explain various organs and internal systems in different vertebrates and correlate its function.	PO4, PO5, PO6
CO5	Summarise the morphology and ecological adaptations in vertebrates and list out the economic importance.	PO3, PO8
Text Books (Latest Editions)		
1.	Lal SS 2009. Practical Zoology Vertebrate, Rajpal and Sons Publishing, 484pp.	
2.	Verma P.S. 2000. A Manual of Practical Zoology. Chordates, S. Chand Limited, 627pp.	
References Books (Latest editions, and the style as given below must be strictly adhered to)		
1.	Robert William Hegner, 2015. Practical Zoology, Biblio Life, 522pp.	
2.	Young, J, Z., 1972. The life of vertebrates. Oxford Uni. London.	
Web Resources		
1.	https://www.youtube.com/watch?v=b04hc_kOY10	
2.	https://bit.ly/3CzTEy8	
3.	http://tolweb.org/Chordata/2499	
4.	https://www.nhm.ac.uk/	
5.	https://bit.ly/3Av1Ejg	
Methods of Evaluation		
Internal Evaluation	Continuous Internal Assessment Test	25 Marks
	Assignments	
	Seminars	
	Attendance and Class Participation	
External Evaluation	End Semester Examination	75 Marks
	Total	100 Marks
Methods 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	Longer essay/ Evaluation essay, Critique or justify with pros and cons	

(K5)	
Create (K6)	Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations

Mapping with Programme Outcomes:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO 1	S							
CO 2	M	S						
CO 3				S		S		
CO 4				S	S	M		
CO 5			S					S

S-Strong (3)

M-Medium (2)

L-Low (1)


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Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
T2ZOSE2	WILDLIFE CONSERVATION AND MANAGEMENT	SEC2	Y	-	-	-	2	2	25	75	100

Learning Objectives:

1. To understand and discuss the importance of wildlife, its values, modern concepts in wildlife management, and relevant conservation policies.
2. To assess and instil strong foundations on wildlife policies and be familiar with a variety of laws and regulations.
3. To analyse and design appropriate approaches to turn conflict into tolerance and coexistence, with an emphasis on the human dimensions of human-wildlife interactions.
4. To evaluate and integrate all the related areas like Fundamentals in Ecology, Forestry, Natural Resource Conservation approaches and develop the role PVA models for protection of Endangered species.
5. To explain the advanced scientific basis for wildlife management and discuss National and International Efforts for successful wildlife conservation.

Unit I: Biodiversity Extinction and Conservation Approaches:

Perspectives and Expressions. Identification and prioritization of Ecologically Sensitive Area (ESA). Coarse filter and fine filter approaches. Regional and National approaches for biodiversity conservation.

Unit II: Theory and Analysis of Conservation of Populations:

Stochastic perturbations - Environmental, Demographic, spatial and genetic stochasticity. Population Viability Analysis-conceptual foundation, uses of PVA models. Management Decisions for small populations using PVA models. Minimum viable populations and recovery strategies for threatened species.

Unit III: National and International Efforts for Conservation:

International agreements for conserving marine life, Convention on wetlands of International Importance (Ramsar convention), Conservation of Natural Resources. Overview of conservation of Forest & Grassland resources. CITES, IUCN, CBD National Forest Policy, 1988, National Wildlife Action Plan 2017-2031, Wildlife Protection Act 1972, National and State Biodiversity Action Plans and other Forests and Environmental Acts.

Unit IV: Wildlife in India: Wildlife wealth of India & threatened wildlife, Reasons for wildlife depletion in India, Wildlife conservation approaches and limitations. Wild life Habitat: Characteristic, Fauna and Adaptation with special reference to Tropical Forest. Protected Area concept: National Parks, Sanctuaries and Biosphere Reserves, cores and Buffers, Nodes and corridors. Community Reserve and conservation Reserves.

Unit V: Management of Wildlife: Distribution, status. Habitat utilization pattern, threats to survival of Slender Loris, Musk deer, Great Indian Bustard, Olive Ridley turtle. Wild life Trade and legislation, Assessment, documentation, Prevention of trade, Wild life laws and ethics.

Text Books:

1. Robinson, W.L. and Eric G Bolen. 1984. Wildlife Ecology and Management, Maximillan Publishing Company, New York, Pp. 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, Pp. 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 Sinclair, 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 existence? Cambridge University.
9. Sinha, P.C. 1998. Wildlife and Forest Conservation, Anmol Publishing Pvt. Ltd., New Delhi.
10. Singh, S.K. 2005. Text Book of Wildlife Management. IBDC, Lucknow.

Suggested Readings

1. Gilas R H Jr. 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-2. WII.
3. Saharia V.B. 1982. Wildlife of India, Natraj Publishers, Dehra Dun.
4. Goutam Kumar Saha and Subhendu Mazumdar. 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.

Web resources

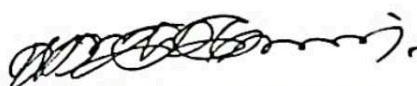
1. <https://bit.ly/39oPj44>
2. <https://bit.ly/3IHdEYJ>
3. <https://bit.ly/3CwBCfY>
4. <https://bit.ly/3EDYr3a>
5. <https://bit.ly/3tVtG4U>

Course Outcomes (COs)

On completion of this course students are able to:

1. understand and recall the importance of wildlife, extinction and Conservation Approaches of wildlife.
2. integrate and assess the National, international approaches for biodiversity conservation.
3. analyse and differentiate threats to wildlife, various action plans, conservation strategies on wildlife of India to turn conflict into tolerance and coexistence.
4. explain the role PVA models, Wildlife conservation approaches, and limitations.
5. construct and simulate National and International strategies for Conservation, Wild life laws and ethics.


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Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CLA	Ext.	Total
T2ZOSE3	AQUARIUM KEEPING	SEC	Y	-	-	-	2	2	25	75	100

Learning Objectives

- 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

UNIT I

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

UNIT II

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

UNIT III

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

UNIT IV

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

UNIT V

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

REFERENCE BOOKS:

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

Course Outcome:

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


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SEMESTER – III

Course Code CC4	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
T3ZO5	CELL BIOLOGY	Core	Y	-	-	-	5	5	25	75	100
Learning Objectives											
CO1	To understand the structures and purposes of basic components of prokaryotic and eukaryotic cells, especially macromolecules, membranes and organelles.										
CO2	To understand how these cellular components are used to generate and utilize energy in cells.										
CO3	To understand the cellular components underlying mitotic cell division.										
CO4	To apply the knowledge of cell biology to selected examples of changes or losses in cell function.										
UNIT		Details							No. of Hours	Course Objectives	
I	History of Cell Biology, Tools and Techniques of Cell Biology Cell Fractionation, Homogenization, Centrifugation, Isolation of sub cellular Components. Histological techniques - Staining - Vital Stains. – Cytoplasmic and Nuclear Stains. Micro Technique Methods, Microscopes - Types - Light, Phase contrast, SEM, TEM - Units of measurement.							12	CO1 CO2		
II	The Cell: Cell theory - Viruses -Types and Structure - Bacteria – Bacterial membrane - Ultra structure of Plant & Animal cell - Cytoplasm - Structure and Composition, Function - Extra Cytoplasmic Structure - Cilia Flagella - Cytoplasmic Inclusions.							12	CO1 CO2 CO4 CO5		
III	Cell components - Plasma Membrane Ultra Structure - Different Models - Functions - Ultrastructure, Composition and Function of Endoplasmic reticulum, Ribosomes, Golgi Complex, Lysosomes, Centrioles, Microtubules Microfilaments, Mitochondria and Microsomes.							12	CO1 CO2 CO3 CO4 CO5		
IV	Nucleus: Ultrastructure, Composition and Functions - Nuclear Membrane - Nucleoplasm - Chromosomes - Heterochromatin and Euchromatin - Nucleolus - Nucleolus Cycle - DNA and RNAs - Protein Synthesis & regulation.							12	CO1 CO2 CO4 CO5		
V	Cell Divisions and Cell Cycle: Amitosis, Mitosis and Meiosis and their Significance - Cancer, Biology – Characteristics of cancer cells, types, theories on Carcinogenesis, Ageing of Cells – Apoptosis and Stem cell studies.							12	CO1 CO2 CO4 CO5		
		Total							60		
Course Outcomes		On completion of this course, students will able to:									
CO1		understand and recall the basic structure, origin and development of cell organelles.								PO1	

CO2	integrate and assess the biochemical, cytological and histological tools to infer cellular basis of organization.	PO1, PO2, PO3
CO3	analyze and differentiate organisms based on structure, composition and inter and intra cellular interactions.	PO3, PO4, PO5
CO4	explain the role of cells and cell organelles in various biological processes.	PO2, PO3, PO5, PO6, PO8
CO5	construct and simulate the role of different cytological tools to explain the structure and complexity of cells and cell organelles.	PO3, PO4, PO5, PO6, PO7, PO8
Text Books (Latest Editions)		
1. Ambrose, E.J. and Dorothy, M. Easty. 1970. Cell Biology. Thomas Nelson & Sons Ltd. Pp500		
2. Kumar P. and Mina U. 2018. Life Sciences: Fundamentals and Practice, Part-I, 6th Edn., Pathfinder Publication. p.608.		
3. Veerbala Rastogi, Introductory cytology. Kedar Nath Ram Nath. Meerut 250 001.		
4. Verma, P.S. and V. K. Agarwal, 1995. Cell and Molecular Biology, 8th Edition, S. Chand & co., New Delhi - 110 055, 567 pp.		
5. Verma P.S. and Agarwal V.K. 2016.		
6. Cell Biology (Cytology, Biomolecules, Molecular Biology), Paperback, S. Chand and Company Ltd.		
References Books		
(Latest editions, and the style as given below must be strictly adhered to)		
1. Albert B., Hopkin K., Johnson A.D., Morgan D., Raff M., Roberts K. and Walter P. 2018. Essential Cell Biology 5th Edn. (Paperback) W.W. Norton & Company p.864.		
2. Burke, Jack. D., 1970. Cell Biology, Scientific Book Agency, Calcutta.		
3. Challoner J. 2015. The Cell: A visual tour of the building block of life, The University of Chicago Press and Ivy Press Ltd., p.193.		
4. Cohn, N. S., 1979, Elements of Cytology, Freeman Book Co., New Delhi – 110007, Pp 495		
5. Cooper G.M. (2019) The Cell – A Molecular Approach, 8th Edn., Sinauer Associates Inc., Oxford University Press p.813.		
6. DeRobertis, E.D.P. and E.M.F. De Robertis, 1988. Cell and Molecular Biology, 8th Edition, International Edition, Info med, Hong Kong, 734pp.		
7. Dowben, R., 1971. Cell Biology, Harper International Edition. Harper and Row Publisher, New York, 565 pp.		
8. Giese, A.C., 1979. Cell Physiology, Saunders Co., Philadelphia, London, Toronto, 609 pp.		
9. Hardin J. and Bertoni G. (2017) Becker's World of the Cell. 9th Edn (Global Edition). Pearson Education Ltd., p. 923		
11. Karp G., Iwasa J. and Masall W. (2015) Karp's Cell and Molecular Biology Concepts and Experiments. 8th Edn. John Wiley and Sons. p.832.		
12. Loewy, A.G. and P.Sickevitz, 1969. Cell Structure and Function, Amerind Publishing Co., New Delhi - 110 020, 516 pp.		
13. Mason K.A., Losos J.B. and Singer S.R. (2011) Raven and Johnson's Biology. 9th Edn. Mc Graw Hill publications. p.1406.		
14. Powar, C.B., 1989. Essential of Cytology, Himalaya Publishing House, Bombay - 400 004, 368 pp.		
15. Swansen, C.P. and P.L.Webster, 1989. The Cell, Prentice Hall of India Pvt. Ltd., New		

Delhi - 110 001, 373 pp.		
16. Urry L.A. Cain M.L., Wasserman S.A., Minorsky P.V., Jackson R.B. and Reece J.B. (2014) Campbell Biology in Focus. Pearson Education. p.1080.		
Web Resources		
1.	http://www.microscopemaster.com/organelles.html	
2.	https://bit.ly/3tXwDSB	
3.	https://bit.ly/3tWNpRX	
4.	https://bit.ly/3AuYR9M	
5.	https://rscience.com/cell-organelles-and-their-functions/	
Methods of Evaluation		
Internal Evaluation	Continuous Internal Assessment Test	25
	Assignments	
	Seminars	
	Attendance and Class Participation	
External Evaluation	End Semester Examination	75
Total		100
Methods 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	

Mapping with Programme Outcomes:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO 1	S							
CO 2		S	S	S	S			S
CO 3		S	S	S	S	S		S
CO 4		S	M			M		
CO 5				S	S	S		S

S-Strong (3) M-Medium (2) L-Low (1)


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Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
T3ZO6P	Major Practical II: CELL BIOLOGY	Core	Y	-	-	-	3	3	25	75	100
SEMESTER	III										
Learning Objectives											
CO1	To encourage students to interpret the organization of genomic material and to research theories of genetic inheritance.										
CO2	To impart the skills required to prepare samples of genetic molecules and to determine their purity, structure and characteristics and to analyze genomic preparations.										
CO3	To study the changes in genetic material and to predict and consider the consequences of those changes.										
CO4	To encourage students to report and justify the results of molecular and genetic experiments in an accurate and meaningful manner.										
UNIT	Details							No. of Hours	Course Objectives		
I	Preparation and Identification of slides of Mitotic divisions with onion root tips. Preparation and Identification of different stages of Meiosis in Grasshopper Testes.							9	CO1		
II	Identification and study of different stages of Mitosis and Meiosis. Buccal epithelium (Barr body) preparation.							9	CO2		
III	Staining and observation of polytene chromosomes in salivary glands of chironomous larva.							9	CO3		
IV	Histochemistry and Micro technique- Fixation and Fixatives: Types of fixatives, Chemistry of fixation, Choice of Fixatives Tissue processing: Dehydration, Clearing and Embedding Microtomy: Types of microtomes, Sectioning of Paraffin blocks.							9	CO4		
V	Staining of paraffin sections: Principle and methods of staining. Histological stains: Haematoxylin and Eosin.							9	CO5		
Total							45				
Course Outcomes											
On completion of this course, students will											
CO1	familiarize with the structural and functional aspects of cell, the basic unit of life, and its different organelles									PO1	
CO2	understand structure and function of different cell organelles.									PO1 PO2	
CO3	be able to understand the cyclic events of cell division and types of cell division									PO4 PO6	
CO4	able do sectioning tissues										
CO5	Know the principle of staining and do staining procedure									PO3	

Text Books (Latest Editions)		
1.	Surya Nandan Meena, Milind Naik, 2019. Advances in Biological Science Research: A Practical Approach, Academic Press, New York, USA.	
2.	Michael Perlin, William Beckerson, Adarsh Gopinath, 2017. Cell, Genetics, and Molecular Biology: A Lab Manual (First Edition), Cognella Inc., USA.	
3.	Saxena J., Baunthiyal M., Ravi I., 2015. Laboratory Manual of Microbiology, Biochemistry and Molecular Biology, Scientific Publishers, India.	
4.	Bansal M.P., 2013. Molecular Biology and Biotechnology: basic experimental protocols, The Energy and Resources Institute (TERI), New Delhi, India.	
5.	Chaitanya K.V., 2013. Cell and molecular biology: A Lab Manual, Phi Learning Pvt. Ltd., New Delhi, India.	
References Books		
(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 Dabner, James Battey, 2012. Basic Methods in Molecular Biology, Elsevier Science Publishing Co., NY, USA.	
7.	Luiz Carlos. 2005. Basic Histology: Text and Atlas (11th Ed). Mc Graw Hill Medical.	
8.	Robert F. Schleif, Pieter C. Wensink, 2012. Practical Methods in Molecular Biology, Springer-Verlag, NY, USA.	
9.	Ross, M.H., Kaye, G.I. & Pawlina, W. 2002. Histology: A text and atlas (4th ed). Lippincott Williams & Wilkins.	
10	Sarah Stauffer, Aaron Gardner, Wilko Duprez, Dewi Ayu Kencana Ungu, Philip Wismer, 2018. Labster Virtual Lab Experiments: Basic Genetics, Springer Publishers, NY, USA.	
Web Resources		
1.	https://www.jove.com/	
2.	https://vlab.amrita.edu/?sub=3&brch=77	
3.	http://cbii-au.vlabs.ac.in/	
4.	https://media.hhmi.org/biointeractive/vlabs/transgenic_fly/index.html	
5.	https://www.ibiology.org/biology-techniques/	
Methods of Evaluation		
Internal Evaluation	Continuous Internal Assessment Test	
	Assignments	
	Seminars	
	Attendance and Class Participation	
		25 Marks

External Evaluation	End Semester Examination	75 Marks
	Total	100 Marks
Methods 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	

Mapping with Programme Outcomes:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO 1	S							
CO 2	M	S						
CO 3				S		S		
CO 4				S	S	M		
CO 5			S					S

S-Strong (3)

M-Medium (2)

L-Low (1)


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Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
T3ZOSE4	APICULTURE	SEC	Y	-	-	-	1	1	25	75	100
Learning Objectives											
CO1	To understand economic importance of honey bees and developments taking place in modern beekeeping.										
CO2	To become familiar with different species and sub-species of honey bees found in the world and know their economic importance and familiar with different body parts of honey bees and their modifications as per their food habit and social life										
CO3	To become familiar with important bee diseases, enemies and their management.										
CO4	To become familiar with different equipment used in modern beekeeping for domesticating hive bees										
CO5	To know the process of honey and bee hive products and their uses										
UNIT	Details							No. of Hours	Course Objectives		
I	Introduction to Apiculture - scope, importance. History of beekeeping: Definition, Beekeeping worldwide and In India. Traditional and modern beekeeping. Role of Central Honey Bee Research & Training Institute. Indian Bee Board. National Honey Mission							6	CO1		
II	Honey Bee Types of honey bees- indigenous, exotic, Species of honey bees. Origin, systematics and distribution of honey bees. Honey Bee morphology, Anatomy and Life cycle. Social organization in honey bees: Colony life and social organization – Queen, drone, worker.							6			
III	Beekeeping: Tools and Equipment. Basic requirements for beekeeping. Types of bee boxes and their parts. Management of an apiary							6			
IV	Honeybee Enemies and Diseases: Bee enemies – Enemy: Mites, Wax Moths, Ants, Bee Eaters, Garden Lizards, Bears. Disease management-Identification of symptoms of Nosema. Sac brood Virus, Thai sac brood virus, American foul brood, and European foul brood diseases.							6			
V	Honey Processing and Bee Products: Honey - its properties. Honey extraction & handling. Processing of honey. Byproducts of Apiculture – Wax, Bee venom, propolis and Royal jelly extraction.							6			
Text Books (Latest Editions)											
1.	2018. M. Tamil Selvi and Abdul Jaffar Ali. A textbook of Apiculture. ISBN 9789394681682										
2.	Textbook of Apiculture (Beekeeping). Dr. D.K. Belsare, Dr. Rakesh Kumar Singh, Dr. Shashikala D. Belsare, Ravi H. Deshmuk. Himalaya Publishing House. Pp 304.										
3.	Sartaj Ahmad Allayie, Junaid Ahmad Malik, Gowhar Rashid. 2022. Apiculture Skill Enhancement Course. World BIOLOGICA (India & USA). Pp 118.										

References Books (Latest editions, and the style as given below must be strictly adhered to)		
1.	Apiculture. www.agrimoon.com	
2.	Honey Bee Biology and Beekeeping. DM Caron and L. J. Coonor.	
3.	R. Sharma, R.K. Kumar and P. Vaijinath. 2023. The Beekeeper's Handbook: A Comprehensive Guide to Apiculture. SHINEEKS Publishers, USA	
Web Resources		
1.	https://abfnet.org/resources-for-beekeepers/	
2.	https://www.perfectbee.com/beekeeping-articles/a-new-beekeepers-journal/educational-resources-for-new-beekeepers	
3.	https://oraravalleyhoney.com.au/online-beekeeping-resources/	
Methods of Evaluation		
Internal Evaluation	Seminars Attendance and Class Participation	25
	Continuous Internal	
	Assessment Test Assignments	
External Evaluation	End Semester Examination	75
Total		100
Methods 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	

Mapping with Programme Outcomes:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO 1	S							
CO 2	M	S						
CO 3				S		S		
CO 4				S	S	M		
CO 5			S					S

S-Strong (3) M-Medium (2) L-Low (1) B N


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Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
T3ZOSE5	ORNAMENTAL FISH FARMING & MANAGEMENT	Core	Y	-	-	-	2	2	25	75	100
Learning Objectives											
CO1	To highlight the importance of ornamental fish culture in relation to entrepreneurship development.										
CO2											
CO3	To enable the identification, culture and maintenance of commercially important ornamental fishes.										
CO4	To provide the knowledge on the techniques of ornamental fish breeding, rearing, disease control and economics of ornamental fish farming										
CO5	To identify the ornamental fishes										
UNIT	Details							No. of Hours	Course Objectives		
I	Introduction to ornamental fish keeping. Scope and importance of ornamental fish culture. Domestic and global scenario of ornamental fish trade and export potential. Commercially important ornamental fishes - Indigenous and exotic varieties.							12	CO1		
II	Biology of egg layers and live bearers. Food and feeding in ornamental fishes. Formulated feed and Live feed; Live feed culture. Breeding, hatchery and nursery management of egg layers (eg. Goldfish) and live bearers (eg. Guppy).							12	CO2		
III	Aquarium design and construction; Accessories - aerators, filters and lighting. Aquarium plants and their propagation. Maintenance of aquarium and water quality management. Ornamental fish diseases, their prevention, control and treatment methods.							12	CO3		
IV	Conditioning, packing, transport and quarantine methods. Economics, Trade regulations, domestic and export marketing strategies.							12	CO4		
V	Identification of locally available ornamental fishes - Egg layers and live bearers. Identification of locally available live feed organisms.							12	CO5		
Total								60			

References:

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 aquaculture. Daya Publishing House, New Delhi.

Web links:

1. <http://ecoursesonline.iasri.res.in/course/view.php?id=297>
2. <https://www.ofish.org/>

3. <https://krishijagran.com/agripedia/income-generation-by-ornamental-fish-culture/>
4. <https://99businessideas.com/ornamental-fish-farming/>

Course Outcome:

- The students will be able to identify, culture, maintain and market the commercially important ornamental fishes.
- The knowledge and skills gained on the different aspects of ornamental fish keeping will enable the students to develop entrepreneurship potential and help in self-employment.



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ENVIRONMENTAL STUDIES							
(for students admitted from the academic year 2023-2024)							
Credit	2	Hours/Week	1	Sub Code	T4ES	Semester	III-IV
Medium of Instruction: English/Tamil						ES	

Objective:

To sensitize students on environmental issues and sustainable development practices.

Course outcomes:

Co No.	Co – Statements	Cognitive Levels
	<i>On successful completion of this course, students will be able to</i>	
CO - 1	understand the concept, structure and functions of various ecosystems.	K1, K2
CO - 2	distinguish renewable resources from non-renewable resources	K3, K4
CO - 3	value the importance of biodiversity and its conservation.	K3
CO - 4	rationalize social issues with environmental issues and realize the importance of the environment and aware of its protection	K4
CO - 5	gain knowledge on human role in environment management and conservation	K5

Unit 1

The Multidisciplinary nature of environmental studies: Scope and importance; Need for public awareness. Natural Resources: Renewable and non-renewable resources; Natural resources and associated problems - a) Forest resources, b) Water resources, c) Mineral resources, d) Food resources, e) Energy resources, f) Land resources Role of an individual in conservation of natural resources. Equitable use of resources for sustainable lifestyles.

சுற்றுச்சூழல் அறிவியல்-பல்துறை தன்மை: நோக்கம் மற்றும் முக்கியத்துவம்; மக்களிடம் விழிப்புணர்வு தேவை. இயற்கை வளங்கள்: புதுப்பிக்கத்தக்க மற்றும் புதுப்பிக்க இயலா வளங்கள்; இயற்கை வளங்கள் மற்றும் பயன்பாடு தொடர்புடைய பிரச்சனைகள் - அ) வன வளங்கள், ஆ) நீர் வளங்கள், இ) கனிம வளங்கள், ஈ) உணவு வளங்கள், உ) ஆற்றல் வளங்கள், ஊ) நில வளங்கள். இயற்கை வளங்களைப் பாதுகாப்பதில் தனிநபரின் பங்கு. நிலையான வாழ்க்கை முறைக்கு வளங்களை சமமாகப் பயன்படுத்துதல்.

Unit II

Ecosystem: Concept, structure and function of an ecosystem; Energy flow in the ecosystem; Ecological succession; Food chains, food webs and ecological pyramids; Introduction, types, characteristic features, structure and function of - a) Forest ecosystem, b) Grassland ecosystem, c) Desert ecosystem, d) Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries).

சுற்றுச்சூழல் அமைப்பு: கட்டமைப்பு மற்றும் செயல்பாடு; சுற்றுச்சூழல் அமைப்பில் ஆற்றல் ஓட்டம்; சுற்றுச்சூழல் தொடர்வழி மாற்றம்; உணவு சங்கிலி, உணவு வலை மற்றும் சுற்றுச்சூழல் கூம்புகள்; அறிமுகம், வகைகள், சிறப்பியல்பு, கட்டமைப்பு மற்றும் செயல்பாடு - அ) வன சுற்றுச்சூழல், ஆ) புல்வெளி சுற்றுச்சூழல், இ) பாலைவன சுற்றுச்சூழல், ஈ) நீர்வாழ் சுற்றுச்சூழல் அமைப்புகள் (குளங்கள், நேரோடைகள், ஏரிகள், ஆறுகள், பெருங்கடல்கள், முகத்துவாரங்கள்).

Unit III

Biodiversity and its conservation: Genetic, species and ecosystem diversity; Biogeographical classification of India; Value of biodiversity; Biodiversity at global, National and local levels; India as a mega-diversity nation; Hot-spots of biodiversity; Threats to biodiversity; Endangered and endemic species of India; In-situ and Ex-situ conservation of biodiversity. Environmental Pollution: Definition, causes, effects and control measures of a) Air Pollution, b) Water Pollution, c) Soil Pollution, d) Marine Pollution, e) Noise pollution, f) Thermal Pollution, g) Nuclear hazards, h) solid waste; Role of an individual in prevention of pollution; Pollution case studies; Disaster management - floods, earthquake, cyclone and landslides.

பல்லுயிர் மற்றும் அதன் பாதுகாப்பு: மரபணு, இனங்கள் மற்றும் சுற்றுச்சூழல் பன்முகத்தன்மை; இந்தியாவின் உயிர் புவியியல் வகைப்பாடு; பல்லுயிர் மதிப்பு; உலகளாவிய, தேசிய மற்றும் உள்ளூர் மட்டங்களில் பல்லுயிர்; இந்தியா ஒரு பெரும்-பன்முகத்தன்மை கொண்ட நாடு; பல்லுயிர் பெருக்கத்தின் செழுமை இடங்கள்; பல்லுயிர் பெருக்கத்திற்கு அச்சுறுத்தல்கள்; இந்தியாவின் அழிந்துவரும் மற்றும் உள்ளூர் இனங்கள்; அக-புறச் சூழல் பல்லுயிர் பாதுகாப்பு. சுற்றுச்சூழல் மாசுபாடு: வரையறை, காரணங்கள், விளைவுகள் மற்றும் கட்டுப்பாட்டு நடவடிக்கைகள் அ) காற்று மாசுபாடு, ஆ) நீர் மாசுபாடு, இ) மண் மாசுபாடு, ஈ) கடல் மாசுபாடு, உ) ஒலி மாசுபாடு, ஊ) வெப்ப மாசுபாடு, எ) அணு அபாயங்கள், ஏ) திடமான கழிவுகள்; மாசுபாட்டைத் தடுப்பதில் தனிநபரின் பங்கு; மாசு கள ஆய்வுகள்; பேரிடர் மேலாண்மை - வெள்ளம், பூகம்பம், சூறாவளி மற்றும் நிலச்சரிவு.

Unit IV

Social Issues and the Environment: from Unsustainable to Sustainable development; Urban problems related to energy; Water conservation, rain water harvesting, watershed management; Resettlement and rehabilitation of people – problems, concerns, case studies; Environmental ethics; Climate change; Global warming; Acid rain; Ozone layer depletion; Nuclear accidents and holocaust; Wasteland reclamation; Consumerism and waste products; Environmental Legislations - Environment Protection Act; Air (Prevention and Control of Pollution) Act, Water (Prevention and Control of Pollution) Act, Wildlife Protection Act, Forest Conservation Act.; Issues involved in enforcement of environmental legislation; Public awareness.

சுற்றுச்சூழல் சார்ந்த சமூகப் பிரச்சினைகள்: நீடித்த வளர்ச்சி, நிலையான வளர்ச்சி வரை; ஆற்றல் தொடர்பான நகர்ப்புற பிரச்சனைகள்; நீர் சேமிப்பு, மழை நீர் சேகரிப்பு, நீர்நிலை மேலாண்மை; மக்களின் மீள்குடியேற்றம் மற்றும் மறுவாழ்வு - பிரச்சினைகள், கவலைகள், வழக்கு ஆய்வுகள்; சுற்றுச்சூழல் நெறிமுறைகள்; பருவநிலை மாற்றம்; உலக வெப்பமயமாதல்; அமில மழை; ஒசோன் அடுக்கு சிதைவு; அணு விபத்துக்கள் மற்றும் மரணங்கள்; தரிக நில மீட்பு; நுகர்வோர் மற்றும் கழிவு பொருட்கள்; சுற்றுச்சூழல் சட்டங்கள் - சுற்றுச்சூழல் பாதுகாப்பு சட்டம்; காற்று (மாசு தடுப்பு மற்றும் கட்டுப்பாடு) சட்டம், நீர் (தடுப்பு மற்றும் மாசு கட்டுப்பாடு) சட்டம், வனவிலங்கு பாதுகாப்பு சட்டம், வன பாதுகாப்பு சட்டம்.; சுற்றுச்சூழல் சட்டத்தை அமல்படுத்துவதில் உள்ள சிக்கல்கள்; பொது விழிப்புணர்வு.

Unit V

Human Population and the Environment: Population growth, Variation among nations, Population explosion, Family Welfare Programmes, Environment and human health, Human Rights, Value Education, HIV/ AIDS, Women and Child Welfare, Role of Information Technology in Environment and human health.

மக்கள்தொகை மற்றும் சுற்றுச்சூழல்: மக்கள்தொகை வளர்ச்சி, நாடுகளிடையே மாறுபாடு, மக்கள்தொகை பெருக்கம், குடும்ப நலத் திட்டங்கள், சுற்றுச்சூழல் மற்றும் மனித ஆரோக்கியம், மனித

உரிமைகள், மதிப்புக் கல்வி, எச்ஐவி/எய்ட்ஸ், பெண்கள் மற்றும் குழந்தைகள் நலன், சுற்றுச்சூழல் மற்றும் மனித ஆரோக்கியத்தில் தகவல் தொழில்நுட்பத்தின் பங்கு.

Text books

1. Erach Bharucha, 2004. Textbook for Environmental studies, UGC, New Delhi.
2. Townsend C.R., Harper, J.L., Begon, M., 2009. Essentials of Ecology, Wiley, 528p.
- N. Arumugam, V. Kumaresan. 2014. Environmental Studies. Saras Publication

Reference books

1. Abbasi, S.A., 1998. Environmental Pollution and its Control, International Publications, Pondichery.
2. Agarwal, K.C. 2001 Environmental Biology, Nidi Public Ltd Bikaner.
3. Clark R.B., 2001. Marine Pollution, 5th edition, Oxford University Press. 248p.
4. Jadhav, H and Bhosale, V.M., 1995. Environmental Protection and Laws Himalaya Pub. House, Delhi 284 p.
5. McNeely, J.A., Miller, K., Mittermeier, R.A., Reid, W.V and Werner, T.B., 1990. Conserving the world's biological diversity, IUCN.
6. Odum, E.P. 1971 Fundamentals of Ecology. W.B. Saunders Co. USA. 574 p.
7. Trivedi R.K., 2010. Handbook of Environmental Laws, Acts, Guidelines, Compliances and Standards, Vol. I and II, B.S. Publications.

Web Resources

- <https://www.ugc.ac.in/oldpdf/modelcurriculum/env.pdf>
- https://www.researchgate.net/publication/349648232_Introduction_to_Environmental_Studies
- https://nitsri.ac.in/Department/CHEMISTRY/EVS_MATERIAL_2.pdf

Relationship matrix for Course outcomes, Programme outcomes /Programme Specific Outcomes

Course Outcomes	Programme Outcomes (PO)					Programme Specific Outcomes (PSO)					Mean Scores
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	Mean Score of COs
CO1	3	2	2	3	3	3	3	2	3	1	2.5
CO2	3	3	3	3	3	3	1	3	2	3	2.7
CO3	3	3	3	2	3	3	1	3	3	3	2.7
CO4	3	3	3	3	3	3	1	3	1	3	2.6
CO5	1	3	3	3	3	3	1	1	1	3	2.2
Mean Overall Score											2.54
Result											High

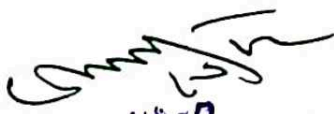
Question Pattern:

Maximum Marks: 75

Duration of Exam: 3 hrs

Part A: 5 x 6 = 30 (5 out of 7 questions, at least one question from each unit)

Part B: 3 x 15 = 45 (One question from each unit)


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SEMESTER -IV

Course Code CC7	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
T4ZO7	ENVIRONMENTAL BIOLOGY	Core	Y	-	-	-	4	4	25	75	100
Learning Objectives											
CO1	To understand the structure and functions of the ecosystem.										
CO2	To explain the relationship between biotic and abiotic factors in an ecosystem.										
CO3	To know the causes and effects of climate change and habitat loss.										
CO4	To bring awareness about the impact of socio-economic development on the environment and the solutions put forward by the government to reduce environmental damage.										
UNIT	Details							No. of Hours	Course Objectives		
I	Ecosystem: Concept (abiotic and biotic factors)-Structure and function of an ecosystem (forest, grassland and pond ecosystems)-Trophic levels: Producers, consumers (primary, secondary and tertiary) and decomposers - Ecological Succession-Food chains, food webs and ecological pyramids.							12	CO1		
II	Population Ecology: Structure and distribution – Growth curves - groups, natality and mortality-density indices, Life study tables - factors affecting population growth - Carrying capacity. Population regulation and human population control.							12	CO2		
III	Biogeochemical Cycles: Gaseous cycles (Carbon, nitrogen and water cycles) and Sedimentary cycle (Phosphorous and sulphur cycles). Environmental Stress and Management: Causes and effects of climatic changes - Global climatic pattern, global warming, atmospheric ozone, acid and nitrogen							12	CO3		
IV	Environmental pollution: Definition, causes, effects and control of air pollution, water pollution, soil pollution, marine pollution, noise pollution, thermal pollution and nuclear hazards - central and state pollution control boards							12	CO4		
V	Biodiversity and Conservation: Definition and types of biodiversity – Roles of biodiversity in ecosystem - Hot spots of biodiversity in India - Causes and consequences of biodiversity crisis; habitat degradation, poaching of wild life, socio economic and political causes of biodiversity loss. <i>In situ</i> and <i>ex situ</i> conservation of biodiversity - Role of government and non-government agencies.							12	CO5		
Total								60			
Course Outcomes											
Course Outcomes	On completion of this course, students will;										
CO1	Understand the fundamental structure and functions of the ecosystem.									PO1	

CO2	Assess the inter-relationship between organisms and between biotic and abiotic factors in an ecosystem.	PO1 PO2
CO3	Analyze the factors that cause pollution, climate change, loss of biodiversity and depletion of resources.	PO4 PO6
CO4	Evaluate the impact of human population growth and socio-economic development on the structure and function of the ecosystem.	PO4 PO5 PO6
CO5	Design plans to scientifically solve environmental problems using biological tools, technologies and government policies.	PO3 PO8
Text Books (Latest Editions)		
Matthew R. Fisher, 2018. Environmental Biology. Open Oregon Educational Resources. James Madison University.		
Asthana, D.K. and Meera, A. 2009. A text book of environmental studies, S. Chand, New Delhi.		
Sanyal, K. Kundu, M. and Rana, s. 2009. Ecology and environment, Books and allied, Kolkata.		
Grant, W.E. and Swannack, T.M., 2008, Ecological Modelling, Blackwell.		
References Books		
(Latest editions, and the style as given below must be strictly adhered to)		
Odum E.P.1983. Basic Ecology, Saunders, New York		
Wilkinson, D.M., 2007, Fundamental Processes in Ecology: An Earth system Approach, Oxford University Press, UK.		
Saha, T.K. 2010. Ecology and Environmental biology, Books and Allied, Kolkata.		
Web Resources		
1.	https://bit.ly/2VYWOM5	
2.	https://bit.ly/2VZQFiT	
3.	https://bit.ly/3kqdXYA	
Methods of Evaluation		
Internal Evaluation	Continuous Internal Assessment Test	25 Marks
	Assignments	
	Seminars	
	Attendance and Class Participation	
External Evaluation	End Semester Examination	75 Marks
Total		100 Marks
Methods 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	

Mapping with Programme Outcomes:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO 1	S							
CO 2	M	S						
CO 3				S		S		
CO 4				S	S	M		
CO 5			S					S
S-Strong (3)			M-Medium (2)		L-Low (1)			



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Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
T4ZO8P	Major Practical IV: ENVIRONMENTAL BIOLOGY	Core	Y	-	-	-	3	3	25	75	100
Learning Objectives											
CO1	To explain the main mechanisms of environmental toxicants in causing a toxic response in living organisms.										
CO2	To describe the optimal use of nature, in the form of plants, animals, bacteria, fungi and algae, to produce renewable energy, food and nutrients in a synergistic integrated cycle of profit-making processes										
CO3	To provide practical knowledge and hands on tools and techniques for dose-response assessment of hazardous substances.										
CO4	The use of biological systems for remediation of contaminated environments (land, air, water), and for environment-friendly processes.										
CO5	To develop data that can ensure appropriate protection of public health from the adverse effects of exposures to environmental agents.										
Experiments 1. Determination of turbidity of water. 2. Measurement of TDS in water. 3. Measurement of Electrical conductivity of water. 4. Measurement of pH in water and soil 5. Estimation of dissolved oxygen in water 6. Estimation of dissolved CO ₂ in water 7. Estimation of calcium in water 8. Estimation carbonate and bicarbonate in water 9. Determination of salinity in water 10. Estimation of chloride in water 11. Culture and identification of bacteria in water. 12. Culture and identification of bacteria in soil. Spotters <i>Animal Association</i> Hermite crab and sucker fish. <i>Animal Adaptations</i> Horse, Balanoglossus, Pigeon, Leech, Taenia solium <i>Rockyshore fauna</i> Star fish, mytilus, chiton, Balanus, Sea anemone, Ascidian, Patella <i>Sandyshore fauna</i> Arenicola, Albunea, Solen, chaetopterus Amphioxus <i>Muddyshore fauna</i> Aplysia, Sea cucumber, Aphrodite, Nereis, Periophthalmus <i>Planktons</i>											

	Mysis, Megalopa larva, Auricularia, cyclops, Nauplius, Zoca, Paramoecium. Instruments and Tools BOD Incubator, Secchi disc, barometer, Hydrometer, Hygrometer, Anemometer Field, industrial and institutional visits.		
Course Outcomes	On completion of this course, students will;		
CO1	Understand the properties of toxicants, effects, origin and occurrence in the environment and explain the principle and procedure for quality evaluation, monitoring and remediation of contaminated environments.	PO1	
CO2	Estimate the toxic chemicals in the environment. Apply tools and techniques for experimenting with environmental problems. Identify and implement solutions to the problems.	PO1 PO2	
CO3	Analyse the consistent and inconsistent range of elements. Interpret the role of the elements in environmental pollution and the effects on organisms.	PO4 PO6	
CO4	Relate the metabolic activity, diseases, ill health and death with reference to exposure to chemicals. Select the suitable experimental design to assess the toxic effects of pesticides and pollutants.	PO4 PO5 PO6	
CO5	Discuss the applicability of chemical analysis and toxicity data, both individually and together, in risk assessment and environmental monitoring.	PO3 PO8	
Text Books (Latest Editions)			
1.	Abhijit Dutta, 2009. Experimental biology: A Laboratory Science, Narosa, New Delhi.		
2.	DAS H.K., 2005. Text Book of Biotechnology. Wiley Dreamtech Pvt Ltd, New Delhi.		
3.	Rastogi, S.C., 2005. Experimental physiology, new age international publishers, New Delhi.		
4.	Ramesh, R and M, Anbu 1996. Chemical methods for environmental Analysis of water and sediment. Macmillan India Limited, Chennai.		
5.	Micheal, P, 1984. Ecological Methods for field visit and laboratory investigation. Tata McGraw Hill, New Delhi.		
6.	Agarwal, A. State of India's Environment: A Citizens Report, Centre for Science and Environment, New Delhi.		
7.	Goel, P.K. Water Pollution: Causes, Effects and Control. New Age International, Publishers, New Delhi (2006).		
References Books (Latest editions, and the style as given below must be strictly adhered to)			
1.	Allan S. Cragg, 2010. Environmental Biotechnology, Oxford University Press. UK.		
2.	APHA, 1992. Standard Methods for the examination of water and waste water, American Public Health association, Washington D.C.		
3.	APHA, 2005. Standard Methods for the examination of water and waste water, 21 st Ed., American Public Health association, Washington D.C.		
4.	Boyd C.E., 1992. Water Quality and Pond Soil Analysis for Aquaculture, C.E. Boyd, C.S. Tucker, Auburn University.		
5.	Csuros, M., 1994. Environmental Sampling and Analysis for Technicians, M. Lewis Publishers, Boca Raton, Florida.		
Web Resources			
1.	http://www.envexp.com/technical/method-downloads/cod-method-410		

2.	https://bit.ly/3u6o0Fb	
3.	https://bit.ly/3hX8Ux0	
4.	https://bit.ly/3EN2nz0	
5.	https://www.ncbi.nlm.nih.gov/pubmed/2170158	
Methods of Evaluation		
Internal Evaluation	Continuous Internal Assessment Test	25 Marks
	Assignments	
	Seminars	
	Attendance and Class Participation	
External Evaluation	End Semester Examination	75 Marks
	Total	100 Marks
Methods 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	

Mapping with Programme Outcomes:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO 1	S							
CO 2	M	S						
CO 3				S		S		
CO 4				S	S	M		
CO 5			S					S

S-Strong (3)

M-Medium (2)

L-Low (1)


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Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
T4ZOSE6	SERICULTURE	EC	Y	-	-	-	2	2	25	75	100
Learning Objectives											
CO1	recall the history of sericulture industry, types of silk worms and silkworm rearing										
CO2	interpret moriculture for supporting growing silkworms										
CO3	identify diseases of silkworm and their management										
CO4	Categorize different sericulture practices										
CO5	apprise the reeling process										
UNIT		Details						No. of Hours	Course Objectives		
I		History of Sericulture - Types of Silk – Mulberry (<i>Bombyx</i>) and Non-mulberry silk (<i>Tasar</i> , <i>Muga</i> and <i>Eri</i>). <i>Bombyx mori</i> – Morphology of silkworm, silk glands and life cycle. Silkworm rearing: equipment used for rearing-rearing racks and trays, disinfectants, bed cleaning, mounting appliances, harvesting and marketing of cocoons.						6	K1		
II		Moriculture - Mulberry Species – Classification, distribution, cultivation, irrigation and common varieties used in India and recommended varieties for Tamil Nadu. Propagation of Mulberry. Mulberry leaf harvesting methods -leaf picking, shoot leaf harvesting & branch cutting.						6	K2		
III		Silkworm diseases and their treatment. Silkworm pests, parasites and their management. Silk reeling techniques						6	K3		
IV		Silkworm rearing methods: Outdoor and indoor rearing- Rearing House- Hatching - Incubation - Feeding Silkworms- Mounting and harvesting						6	K4		
V		Silk fiber formation- Properties of filament- Pre reeling process- Cocoon- Boiling – Reeling technology- Re-reeling technology- raw silk industry- by products of silk industries.						6	K5		

Text Books

1. H. Aruga and AA Balkema. 1994. Principles of Sericulture. Rotterdam. Pp. 367.
2. Ganga G and Sulochana Chetty J. 2003. Introduction to Sericulture (2nd Edition), LBH Publishing co. Pvt. Ltd., New Delhi.
3. Mariappan P. 2017. Sericulture (Pattupulu valarppu) Iyal Publication Thanjavur, Tamil Nadu.

Reference Books

1. Manual of Silkworm Rearing: Manual of Mulberry Cultivation by Food and Agricultural Organization (FAO), United States.

Web resources

<https://www.davuniversity.org/images/files/study-material/SERICULTURE%20PDF.pdf>
<https://www.ignfa.gov.in/document/biodiversity-cell-ntfp-related-issues4.pdf>

<https://www.teachmint.com/tfile/studymaterial/b-sc/zoologypaper-ii/sericulturepdf/a7586519-5ebb-4124-af72-962a333c89bb>

Relationship matrix for Course outcomes, Programme outcomes /Programme Specific Outcomes

Course Outcomes	Programme Outcomes (PO)					Programme Specific Outcomes (PSO)					Mean Scores
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	Mean Score of COs
CO1	3	2	3	2	3	3	3	2	3	2	2.5
CO2	3	2	2	3	3	3	3	2	3	2	2.6
CO3	3	2	2	3	3	2	3	3	2	3	2.6
CO4	2	3	2	3	3	2	2	3	2	2	2.4
CO5	3	3	2	3	2	2	3	2	3	2	2.5
Mean Overall Score											2.5
Result											High



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Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
T4ZOSE7	MEDICAL LABORATORY TECHNIQUES	EC	Y	-	-	-	2	2	25	75	100
Learning Objectives											
CO1	To understand the different protocols and procedures in laboratory and disposal of wastes										
CO2	To explain the characteristics of clinical samples										
CO3	To evaluate the safety precautions while handling clinical samples										
CO4	To demonstrate skill in handling biomedical equipment										
CO5	To illustrate the skill in histopathology										
UNIT		Details							No. of Hours	Course Objectives	
I	Laboratory Safety and Human Health and Hygiene: Laboratory safety –toxic chemicals and biohazards waste-biosafety level- good laboratory practice – hygiene and health issue – physiology effect of alcohol, tobacco, smoking and junk food & its treatment - biomedical waste management							6			
II	Haematology: Composition of blood and their function-collection of blood and lab procedure-haemopoiesis- types of anaemia- mechanism of blood coagulation- bleeding time-clotting time- determination of hemoglobin-erythrocyte sedimentations rate- packed cell volume- Total count of RBC & WBC- Differential count WBC- blood grouping and typing-haemostasis- bleeding disorder of man - Haemolytic disease of newborn, Platelet count, reticulocytes count, Absolute Eosinophil count							6			
III	Medical Microbiology and Instrumentation Techniques: Definition and scope of microbiology- structure and function of cells - parasites - Entamoeba- Plasmodium- Leishmania and Trypanosome infection and handling method							6			
IV	Medical Physiology: Cardiovascular system- Blood pressure - Pulse – regulation of heart rate, cardiac shock. Heart sounds, Electrocardiogram (ECG) – significance – ultra sonography- Electroencephalography (EEG). Computer tomography (CT scan)-Magnetic Resonance imaging-flowcytometry-treadmill test – PET							6			
V	Diagnostic Pathology: Handling and labelling of histology specimens - processing of histological tissues for paraffin embedding, block preparation. Microtomes – types of microtomes- sectioning, staining –staining methods- vital staining - mounting- problems encountered during section cutting and remedies - Frozen section techniques- freezing microtome							6			

Text Books

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

Suggested Readings

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

Web Resources

1. <https://bit.ly/3tUs8ln>
2. <https://bit.ly/2XKu7mT>
3. <https://bit.ly/3hNS1EP>
4. <https://bit.ly/2ZgrLga>
5. <https://bit.ly/3hTBO1b>


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Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
T5ZO9	EVOLUTIONARY BIOLOGY	Core	Y	-	-	-	4	6	25	75	100
Learning Objectives											
CO1	Evolutionary biology is a branch of the biological sciences concerned with the origin of life and the diversification and adaptation of life forms over time.										
CO2	This course helps to understand the important processes, principles, and concepts on evolution.										
CO3	To provide adequate information on the Lamarckism - Neo Lamarckism – Darwinism, Neutral Theory of Molecular Evolution, and Human Genome Project.										
CO4	To explain the importance of the fossil records in evolutionary studies, and the role of phylogenetic studies in the wider context of biodiversity and conservation.										
CO5	In this course, we will apply the knowledge of human evolutionary history to simulate how genetic variation within and among human populations affects risk, diagnosis, and treatment of modern diseases.										
UNIT		Details						No. of Hours	Course Objectives		
I	History of evolutionary thoughts-Inorganic and organic evolution. Primordial earth and primeval atmosphere, Chemical origin of life: Synthesis of organic molecules, Urey-Miller experiment, Origin of prokaryotes and eukaryotes.						12	CO1			
II	Lamarckism-Neo Lamarckism. Darwinism-Neo Darwinism. Modern synthetic theory - DeVrie's Mutation theory – modern concepts of mutation - Mutation and their role in evolution. Concept of variation. Adaptation, fitness and natural selection. Animal Colouration and Mimicry.						12	CO2			
III	Speciation: Isolating mechanisms-Modes of speciation-Allopatric and Sympatric speciation. Hybridization is an evolutionary catalyst- Law of Adaptive Radiation- Adaptive radiation in reptiles and mammals - Convergence and divergence						12	CO3			
IV	Evidences of Evolution: Morphological, physiological and biochemical, embryological, taxonomical and geographical, palaeontological. Geological time scale. Fossils: Nature of fossils-Dating of fossils-Fossil records of horse and man						12	CO4			
V	Natural selection. Action in man-level of selection- Eugenics, Euphenics and Euthenics- Adaptation-Adaptive radiation, types, adaptive radiation in Darwin Finches. Evolution and ethics.						12	CO5			
		Total						60			
Course Outcomes											
Course Outcomes		On completion of this course, students will;									

CO1	To understand the Primordial earth and theories on origin of life	PO1
CO2	To integrate and assess Lamarckism - Neo Lamarckism - Darwinism	PO1 PO2
CO3	To analyse various fossil records of man and fossil records of horse, various types of rocks - Geological time scale.	PO4 PO6
CO4	To explain the Nature of fossils- Dating of fossils, evidences of evolution, Adaptive radiation in reptiles and mammals,	PO4 PO5 PO6
CO5	To construct and compile the role of Human Genome Project, Evolution in the diagnosis, and treatment of diseases.	PO3 PO8
Text Books (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.	Brian K. Hall and Benedikt Hallgrímsson. 2013. Strickberger's Evolution. 5 th Edition. Jones & Bartlett, USA.	
8.	Colbert, E.H. Morales, M. and Minkoff, E.C. 2011. Colbert's Evolution of The Vertebrates: A History of the Backboned Animals Through Time, Wiley, India.	
References Books		
(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 Bartlett Publ. Boston.	
4.	Levine L. 1969. Biology of the Gene. Toppan.	
5.	Pedder IJ. 1972. Genetics as a Basic Guide. W. Norton & Company, Inc.	
6.	Rastogi VB. 1991. A Text Book of Genetics. Kedar Nath Ram Nath Publications, Meerut, Uttar Pradesh, India.	
7.	White MJD. 1973. Animal Cytology and Evolution. Cambridge Univ.Press.	
Web Resources		
1.	https://bit.ly/3nPD09m	
2.	https://bit.ly/3CHOdGL	
3.	https://bit.ly/2XvcCXl	
4.	https://bit.ly/2XAL1Vh	
5.	https://bit.ly/3zoU9Jl	
Methods of Evaluation		
Internal	Continuous Internal Assessment Test	25 Marks

Evaluation	Assignments	
	Seminars	
	Attendance and Class Participation	
External Evaluation	End Semester Examination	75 Marks
	Total	100 Marks
Methods 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	

Mapping with Programme Outcomes:

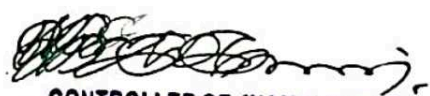
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO 1	S							
CO 2	M	S						
CO 3				S		S		
CO 4				S	S	M		
CO 5			S					S

S-Strong (3)

M-Medium (2)

L-Low (1)


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Course Code CC9	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
T5ZO10	ANIMALPHYSIOLOGY	Core	Y	-	-	-	4	6	25	75	100
Learning Objectives											
CO1	To familiarise students with the principles and basic facts of Animal Physiology										
CO2	To give students an insight about the molecular and cellular basis of physiological functions in animals.										
CO3	To give an idea about the regulation of organ system functions in a whole animal using a conceptual model of feedback to explain homeostasis.										
CO4	To make the students aware about how the structure-function relationships and its synchronisation with the molecular signals.										
UNIT		Details						No. of Hours	Course Objectives		
I	Nutrition & Respiration: Nutrition: Digestion and absorption of carbohydrates proteins and lipids. Minerals & Vitamins—their deficiency. Hormonal control of digestion. Types of Respiration, Respiratory pigments - structure of Hemoglobin, Transportation of gases - Bohr Effect-Regulation of respiration-bronchitis, asthma - Physiological effects of smoking						15	CO1			
II	Circulation & Excretion: Blood- composition and functions, Mechanism of clotting. Types of Heart –Human Heart and Heartbeat and its regulation -pace maker – Cardiac cycle – ECG - Pulse and blood pressure. Nephron structure & mechanism of urine formation, Regulation of acid base balance, Excretory products, Osmoregulation in fishes.						15	CO2			
III	Muscle & Nerve Physiology: Types of muscles – Ultra structure of striated muscle, Muscle contraction & properties, Neurons—structure & types- Impulse propagation, synaptic transmission, neurotransmitters - Reflex action, Nerve disorders – epilepsy, Alzheimer's disease, Parkinson's disease.						15	CO3			
IV	Sense Organs: Structure of eye, physiology of vision, visual elements and pigments, photo chemistry of vision - Eye defects – myopia, hyperopia, presbyopia, astigmatism, cataract - Structure of ear and mechanism of hearing - Hearing impairments – deafness, labyrinthine disease -Olfactory, gustatory and tactile sense organs						15	CO4			
V	Reproductive Physiology: Endocrine glands in man-hormones, action and disorders-Feedback mechanism, mechanism of hormonal action. puberty, adolescence, pregnancy, parturition, lactation and birth control.						15	CO5			
		Total						90			
Course Outcomes											
Course Outcomes		On completion of this course, students will;									

CO1	Be able to explain how the various organ systems are coordinated and controlled.	PO1
CO2	be able to list the functions of various organs in relation to physiological process.	PO1 PO2
CO3	be able to develop the idea of multilevel controlling and feedback mechanism in relation to various physiological functions.	PO4 PO6
CO4	Be able to understand the basic physiological process related to adaptation, metabolism and major requirements	PO4 PO5 PO6
CO5	be able to correlate and understand human physiology	PO3 PO8
Text Books (Latest Editions)		
1.	Agarwal R A., Anil K Srivastava., Kaushal Kumar., 1978. Animal Physiology and Biochemistry, S. Chand & Co. Ltd., New Delhi Publishing., Pp392.	
2.	Ambika Shanmugam, 2001. Fundamentals of Biochemistry for Medical students, Karthik Offset Printers, Chennai, 590pp	
3.	Berry A.K.1998. A text book of Animal Physiology and Biochemistry. Emkay Publications, New Delhi, 320 pp.	
4.	Parameswaran, Ananta Krishnan and Ananta Subramanian, 1975. Outlines of Animal Physiology, S. Viswanathan (Printers & Publishers) Pvt. Ltd., 329 p p.	
5.	Verma P.S., Tyagi B.S & Agarwal V.K., 2010. Animal Physiology, S. Chand & Co. Ltd., New Delhi Publishing., 417 pp.	
References Books		
(Latest editions, and the style as given below must be strictly adhered to)		
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 (4th edn). 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., and 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. and 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.	
Web Resources		
1.	https://microbenotes.com/category/biochemistry/	

Credits : 2
Hours/Week : 2
Medium of Instruction : English/Tamil

Code: T5VE

இளநிலை யட்ட வகுப்பு - பகுதி IV

(2023-2024 ஆம் கல்வியாண்டு முதல் சேர்க்கப்பட்ட மாணவர்களுக்குரியது)

5ம் பருவம்

வாழ்வியல் கல்வி (Value Education)

அலகு - 1

வாழ்வியல் கல்வி ஓர் அறிமுகம், தனி மனித நெறிமுறைகள், சமுதாய நெறிமுறைகள், ஆன்மீக நெறிமுறைகள், வாழ்வியல் நெறிகளின் மூலங்கள், வாழ்வியல் நெறிகளின் அவசியம், நன்னடத்தையும் நற்செயல்களும், நற்பண்புகள் உருவாக்கம்.

அலகு - 2

சமூக நற்பணி, சமூக நலப்பணித் திட்டங்கள், சமுதாயத் தீமைகள் குறித்த விழிப்புணர்வு, போதை மருந்துகளுக்கு அடிமையாதல், மதுப்பழக்கம், புகைப்பிடித்தல், தற்கொலை.

அலகு - 3

இந்து சமயத்தின் போதனைகள், இஸ்லாம் போதிக்கும் நெறிகள், கிறித்துவம் போதிக்கும் நெறிகள், சமயச் சார்பின்மை, சமய நல்லிணக்கம்.

அலகு - 4

காந்தியடிகளின் அகிம்சை கொள்கை, அன்னை தெரசாவின் தொண்டுகள், தன்னலமின்மையின் வடிவம் பெருந்தலைவர் காமராசர்.

அலகு - 5

சமூக நீதி, மனித உரிமைகளும் அவற்றின் பாதுகாப்பும், மகளிர்க்கு எதிரான வன்முறைகள், நாட்டின் ஒருமைப்பாடு.

Question Paper Pattern

Maximum Marks : 75

Exam Duration : 3 Hours

Part A - 5 x 6 = 30 (Either or Questions, One Pair from each Unit)

Part B - 3 x 15 = 45 (3 Out of 5 - 1 Question from each Unit)


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2.	https://www.stem.org.uk/resources/collection/3931/animal-physiology	
3.	https://animalphys4e.sinauer.com	
4.	https://nptel.ac.in/courses/102/104/102104042/	
5.	https://biochem.oregonstate.edu	
Methods of Evaluation		
Internal Evaluation	Continuous Internal Assessment Test	25
	Assignments	
	Seminars	
	Attendance and Class Participation	
External Evaluation	End Semester Examination	75
	Total	100
Methods 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	

Mapping with Programme Outcomes:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO 1	S							
CO 2	M	S						
CO 3				S		S		
CO 4				S	S	M		
CO 5			S					S


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Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
T5ZO11	DEVELOPMENTAL BIOLOGY	Core	Y	-	-	-	4	5	25	75	100
Learning Objectives											
1	To create an awareness to the students about the theories, concepts and basics of Developmental Biology.										
2	To provide students about the idea of sex cells, fertilization, cleavage, differentiation and development of organs.										
3	To make an awareness of the induction, organizers and development of extra embryonic structures.										
4	To provide adequate explanation to students about the late embryonic developments and post embryonic development and ageing										
5	To give an idea about teratogenesis, invitro fertilization, stem cells and amniocentesis to the students										
UNIT	Details							No. of Hours	Course Objectives		
I	Gametogenesis & Fertilization: Basic concepts of developmental biology. Structure& types of Spermatozoa, Mammalian egg-Egg membranes. types of egg-Spermatogenesis-Oogenesis. Fertilization – mechanism, theories and significance – Parthenogenesis.							12	CO1		
II	Blastulation & Gastrulation: Cleavage - Planes and Patterns, Factors controlling cleavage - Fate map and its construction. Blastulation-types of blastula. Morphogenetic movements - Gastrulation of frog & chick.							12	CO2		
III	Organogenesis: Development of Brain, Eye and Heart in frog. Development of Nervous system in chick. Foetal membranes in chick. Development of Pro, Meso Metanephric kidneys. Placentation in Mammals.							12	CO3		
IV	Applied Embryology: Organizer concept –Structure – mechanism of induction and competence. Nuclear transplantation - teratogenesis – Regeneration: types - events and factors. Embryonic stem cells & significance. Methods to culture embryo							12	CO4		
V	Human embryology: Reproductive organs, Menstrual cycle and menopause-Pregnancy-trimesters-development. Erythroblastosis foetalis -Twins-types. Infertility-causes - Test tube baby and Assisted Reproductive Technology- Embryo transfer- Amniocentesis.							12	CO5		
								60			
Course Outcomes											
CO1	To describe and illustrate the significance of cellular processes in embryonic development.										PO1

CO2	To relate the factors that contribute to the developmental process, construct fate maps and illustrate the steps in morphogenesis and organogenesis.	PO1 PO2
CO3	To correlate the involvement of specific cell types in the formation of specific organs and explain the importance of morphogens.	PO4 PO6
CO4	To distinguish between the different types of developmental mechanisms in various organisms and appraise the species-based differences in development.	PO4 PO5 PO6
CO5	To justify and validate the role of environment and genetics in influencing embryonic development	PO3 PO8

Text Books

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

References Books

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

Web Resources

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

Methods of Evaluation

Internal Evaluation	Seminars Attendance and Class Participation	25 Marks
	Continuous Internal	
	Assessment Test	
	Assignments	
External Evaluation	End Semester Examination	75 Marks
Total		100 Marks

Methods 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

Mapping with Programme Outcomes:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO 1	S							
CO 2	M	S						
CO 3				S		S		
CO 4				S	S	M		
CO 5			S					S

S-Strong (3) M-Medium (2)

L-Low (1) B N



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SEMESTER - V

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
T5ZO12P	Laboratory Course V	Core	Y	-	-	-	3	3	25	75	100
Evolution, Animal Physiology and Developmental Biology Laboratory											
Learning Objectives											
1	To demonstrate the core ecological principles, and to define scientific principles and concepts as related to environmental studies and sustainability.										
2	To understand the physiological processes that regulate body functions.										
3	To strive to demonstrate the role of experimentation in developing our understanding of living animals.										
4	To attain knowledge of important biomolecules such as carbohydrates, lipids, amino acids, proteins and enzymes.										
5	To Measure and interpret experimental data and demonstrate laboratory skills in animal physiology and ecology.										
UNIT		Details						No. of Hours	Course Objectives		
I	Evolution: Study of homologous organs: Forelimbs of Frog & bird; mouth parts of cockroach & mosquito, serial homology in crustacean (appendages). Study of analogous organs: vertebrae & cephalopod eye, wing of bird & insect. Study of vestigial organs: Vermiform appendix, Wisdom teeth (molar teeth in man), coccyx (tail bone), Tonsils, Body hairs, Nipples on males, Nictitating membranes of eye. (Any three). Study of adaptive radiations in feet of birds and mouth parts of insects.						12	CO1			
II	Animal Physiology: Estimation of Haemoglobin by using haemoglobino meter Total RBC count by using Neubauer chamber (haemocytes meter) Total WBC count by using Neubauer chamber (haemocytes meter) Identification of type of nitrogenous waste present in the given samples. Qualitative analysis of macromolecules (Carbohydrate, proteins and lipids)						12	CO2			
III	Developmental Biology: Temporary mounting of chick embryo (24 – 48Hrs.) Observation of mammalian sperm (Bull sperm) motility						12	CO3			
IV	Spotters: Archacopteryx, Trilobites, Nautilus, ammonites,						12	CO4			

	limulus, sphenodon and latimeria. Sphygmomanometer, Stethoscope, colorimeter, frog blood cell, Human RBC and WBC Developmental stages of chick embryo: 18 hrs, 24 hrs, 48 hrs, 72 hrs, and 96 hrs. Frog development: 4 cell stage, 8 cell stage, Blastula, Gastrula and yolk plug stage.		
V	Field Visit: Visit to the fossil museum, observe the fossils, understand their importance in evolution and submit the field visit report.	12	CO5
Total		60	
Course Outcomes			
Course Outcomes	On completion of this course, students will;		
CO1	List and recall the basic equipment used in physiology and ecology lab and develop skill about quantitative determination of biomolecules and quantitative analysis of blood.		PO1
CO2	Demonstrate the instruments, discuss the clinical importance and its applications, and explain the principle of bioinstruments.		PO1, PO2
CO3	Understand and identify the chemical composition of major and minor nutrients and analyse Physio - chemical parameters that regulate metabolism.		PO4, PO6
CO4	Evaluate and examine the various parameters of haematology and biochemistry and identify the nitrogenous waste products of animals.		PO4, PO5, PO6
CO5	Summarise the effect of various physical and chemical factors on enzyme activity/. Compile the changes in various physiological parameters in man and other animals using various tools and techniques.		PO3, PO8
Text Books (Latest Editions)			
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, India, 298 PP.		
3.	Burtis, C.A. and Ashwood, E.R. 2008. Text book of Fundamentals of clinical chemistry and molecular diagnostics, Elsevier, Philadelphia.		
4.	Agarwal R A., Anil K Srivastava., Kaushal Kumar.,1978. Animal Physiology and Biochemistry, S. Chand & Co. Ltd., New Delhi Publishing., 377 PP.		
5.	Abhijit Dutta, 2009. Experimental biology: A Laboratory Science, Narosa, New Delhi.		
6.	Michael, P, 1984. Ecological Methods for field visit and laboratory investigation. Tata McGraw Hill, New Delhi.		
7.	APHA, 1992. Standard Methods for the examination of water and waste water, American Public Health association, Washington D.C.		
References 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.
6.	Eugenia, 2008. Environmental Biotechnology and cleavers Bioprocesses, London.
7.	Ramesh, R & M, Anbu 1996. Chemical methods for environmental Analysis of water and sediment. Macmillan India Limited, Chennai.

Web Resources

1.	https://bit.ly/3hNyeFN
2.	https://www.medicinenet.com/alp_test/article.htm
3.	https://vlab.amrita.edu/?sub=3&brch=63
4.	https://www.asbmb.org/education/online-teaching/online-lab-work
5.	https://open.umn.edu/opentextbooks/textbooks/687

Methods of Evaluation

Internal Evaluation	Continuous Internal Assessment Test Seminars Attendance and Class Participation Assignments	25 Marks
	External Evaluation	End Semester Examination
Total		75 Marks
		100 Marks

Methods 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

Mapping with Programme Outcomes:

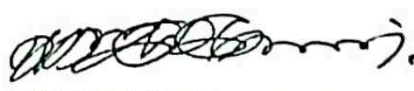
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO 1	S							
CO 2	M	S						
CO 3				S		S		
CO 4				S	S	M		
CO 5			S					S

S-Strong (3)

M-Medium (2)

L-Low (1)


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Course Code CC13	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
T6ZO13	GENETICS	Core	Y	-	-	-	5	6	25	75	100
Learning Objectives											
CO1	To study the nature of inheritance										
CO2	To understand the structure and functions of nucleic acids in the cell.										
CO3	To know the causes and effects of mutations.										
CO4	To comprehend the importance of genetic variation in evolution.										
CO5	To know about the harmful effects of genetic variations in humans, their cumulative effect in human population and the molecular basis of variations.										
UNIT		Details							No. of Hours	Course Objectives	
I		Mendelian Genetics and Inheritance: Mendelian genetics: Mendelian experiments, laws of Mendel, Monohybrid, Dihybrid, back and test cross; Interaction of genes: Incomplete dominance, codominance, complementary genes, supplementary genes, inhibiting genes, lethal genes and atavism. Inheritance: Polygenic inheritance- skin colour; multiple alleles- ABO blood groups and coat colour in rabbit; extra chromosomal inheritance- shell coiling, kappa particles; sex linked inheritance – eye colour in Drosophila, colour blindness and hemophilia in man.							15	CO1, CO2	
II		Linkage and Crossing Over: Linkage: Linked genes, complete and incomplete linkage. Crossing over: molecular mechanisms of crossing over, kinds of crossing over, models of recombination. Chromosome mapping: inference and coincidence, haploid mapping, somatic cell hybridization.							15	CO1, CO2, CO4, CO5	
III		Cytogenetics: Variation in chromosome number and structure: position effect, chromosomal mutation and evolution. Gene mutation: types, molecular basis of mutation, mutational hot spots, reversion; radiation and chemical agents as mutagens; Detection of mutation - CIB method and muller-5 method.							15	CO1, CO2, CO3, CO4, CO5	
IV		Human and Microbial Genetics: Human genetics: Karyotype and ideogram; sex determination - Barr body technique, drumstick method; chromosomal abnormalities in humans, Pedigree analysis; diagnosis of genetic abnormalities; Eugenics, Euphenics, and Euthenics. Population genetics and evolution: gene pool, gene frequency and genotype frequency; Hardy-Weinberg law of equilibrium.							15	CO1, CO2, CO4, CO5	
V		Bacterial genetics: Conjugation, transformation, transduction and chromosome mapping Molecular Genetics: Insertion elements, transposable elements, retroelements; integrons and antibiotic resistance							15	CO1, CO2, CO4, CO5	

	cassettes; the lactose system and operon model, tryptophan operon, role and relative positions of promoters and operators, feedback mechanism.		
Total		90	
Course Outcomes			
Course Outcomes	On completion of this course, students will;		
CO1	Understand the basis of inheritance and expression of genes.	PO1	
CO2	Correlate changes in genetic makeup and phenotypic changes in progeny.	PO2, PO3, PO5	
CO3	Analyse the causes of variations in genetic material and predict the effect in a population using different techniques.	PO2, PO3, PO4, PO5, PO6	
CO4	Explain the role of cellular processes and different genetic elements in the expression of genes.	PO2	
CO5	Compile the factors which contribute to changes in gene expression and specify the changes which contribute to evolution.	PO1, PO3, PO4, PO5, PO6, PO8	
Text Books			
1	David E Sadava, 1993. Cell Biology - Organelle Structure and Function, Jones Bartlett Publishers.		
2	Guptha G. K., 2013. Genetics Classical to Modern, Rastogi publishers, Meerut.		
3	Lewin B., 2008. Genes IX, Jones and Bartlett publishers.		
4	Veer Bala Rastogi., 2019. Text Book of Genetics, Medtech		
5	Verma P.S and Agarwal V.K., 2006. Cell Biology, Genetics, Molecular Biology, Evolution and Ecology, S. Chand & Company Ltd.		
6.	Verma P. S. and V. K. Agarwal., 2018. Genetics, S. Chand & Company Pvt Ltd.		
References Books			
(Latest editions, and the style as given below must be strictly adhered to)			
1	Cooper, Geoffrey M., 2018. The cell: A Molecular Approach, Eighth Edition, Oxford University Press.		
2	De Robertis, E. D. P and E.M.F Robertis, 2017. Cell and Molecular Biology 8 th Edition, I.W.W.		
3	Dobzhansky T., 1982. Genetics and The Origin of Species, Columbia University.		
4	Fletcher H and Hickey L., 2015. Genetics, IV Edition. GS, Taylor and Francis Group, New York and London.		
5	Gardner, Anne. 2009. Human Genetics, Scion Publishing Ltd.		
6	Klug, W. S., Cummings, M. R., Spencer, C. A., 2012. Concepts of Genetics. X Edition. Benjamin Cummings.		
7	Lodish, Harvey, Arnold Berk <i>et al.</i> , 2007. Molecular cell biology. 6th edition, W. H. Freeman.		
8	Russel, Peter J. 2013. iGenetics: A Molecular Approach, Pearson.		
9	Strickberger M. W., 1995. Genetics, Prentice Hall India Learning Private Limited.		
Web Resources			
1.	https://go.nature.com/2XE8V1q		
2.	https://bit.ly/3zoTt6B		
3.	https://bit.ly/2XAm7on		
4.	https://bit.ly/2XEbhxl		

5.	https://bit.ly/3AB4bso	
6.	https://bit.ly/39pZSE4	
7.	https://www.genome.gov/genetics-glossary/Sex-Linked	
8.	https://www.vedantu.com/biology/mutagens	
Methods of Evaluation		
Internal Evaluation	Continuous Internal Assessment Test	25 Marks
	Assignments	
	Seminars	
	Attendance and Class Participation	
External Evaluation	End Semester Examination	75 Marks
	Total	100 Marks
Methods 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	

Mapping with Programme Outcomes:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO 1	S							
CO 2		S	S		S			M
CO 3			S	S	S	S		S
CO 4		S						
CO 5		S	S	S	S	S		S

S-Strong (3) M-Medium (2) L-Low (1)


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Course Code CC14	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
T6ZO14	BIOTECHNOLOGY	Core	Y	-	-	-	5	6	25	75	100
Learning Objectives											
CO1	To impart the skills required to explain the protocols for genetically manipulating cells and produce transgenic animals.										
CO2	To encourage the use of the apt molecular techniques to evaluate and analyze animal traits and diseases at the genomic level and employ methods for easy taxonomical identification and classification for biodiversity and environmental studies.										
CO3	To study methods of transgenesis and to consider their use in improving animal husbandry and animal health.										
CO4	To motivate students to review the ethics and speculate on the environmental implications of animal biotechnological methods										
UNIT		Details							No. of Hours	Course Objectives	
I	Fundamentals of Biotechnology: Animal cell culture: Basic requirements and techniques of cell culture, natural and synthetic culture media, primary culture and cell lines; Stem cell: types, culture and applications. r-DNA technology: Enzymes; Vectors – pBR322, Phage lambda, Cosmid, HAC, BAC, YAC; Host cells; Gene cloning: steps in cloning, selection of clones–chromogenic substrate, antibiotics							15	CO1		
II	Techniques in Biotechnology: Blotting techniques: Southern, Northern and Western blotting. DNA sequencing: Sanger method. DNA microarray. PCR: working principle, types and applications. Gene library and its applications. Site directed mutagenesis and its applications. Gene transfer in animal cells: transfection, liposomal, viral mediated, electroporation, biolistic, direct DNA injection.							15	CO2		
III	Transgenic Animal Technology: Transgenesis: Concept, transgenes, transgenic animal models - knock out mice, sheep; Applications of transgenesis. Molecular farming, transgenic fishes, transgenic live stocks and animals as bioreactors.							15	CO3		
IV	Animal Biotechnology and Health Care: Monoclonal Antibodies, Recombinant hepatitis B vaccine, Genetic manipulation of <i>E.coli</i> for Insulin production. Gene therapy: <i>ex vivo</i> and <i>in vivo</i> , role in cancer treatment. Molecular markers: RFLP, RAPD. DNA fingerprinting and its applications.							15	CO4		
V	Industrial biotechnology and Ethics: Human Genome Project (HGP) and its applications. Bioreactors: Bioreactor types – Stirred tank fermenter, Air-lift fermenter, Tower fermenter, Hollow fibre bioreactor. Stages of fermentation – upstream and downstream processing. Production of ethanol and streptomycin by bioprocess technology. Ethics: ethical problems associated with biotechnology.							15	CO5		
Total								90			

Course Outcomes		
Course Outcomes	On completion of this course, students will;	
CO1	To describe the methodologies for handling animal cells based on their diverse characteristics and identify the correct biotechnological tools to obtain the desired products from the cells.	PO1
CO2	To develop and explain the protocols for genetically manipulating cells and produce transgenic animals	PO1 PO2
CO3	To select the apt molecular techniques to evaluate and analyze animal traits and diseases at the genomic level and devise methods for easy taxonomical identification and classification for biodiversity and environmental studies.	PO4 PO6
CO4	To choose the correct methods of transgenesis and to consider their use in improving animal husbandry nationally and globally	PO4 PO5 PO6
CO5	To speculate on the environmental implications of animal biotechnological methods and design responsible, ethical solutions to livestock production and health issues.	PO3 PO8
Text Books (Latest Editions)		
1. Singh B. D. 2015. Biotechnology: Expanding horizon, Kalyani publishers.		
2. Sasidhara, R. 2015. Animal biotechnology, MJP publishers.		
3. Dubey R. C. 2014. A text Book of Biotechnology, S. Chand & Co Ltd, Ram Nagar, New Delhi.		
2. Dubey S. K. Bandana Ghosh, 2012. Fish biotechnology, Wisdom Press.		
3. Dubey R.C. 2014. Advanced Biotechnology, S. Chand Publication.		
4. Ramdoss P. 2009. Animal Biotechnology. Recent concepts and developments, MJP Publishers.		
5. Sathyanarayana U. 2008. Biotechnology, Books and Allied, Kolkata.		
6. Ignacimuthu, S. 2008. Basic Biotechnology, Tata McGraw hill, New Delhi.		
7. Rastogi S. C. 2007. Biotechnology: Principles and applications, Alpha Science Publishers		
References Books (Latest editions, and the style as given below must be strictly adhered to)		
1	Veer Bala Rastogi, 2016. Principles of Molecular biology, Medtech, Maine, USA.	
2	Michael Crichton, 2014. Essentials of Biotechnology, Medtech, Maine, USA.	
3	Godbey W.T., 2014. An Introduction to Biotechnology, Academic press, New York, USA.	
4	Peters, P., 2009. Biotechnology – A guide to genetic engineering, WMC brown publisher, UK.	
5	Ramawat, K.G and Shailey Goyal, 2009. Comprehensive biotechnology. S. Chand company, New Delhi, India.	
6	Primrose S.B., R. M. Twyman and R.W. Old. 2001. Principles of gene manipulation, Wiley- Blackwell, UK.	
7	Primrose S.B. 2001. Molecular Biotechnology, Panima Publishing Corporation, New Delhi, India.	
8	Hames B.D. and Higgins S.J. 1995. Gene Probes: A Practical Approach, Oxford University Press, UK.	
Web Resources		

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

Methods of Evaluation

Internal Evaluation	Continuous Internal Assessment Test	25
	Assignments	
	Seminars	
	Attendance and Class Participation	
External Evaluation	End Semester Examination	75
	Total	100

Methods 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

Mapping with Programme Outcomes:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO 1	S							
CO 2	M	S						
CO 3				S		S		
CO 4				S	S	M		
CO 5			S					S

S-Strong (3)

M-Medium (2)

L-Low (1)


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Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
T6ZO15P	Genetics, Microbiology, Biotechnology and aquaculture Lab Course	Core	Y	-	-	-	4	6	25	75	100
Learning Objectives											
CO1	To encourage students to interpret the organization of genomic material and to research theories of genetic inheritance.										
CO2	To encourage students to interpret the organization of genomic material and to research theories of genetic inheritance.										
CO3	To impart the skills required to prepare samples of genetic molecules and to determine their purity, structure and characteristics and to analyze genomic preparations.										
CO4	To study the changes in genetic material and to predict and consider the consequences of those changes.										
CO5	To encourage students to identify the age of fish and planktons for aquaculture.										
UNIT	Details							No. of Hours	Course Objectives		
I	Genetics Carry out the human karyotype experiment with the given human metaphase chromosome spreads. Application of Hardy-Weinberg Equilibrium in population to understand that allele and genotype frequencies in a population remain constant generation after generation, in the absence of evolutionary forces. Identification of inactivated X chromosome (bar body) in the human buccal epithelial cells. Determination of sex-linked inheritance in drosophila.							15	CO1		
II	Microbiology Isolation of bacteria from natural source - soil (serial dilution method). Hanging drop for demonstrating motility of bacteria. Culture and identification of edible mushroom.							15	CO2		
III	Biotechnology Isolation of DNA from animal tissue (chicken /goat liver). Enzyme Immobilization by gel entrapment method. Agarose gel electrophoresis of DNA. Molecular modelling of protein molecule(enzyme). Protoplast isolation from plant cell (mechanical method).							15	CO3		
IV	Aquaculture Determine the age of fish by using their scales. Identification of phyto and zoo planktons (Fresh water/ Marine)							15	CO4		
V	Spotters Agarose, Inoculation loop, Nutrient agar, Laminar airflow chamber, Autoclave, AGE, types of fish scales, fresh water							15	CO5		

	/ marine planktons (phyto and Zoo), broth, Slant, Petri dish, cooling centrifuge, Human chromosome spread, Karyotype, micropipette, Blotting apparatus (Southern, western and Northern), UV trans illuminator. COD reflux unit, BOD incubator, Ethanol/ Methanol, PCR machine, Vector (any two types).		
	Total	90	
Course Outcomes			
Course Outcomes	On completion of this course, students will able to		
CO1	describe, examine and interpret the organization of genomic material and to research theories of genetic inheritance.	PO1	
CO2	prepare samples of genetic molecules and to determine their purity, structure and characteristics.	PO1 PO2	
CO3	experiment with genomic preparations and devise techniques to distinguish genetic material in different organisms to survey biodiversity.	PO4 PO6	
CO4	assess the changes in genetic material and to predict and consider the consequences of those changes.	PO4 PO5 PO6	
CO5	To report and justify the results of molecular and genetic experiments in an accurate and meaningful manner.	PO3 PO8	
Text Books (Latest Editions)			
1.	Surya Nandan Meena and Milind Naik. 2019. Advances in Biological Science Research: A Practical Approach, Academic Press, New York, USA.		
2.	Michael Perlin, William Beckerson, Adarsh Gopinath, 2017. Cell, Genetics, and Molecular Biology: A Lab Manual (First Edition), Cognella Inc., USA.		
3.	Saxena J., Baunthiyal M., Ravi I., 2015. Laboratory Manual of Microbiology, Biochemistry and Molecular Biology, Scientific Publishers, India.		
4.	Bansal M.P., 2013. Molecular Biology and Biotechnology: basic experimental protocols, The Energy and Resources Institute (TERI), New Delhi, India.		
5.	Chaitanya K.V., 2013. Cell and molecular biology: A Lab Manual, Phi Learning Pvt. Ltd., New Delhi, India.		
References Books			
(Latest editions, and the style as given below must be strictly adhered to)			
1.	Andreas Hofmann and 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 Publishing 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.		
Web Resources			
1.	https://www.jove.com/		

2.	https://vlab.amrita.edu/?sub=3&brch=77		
3.	http://cbii-au.vlabs.ac.in/		
4.	https://media.hhmi.org/biointeractive/vlabs/transgenic_fly/index.html		
5.	https://www.ibiology.org/biology-techniques/		
Methods of Evaluation			
Internal Evaluation	Continuous Internal Assessment Test		25 Marks
	Assignments		
	Seminars		
	Attendance and Class Participation		
External Evaluation	End Semester Examination		75 Marks
Total			100 Marks
Methods 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		

Mapping with Programme Outcomes:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO 1	S							
CO 2	M	S						
CO 3				S		S		
CO 4				S	S	M		
CO 5			S					S
	S-Strong (3)			M-Medium (2)		L-Low (1)		


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ELECTIVE COURSES

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
TZOECA	ANIMAL BEHAVIOUR	Core	Y	-	-	-	4	4	25	75	100
Learning Objectives											
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 behavior, with an evolutionary and ecological emphasis.											
To Compare innate and learned behavior and differentiate between various mating system.											
To impart the knowledge about visual and auditory communication; courtship, mate choice, and mating systems; social behavior and social systems; and animal personality.											
To discuss how movement and migration behaviors are a result of natural selection.											

Unit I: Genetics and Behaviour: Genetic material, Genes and chromosomes, Genetic variation, Single and Polygenic inheritance of behaviour, Heritability of behaviour, Natural selection and behaviour, Frequency distribution of phenotypes, Darwinian fitness, Evolution of adaptive strategies.

Unit II: Evolution and Social Behaviour: Sexual selection, Altruism, Sexual strategy and social organisation, Animal perception, Neural control of behaviour, Sensory processes and perception, Visual adaptations to unfavourable environments.

Unit III: Animal and the Environment: Coordination and Orientation, Homeostasis and Behaviour, Physiology and Behaviour in changing environments, Animal Learning, Conditioning and Learning, Biological aspects of learning, Cognitive aspects of learning.

Unit IV: Understanding Complex Behaviour: Instinct and learning, Displacement activities, Ritualization and Communication, Decision making behaviour in Animals, Complex behaviour of honey bees, Evolutionary optimality, Mechanism of Decision making. The mentality of Animals: Languages and mental representation, non-verbal communication in human, mental images, Intelligence, tool use and culture, Animal awareness and Emotion.

Unit V: Chronobiology : Organization of circadian system in multicellular animals; Concept of central and peripheral clock system; Circadian pacemaker system in invertebrates with particular reference to Drosophila; Photoreception and photo- transduction; The physiological clock and measurement of day length; Molecular bases of seasonality; The relevance of biological clocks for human welfare - Clock function (dysfunction); Human health and diseases - Chronopharmacology, chronomedicine, chronotherapy.

Text Books

1. David McFarland, 1985. Animal Behaviour, Longman Scientific & Technical, UK. 576pp.
2. Harjindra Singh, 1990. A Textbook of Animal Behaviour, Anomol Publication, 293pp.
3. Hoshang S. Gundevia and Hare Govind Singh, 1996. Animal Behaviour, S. Chand & Co, 280pp.
4. Shukla, J. P 2010, Fundamentals of Animal Behaviour, Atlantic, 587pp.
5. Vinod Kumar, 2002. Biological Rhythms. Narosa Publishing House, Delhi.

Suggested Readings

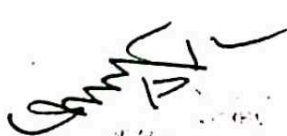
1. Michael D. Breed and Janice Moore, 2012. Animal Behaviour, Academic Press, USA, 359pp.
2. Aubrey Manning and Martin Stamp Dawkins, 2012. An Introduction to Animal Behaviour, 6th Edition, Cambridge University Press, UK. 458pp.
3. Davis E. Davis, 1970. Integral Animal Behaviour, Mac Millan Company, 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.

Web Resources

1. <https://www.ncbs.res.in/content/animal-behaviour>
2. <https://bit.ly/3i6wUxR>
3. <https://www.behaviour.univie.ac.at/>
4. <https://www.ru.nl/bsi/>

Course Outcomes (COs)

1. Recall and record genetic basis and evolutionary history of behaviour.
2. Classify movement and migration behaviors and explain environmental influence upon behaviour.
3. Analyze and identify innate, learned and cognitive behavior and differentiate between various mating systems.
4. Assess complexity involved in behavioural traits and evaluate hormones and their role in aggression and reproduction.
5. Discuss the rhythmicity of behavioural expressions and the scientific concepts in behavior and behavioral ecology.


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Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CLA	Ext.	Total
TZOEBCB	NANOBIOLGY	SEC	Y	-	-	-	2	2	25	75	100

Learning Objectives:

This course provides knowledge about the basic concepts of nanobiology. The learners will be able to acquire skills in the assembly, design and types of nanomaterials and nanoparticles, they will be able to appreciate the applications of nanobiology in diverse fields.

Course outcomes (Cos)

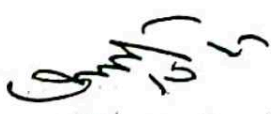
Students will be able to:

- Understand basics of Nano-science and Nano-biology.
- Gain knowledge on nanomaterials and nanoparticles.
- Know the biological applications of nanomaterials and nanoparticles.
- Apply their knowledge in their career development in higher education, research and development.

Unit	Content
I	Nanobiology- Definition-concepts and scope. History of nanotechnology and nanoscience in Nature; Structure and Properties of nano materials: size, surface charge, conductivity, optical properties and biocompatibility
II	Synthesis and characterization of nanomaterials, Fabrication of nanostructures. Metallic nanoparticles, semiconductor, biopolymeric nano-structures and nanoparticles.
III	Composition and functional properties of nanostructures: Protein and peptide-based nanostructures, carbohydrate and nucleic acid-based nanomaterials; Use of gold, silver and other metallic nanoparticles
IV	Strategies to design biologically active nanostructure-based biomaterials. Interaction of nanoparticles with biomolecules to study their conformational and functional properties.
V	Biological Applications of Nanomaterials and nanoparticles – therapeutics – biomaterials - Immobilized enzymes - drug delivery systems – Biosensors - Cellular imaging tools and diagnostics.

References

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.


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Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	Ext.	Total
TZOECC	RADIATION BIOLOGY	SEC	Y	-	-	-	2	2	25	75	100

Learning Objectives:

The course covers basic knowledge on different types of radiation, biological effects of radiation and risks on cellular level to humans, a deeper knowledge on radiation protection for ionizing and non-ionizing radiation, both in legislation and practical radiation protection technology.

COURSE OUTCOMES:

To describe the various types of ionizing radiation.

To define the radiation units used in measurement/calculations of “dose”.

To describe the biological impact of radiation on living cells and tissues

To highlight the applications of radiation in different fields

To create awareness about safety precautions when using radioactive isotopes

UNIT-I

Scope of Radiation Biology – Sources of Natural Radiation: Terrestrial and cosmic sources - Man made radiations - Medical (occupational and diagnostic). Types of radiation – Ionizing and non-ionizing radiation.

UNIT-II

Properties of Radiation – Radiation Units (Becquerel, RAD, Gray & Curie, Sievert). Measurement of Radiation in the Environment - Alpha and Beta counters and Scintillometer.

UNIT-III

Biological effects of Radiation - Cellular level – Organ and system level – Genetic effects (chromosomal aberrations), radiation induced mutations – Radiation sickness – Syndromes – Cancer induction – Dosimetry.

UNIT-IV

Radiation safety measures - Safety standards disposal of radioactive waste management, administrative & legislative aspect of radiation protection. Nuclear reactors – Nuclear energy programme in India. Regulatory authorities– AERB, BARC, DAE, IAEA & ICRP.

UNIT-V

Applications of Radioisotopes in biology- Auto radiography, Radioimmunoassay; Agriculture -insect, pest and disease management- Sterile Insect Technology (SIT); Medicine - (Therapy & diagnosis); Food preservation.

REFERENCES

1. Rao, B.M. (2002), Radioactive Materials, Himalayas publishing House.

2. Sood, D.D. Reddy, A.V.R. and Ramamoorthy, N. (2000) Fundamentals of Radiochemistry, Indian Association of Nuclear Chemists and Allied Scientists, Radiochemistry Division, Mumbai.
3. Sharma, B.K., (1990) Environmental Chemistry, Goel Publishing House, Meerut.
4. Kiefer, J. (1990) Biological Radiation Effects, Springer-verlag.
5. Radiation Biology: A Handbook for Teachers and Students International Atomic Agency (IAEA), 2010 - Training Course Series42.



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Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	Ext.	Total
TZOECD	HUMAN REPRODUCTIVE BIOLOGY	SEC	Y	-	-	-	2	2	25	75	100

Learning Objectives:

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

Unit	Content
I	Gonadal hormones and mechanism of hormone action, steroids, glycoprotein hormones and prostaglandins, hypothalamo – hypophyseal – gonadal axis, regulation of gonadotrophin secretion in male and female; Reproductive System: Development and differentiation of gonads, genital ducts, external genitalia, mechanism of sex differentiation; Puberty
II	Outline and histoarchitecture of male reproductive system; Testis: Cellular functions; Spermatogenesis; Androgen synthesis and metabolism; Epididymal function and sperm maturation; Sperm transportation in male tract; Andropause
III	Outline and histoarchitecture of female reproductive system; Ovary: oogenesis; Steroidogenesis and secretion of ovarian hormones; Reproductive cycles and their regulation, changes in the female tract; Menopause
IV	Ovum transport in the fallopian tubes; Sperm transport in the female tract, Fertilization; Hormonal control of implantation; Hormonal regulation of gestation, pregnancy diagnosis, foeto – maternal relationship; Mechanism of parturition and its hormonal regulation; Lactation and its regulation
V	Infertility in male and female: causes, diagnosis and management; Assisted Reproductive Technology: sex selection, sperm banks, frozen embryos, Stem Cell banks, <i>in vitro</i> fertilization, ET, EFT, IUT, ZIFT, GIFT, ICSI, PROST; ethical issues related to ART; Surrogate motherhood; ethical issues; Consanguinity; Fetal Loss and Birth Defects; Adoption. Sexually transmitted Infections; Modern contraceptive technologies

COURSE OUTCOMES

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

- Recall the functioning of reproductive endocrine system, associated endocrinology,

- causes for infertility and assisted reproductive technology
- Describe the structure and physiology functions of male and female reproductive systems.
- Explain the role of structures, accessory glands and hormones associated with the reproductive tracts and their control
- Explain the mechanism of sex determination.
- Discuss age-associated physiological changes in the reproductive tract
- Describe physiological changes during pregnancy and benefits of breastfeeding.
- Identify causes for infertility, treatments available and ethical issues related to treatments.
- Discuss advantages and disadvantages of available contraceptives.
- Analyze the different techniques and associated ethical issues related to reproductive technology

BOOKS FOR REFERENCE

- Cassan, A. 2005. *Human reproduction and Development (Inside the Human Body)*. New York: Chelsea Clubhouse.
- Field, M.A. 1990. *Surrogate Motherhood*. Massachusetts: Harvard University.
- Gardner, D. K. 2001. *Textbook of Assisted Reproductive Techniques: Laboratory and Clinical Perspectives*. London: Martin Dunitz.
- Gardner, D.K. 2006. *In vitro Fertilization: A Practical Approach*. CRC Press.
- Johnson, M. H. (2018). *Essential Reproduction*. New Jersey: Wiley-Blackwell.
- Jones, R.E. 2013. *Human Reproductive Biology*. Amsterdam: Elsevier.
- Neill, Jimmy D. 2006. *Knobil and Neill's Physiology of Reproduction*. Volume I. Third edn. Elsevier Academic Press.
- Pinon, R. 2003. *Biology of Human Reproduction*. California: University Science Books.


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Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	Ext.	Total
TZOECE	BASICS OF MARINE BIOLOGY	SEC3	Y	-	-	-	2	2	25	75	100

Learning Objective

1. To understand and learn the physical, chemical and biological aspects of marine environment and to gain knowledge about the management of oceans.
2. To introduce students to the marine environment and its indigenous organisms.
3. To study the principles, concepts and facts through which the student can better understand and appreciate the nature of the sea and its inhabitants.
4. To acquaint the student with the characteristics used to identify and classify marine plants and animals and to develop an awareness of the career possibilities available to students in this area.

Unit I: Marine Ecology: Marine environment- ecological factors- light, temperature, salinity, pressure; Classification of marine environment; Pelagic environment – Planktonic and Nektonic adaptations; Benthic environment - intertidal, interstitial and deep-sea adaptations; Distribution and ecological role of other coastal environments - coral reefs, estuaries, mangroves, seagrass beds, kelp forests polar seas and hydrothermal vents.

Unit II: Physical Oceanography: Physical Properties of Seawater- density, viscosity, surface tension, conductivity and their relationship; temperature distribution in the sea - heat budget, UV radiation; El Nino/La Nina – global impact; Dynamics of the ocean-general surface circulation, Waves, Currents and Tides, Tsunami.

Unit III: Chemical Oceanography: Chemical composition of seawater- ionic, major and minor constituents, constancy- ionic compositions and factors affecting constancy- major and minor elements, trace elements- their importance, distribution. Chemistry of seawater constituents- concept of chlorinity and salinity - methods of measurements, nutrients - biogeochemical cycles.

Unit IV: Biological Oceanography: Sea as a biological environment- Plankton- classification based on size, mode of life and habitat. Phytoplankton and Zooplankton - methods of collection, estimation of standing crop-wet and dry weight estimation-plankton volume settling and displacement methods. Oxidation as carbon (as organic matter). Primary productivity – estimation and factors affecting primary productivity.

Unit V: Marine Pollution and Ocean Management: Ocean pollution- kinds and quantities of pollutants, toxic effects and control measures – oil spills, plastics, nuclear waste disposal in marine environment, Eutrophication. Role of National and international agencies and

organizations in ocean management-FAO, UNEP, DOD, WOCE, WHOI, IOI Malta, IMO INMARSAT- IUCN, SCAR, SCOR, Marpol, Traffic. Ocean policy (India) - research and management.

Text Books

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 Resch Jr. 1979, Marine Biology. Reston Publishing Company, Virginia. 257 pp.

Suggested Readings

1. Barbara E. Curry, 2016. Advances in Marine Biology, Volume 74, I 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, I 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. Pergamon Press, 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.
9. Van Der Spoel, S. and Pierrot Bults, A. C (Eds) 1979. Zoogeography and diversity of plankton. Bungs Scientific Publishers Utrecht, 410pp.
10. Riley, J.P. and Skirrow, 1975-1984. Chemical Oceanography Vols. 1 to 8. Academic Press, London

Web Resources

1. <https://www.livescience.com>
2. <https://www.icriforum.org>
3. <https://www.cbd.int>

Course Outcomes (COs)

1. Define marine ecosystem, recognize and describe the interrelationship between biology and ocean technology.

2. Articulate and classify the dynamics and the physical attributes of the ocean, interpret the factors which affect the global climate.
3. Identify and analyze the physical and biological factors of marine environments, and focus life in the open sea.
4. Evaluate the impact of variations in abiotic factors in marine productivity and justify the role of human activities in the degradation of marine ecosystems.
5. Categorize marine pollutants and develop controlling measures in collaboration with the institutions for ocean management.


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Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
TZOECE	AGRICULTURAL ENTOMOLOGY	EC	Y	-	-	-	4	4	25	75	100
Learning Objectives											
01	Explain the basic concepts of entomology and observe the pest status of agriculture										
02	Illustrate and examine the systemic and functional morphology of various group of agricultural insect pests										
03	Differentiate and classify the various groups of insect animals and estimate biodiversity										
04	To compare and distinguish the general and specific characteristics integrated pest management										
05	Infer and integrate the economic importance of insect species										

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

Unit II: Insect vectors of plant diseases, most common insect pests of the following plants and their control measures: Paddy, Sugarcane, Coconut. Locust and its control. Insect pollinators and scavengers.

Unit III: Apiculture: Introduction, types of honey bees, hive, apiary, selection of bees for apiary, Newton's bee hive, enemies and diseases of honey bees.

Unit IV: Sericulture: Introduction, types of silk worms, silk worm races, life history of mulberry silk worm, features of sericulture industry, pests and diseases of silk worm.
Lac Insect: Culture, Natural Enemies and their management

Unit V: Pest Management Tools and their integration: Physical, Mechanical, Chemical and Biological control methods, Pesticide application equipment. Introduction and steps towards IPM. Pheromones, antifeedants, repellents and biopesticide.

Text Books

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

Suggested Readings

1. Abishek Shukla, D. 2009. A Hand Book of Economic Entomology, Vedamse Books, New Delhi.
2. Ministry of Agriculture, Government of India, 1995. Manual on Integrated Pest Management in Rice and Cotton.
3. John William S. 1995. Management of Natural Wealth, Loyola College Publications, Chennai.

Web resources

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

Course Outcomes (COs)

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


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Course Code EC9		Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
										CIA	External	Total
TZOECG		MICROBIOLOGY & IMMUNOLOGY	Ele	Y	-	-	-	3	6	25	75	100
Semester		VI										
Learning Objectives												
CO1	To become familiar with the history and scope of Microbiology											
CO2	To understand the structure of a typical prokaryotic and eukaryotic cell											
CO3	To know the historical developments of immunology and immunity types.											
CO4	To gain knowledge on lymphoid organs and immune system cells.											
CO5	To study the structure of immunoglobulins, antigen-antibody interactions, immunodeficiency disorders											
UNIT	Details								No. of Hours	Course Objectives		
I	Microbiology: History and Scope Classification of bacteria (Bergey's) and fine structure of bacteria; bacterial growth curve. Staining-Types of staining – simple, negative and Gram staining; pathogenicity, clinical symptoms, diagnosis, prevention and treatment of Tuberculosis.								12	CO1		
II	General characteristics and outline classification of virus; pathogenicity, clinical symptoms, diagnosis, prevention and treatment of Hepatitis B virus. General characteristics and outline the classification of fungi; Morphology of Saccharomyces - pathogenicity, clinical symptoms, diagnosis, prevention and treatment of Pneumonia								12	CO2		
III	Immunology-history and scope. Immunity types. Innate immunity – physical, biochemical, cellular and genetic barriers. Acquired immunity-characteristics-active and passive immunity- humoral and cell mediated immunity								12	CO3		
IV	Cells and Organs of immune system (primary and secondary lymphoid organs) Cells of the immune system: Cells of lymphoid lineage - lymphocytes, null cells; Cells of myeloid lineage - monocytes, macrophages, polymorphonuclear leucocytes, mast cells, antigen presenting cells, platelets. Antigens. Characteristics, Types.								12	CO4		
V	Immunoglobulin-structure, types and biological properties. Antigen and antibody interactions. Autoimmune disorders- Immunodeficiency disorders-Vaccine and its types								12	CO5		
Total								60				
Course Outcomes												
Course Outcomes		On completion of this course, students will										

CO1	understand history, relevance of microbiology and classification of microbes	PO1
CO2	understand the working of various microscopes and their applications	PO1, PO2
CO3	gain knowledge of various (physical and chemical) methods of control of microorganisms and safety measures to be followed while handling microbes	PO4, PO6
CO4	appraise the structure of bacterial cells, its organelles, physiology and behaviour.	PO4, PO5, PO6
CO5	interpret different methods of staining bacteria and demonstrate proficiency in handling aseptic bacteriological specimen.	PO3, PO8
Text Books (Latest Editions)		
1.	Aneja K.R., Experiments in Microbiology, plant pathology, Tissue culture and Mushroom Cultivation, New Age International, New Delhi.	
2.	Atlas R.M., Microbiology – fundamentals and applications, Macmillan Publishing Company, New York.	
3.	Ravindra Nath, Fundamentals of Biology Courses for Biotechnology, - Vol.1, Special Bangalore University edition, Kalayani Publishers.	
4.	Greenwood D, Richard CD, John S and Peutherer F (1992). Medical Microbiology, 16th edition. ELBS, Churchill living stone.	
References Books (Latest editions, and the style as given below must be strictly adhered to)		
1.	Alexopoulos C.J. and Mims C.W., Introductory Mycology, New Age International, New Delhi.	
2.	Thomas M. Bell, 1965. An Introduction to General Virology, William Heinemann Medical books, London.	
3.	Stanier R.Y., Ingraham J.L., General Microbiology, Prentice Hall of India Private Limited, New Delhi.	
4.	Salle A.J., Fundamental Principles of Bacteriology, Tata McGraw – Hill Publishing Company Limited, New Delhi.	
5.	Pelczar. J. Chan E.C.S. and Krieg N.R., Microbiology, McGraw Hill Book Company, New York.	
6.	Benson Harold J, Microbiological Applications, WCB McGraw – Hill, New York.	
7.	Brock T.D. and Madigan M.T., Biology of Microorganisms, Prentice Hall of India Private Limited.	
8.	Collins CH, Patricia M, and Lyne JM (1995). Collins and Lynes Microbiological Methods 7th edition. Grange, Butter Worth, Oxford.	
9.	Cappucino JG and Sherman N (1996). Microbiology, A Laboratory Manual 4th edition. Benjamin Cumings Inc. California.	
10.	Madigan MT, Martinko JM and Parker J (2012). Brock Biology of Microorganism, 11th edition Prentice Hall International Inc. London.	
Web Resources		
1.	https://vlab.amrita.edu/?sub=3&brch=73	
2.	https://learn.chm.msu.edu/vibl/	
3.	https://mvi-au.vlabs.ac.in/	
4.	https://virtuallab.tlc.ontariotechu.ca/intro.php	
5.	https://www.merlot.org/merlot/viewMaterial.htm?id=79694	

Methods of Evaluation		
Internal Evaluation	Continuous Internal Assessment Test Assignments Seminars Attendance and Class Participation	25 Marks
External Evaluation	End Semester Examination	75 Marks
Total		100 Marks
Methods 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	


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Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	Ext.	Total
TZOECH	ECONOMIC ZOOLOGY	SEC3	Y	-	-	-	2	2	25	75	100

Learning Objective

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

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

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

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

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

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

Unit V: Dairy Farming: Dairy farming – advantages of dairying – classification of breeds of cattle – Indigenous and exotic breeds – Selection of dairy cattle. Breeding – artificial insemination – Dairy cattle management – housing – water supply – cattle nutrition feeding standards – Common contagious diseases. Milk - Composition of milk – milk spoilage –

pasteurization – Role of milk and milk products in human nutrition – Dairying as a source of additional income and employment.

Text Books

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

Suggested Readings

1. Glenn Munroe, 2017. Manual of on-Farm vermicomposting and vermiculture, Holdanca Farms Ltd, Wallace, Nova Scotia.
2. Hanifa, M.A., 2011. Aquatic resources and aquaculture, Dominant, New Delhi.
3. Gupta, P.K., 2008. Vermicomposting for sustainable agriculture, 2nd Edition, Agrobios, India.
4. Talashikar, S.C., 2008. Earthworms in Agriculture, Agrobios, India.
5. Abishek Shukla, D. 2009. A Hand Book of Economic Entomology, Vedamse Books, New Delhi.
6. Banerjee, G.C., 2006. Text book of Animal Husbandry 8thEd.Oxford and IBH Publishing Company Ltd., New Delhi.

7. Walstra, P. Wouters, J.T.M. and Geurts, T.J. 2006. Dairy Science and Technology. CRC Press, New York.
8. Dunham, R.A., 2004. Aquaculture and Fisheries Biotechnology Genetic Approaches. CABI publications, U.K.
9. Donald.D Bell and William. D. Weaver, 2002. Commercial chicken meat and egg production, Springer, New York.
10. Eckles C.H. and Anthony, E.L., 2001. Dairy Cattle and milk production, Biotech. Tata McGraw Hill Publishing Co.Pvt.Ltd., New Delhi.
11. Edwards, C.A., and Bother, B., 1996. Biology of earthworms, Chapman Hall Publication company.
12. ICAR, 1997. Handbook of Animal Husbandary– The Indian Council of Agricultural Research, New Delhi.
13. Banerjee G.C., 1992. Poultry, Oxford and IBH, New Delhi.
14. Jhingran, AVG, 1991. Fish and Fisheries of India. Hindustan Publishing Co. New Delhi.
15. James. N. Marner, 1975. Principles of dairy processing, wiley eastern limited, New Delhi.
16. Baradach, JE. Ryther. JH. and, MC larney WO., 1972. Aquaculture. The farming and Husbandry of Freshwater and Marine Organisms. Wiley InterScience, NewYork.

Web Resources

1. <https://bit.ly/3tXHjk8>
2. <https://bit.ly/3tUTHBu>
3. <https://bit.ly/3hVv96q>
4. <https://bit.ly/39nztH1>

Course Outcomes (COs)

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



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Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	Ext.	Total
TZOECI	BIOINSTRUMENTATION	SEC3	Y	-	-	-	2	2	25	75	100

Course Objectives

1. To induce interest in the use of various biological instrumentation and employ them for the study of cells, tissues and genetic material.
2. To help students to map the use of specific bioinstrumentation for specific biological experiments and infer the results of such experiments.
3. To study the working principle of different bioinstrumentation and their applications.
4. To enable students to design experiments and justify them with the underlying principles of bioinstrumentation.

Unit I: Good Laboratory Practices: Guide lines, Laboratory symbols; Cleaning and sterilization of labware and reagents; handling and caring of laboratory animals; Laminar flow hood: types and use; Concepts of atomic weight, molecular weight, equivalent weight. Preparation of solutions: normal, molar and percentage solutions; pH meter; Safety and ethical issues in laboratory settings

Unit II: Microscopy: Light microscope, SEM, TEM, Atomic force microscope; Cryopreservation - principle and procedure; Fluorescence activated cell sorting; X-ray crystallography.

Unit III: Centrifugation: Types of centrifuges (Table top, microfuge, refrigerated centrifuge, ultracentrifuge). Spectrophotometer (UV-Visible, IR, AAS, Fluorescence photometer and NMR) Chromatography - principle and types of chromatography (Paper, TLC, Column Chromatography, Ion Exchange Chromatography, GCMS, HPLC)

Unit IV: Biomedical Instrumentation: ESR measurement, haemoglobin measurement, blood pressure, blood flow, ECG, cardiac pacemakers; X-ray imaging, CT scan and NMR imaging; Ultrasound imaging; medical applications of laser; Biosensors - glucose biosensor, alcohol biosensor, artificial retina, environmental biosensors, cantilever-based biosensors, DNA biosensor.

Unit V: Molecular Techniques: Isolation of DNA, RNA and proteins; Electrophoresis of DNA and proteins (AGE and PAGE); Polymerase Chain Reaction (PCR); ELISA; Immunofluorescence; Fluorescent *in situ* hybridization (FISH); Southern and Western blotting.

Text Books

1. SabariGhosal 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.

Suggested Readings

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.

Web Resources

1. <https://bit.ly/3i5flym>
2. <https://pbiol.rsb.org.uk>
3. <https://www.nature.com/subjects/biological-techniques>
4. <https://www.ibiology.org>

Course outcomes (COs)

1. To describe and explain the steps in the use of various biological instrumentation that are used in the study of different animal specimens.
2. To relate the applications of biological techniques and employ them for the study of cells, tissues and genetic material.
3. To correlate and appraise the use of specific bioinstrumentation for specific biological experiments and infer the results of such experiments.
4. To compare the working principle of different bioinstrumentation and to summarize their applications.
5. To devise experiments and justify them with the understanding of the underlying principles of bioinstrumentation that are ecofriendly, ethical and have national and global relevance.



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Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
TZOECH	AQUACULTURE	Core	Y	-	-	-	4	4	25	75	100
Learning Objectives											
To ensure active participation in activities connected with basic aquaculture practices.											

Unit-I

Scope and importance of aquaculture. Current status and trend for aquaculture in India and world. Basic Fish farm design and construction - basic introduction to culture techniques- modern approach of composite fish culture- Integrated fish farming

Unit-II

Water quality management. Fishfeed-formulation. Live feeds- addition of probiotic in formulated. Cultivable species of fishes, crustaceans, molluscs and algae.

Unit-III

Fish culture: Culture of Indian Major Carps-Catla, Rohu and Mrigal. Pearl Oyster culture. Crustacean Culture: Penaeu spp.

Unit-IV

Fish diseases and management: Common bacterial, viral, fungal, protozoan and crustacean diseases, their symptoms and control measures

Unit-V

Preservation techniques- Canning and Freezing. By products of fishes. Marketing the fish to local markets and for export. Quality control of processed fish and prawn, fish and prawn processing industries in India, Quality control and norms of MPEDA for export of fishes.

Text Book:

1. Reddy, S.M. 2004. A Text Book of Aquaculture. Discovery Publishing Pvt. Ltd. Pp 163.
- 2.

Reference Books:

1. Santhanam, R., N. Sugumaran and P. Natarajan. 1987. A manual of Freshwater aquaculture. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
2. Shanmugam, K. 1992. Fishery Biology and Aquaculture. Leo Pathipagam, Madras.
3. Jameson, J.D. and R. Santhanam. 1996. Manual of ornamental fisheries and farming technology. Fisheries College and Research Institute, Thoothukudi.

Web resources:

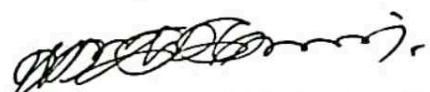
https://www.researchgate.net/profile/Arvind_Singh56/post/What-are-good-aquaculture-practices-GAPs-in-oxbow-lakes/attachment/59d64d6f79197b80779a6ff8/AS%3A488132433977345%401493391249892/download/2.pdf

<https://www.notesonzooology.com/india/aquaculture/aquaculture-characters-types-and-qualities/657>

Course outcomes:

CO No	CO-Statement	Cognitive Level (K)
<i>On successful completion of this course, students will be able to</i>		
CO1	describe and demonstrate current status of aquaculture in India and abroad	K1, K2
CO2	organize fish nutrition and feed formulation	K3
CO3	illustrate different aquaculture systems	K3
CO4	examine fish diseases and other management strategies	K4
CO5	appraise marketing and preservation techniques of fishes	K5


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Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
T3ZOSE4	APICULTURE	SEC	Y	-	-	-	1	1	25	75	100
Learning Objectives											
CO1	To understand economic importance of honey bees and developments taking place in modern beekeeping.										
CO2	To become familiar with different species and sub-species of honey bees found in the world and know their economic importance and familiar with different body parts of honey bees and their modifications as per their food habit and social life										
CO3	To become familiar with important bee diseases, enemies and their management.										
CO4	To become familiar with different equipment used in modern beekeeping for domesticating hive bees										
CO5	To know the process of honey and bee hive products and their uses										
UNIT	Details							No. of Hours	Course Objectives		
I	Introduction to Apiculture - scope, importance. History of beekeeping: Definition, Beekeeping worldwide and In India. Traditional beekeeping, Modern beekeeping, Urban or backyard beekeeping. Role of Central Honey Bee Research & Training Institute. Indian Bee Board. Honey Mission							6	CO1		
II	Honey Bee morphology, Anatomy and Life cycle Basic concepts of morphology of Honey bees. Types of honey bees- indigenous, exotic, Species of honey bees. Origin, systematics and distribution of honey bees. Social organization in honey bees: Colony life and social organization – Queen, drone, worker.							6			
III	Honeybee Enemies and Diseases. Bee enemies – Enemy: Mites, Wax Moths, Ants, Bee Eaters, Garden Lizards, Bears. Disease management-Identification of symptoms of Nosema. Sac brood Virus, Thai sac brood virus, American foul brood, and European foul brood diseases. Preventive and control measures of the diseases, Vit B supplementation, Management of Dehydration							6			
IV	Beekeeping: Tools and Equipment. Basic requirements for beekeeping start up. Introduction to types of bee boxes and their parts. Management of an apiary							6			
V	Honey Processing and Bee Hive Products: Honey - its properties and application in various fields Honey extraction & handling - Quality control standards, Processing of honey. Other valuable by-products of honey bees – Wax, Bee venom & Royal jelly extraction.							6			
Text Books (Latest Editions)											
I.	2018. M. Tamil Selvi and Abdul Jaffar Ali. A textbook of Apiculture. ISBN										

	9789394681682	
2.	Textbook of Apiculture (Beekeeping). Dr. D.K. Belsare, Dr. Rakesh Kumar Singh, Dr. Shashikala D. Belsare, Ravi H. Deshmuk. Himalaya Publishing House. Pp 304.	
3.	Sartaj Ahmad Allayie, Junaid Ahmad Malik, Gowhar Rashid. 2022. Apiculture Skill Enhancement Course. World BIOLOGICA (India & USA). Pp 118.	
References Books (Latest editions, and the style as given below must be strictly adhered to)		
1.	Apiculture. www.agrimoon.com	
2.	Honey Bee Biology and Beekeeping. DM Caron and L. J. Coonor.	
3.	R. Sharma, R.K. Kumar and P. Vaijinath. 2023. The Beekeeper's Handbook: A Comprehensive Guide to Apiculture. SHINEEKS Publishers, USA	
Web Resources		
1.	https://abfnet.org/resources-for-beekeepers/	
2.	https://www.perfectbee.com/beekeeping-articles/a-new-beekeepers-journal/educational-resources-for-new-beekeepers	
3.	https://oravalleyhoney.com.au/online-beekeeping-resources/	
Methods of Evaluation		
Internal Evaluation	Seminars Attendance and Class Participation	25 Marks
	Continuous Internal	
	Assessment Test Assignments	
External Evaluation	End Semester Examination	75 Marks
Total		100 Marks
Methods 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	

Mapping with Programme Outcomes:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO 1	S							
CO 2	M	S						
CO 3				S		S		
CO 4				S	S	M		
CO 5			S					S

S-Strong (3) M-Medium (2) L-Low (1)


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Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
TZOECK	BASIC COURSE IN ORNITHOLOGY	SEC	Y	-	-	-	1	1	25	75	100
Learning Objectives											
CO1	to equip students with the required knowledge to understand the taxonomic position and role played by birds in the ecosystem, their importance to humans and their evolution										
CO2	to enable students to comprehend the biological evolution of birds and their structural adaptations										
CO3	To enable students to understand and learn aspects of bird behaviour										
CO4	To enable students to learn about the breeding biology of birds										
CO5	To equip students with a knowledge of macroecology of birds, bird populations and communities, bird diseases, bird conservation and on the role of citizen science in ornithology.										
UNIT	Details							No. of Hours	Course Objectives		
I	Introduction to Ornithology; Bird Lore; Birds and Humans; Classification of Birds, Bird Evolution and Speciation; Endemism							3			
II	External Morphology of the Bird; Structure of bird feather, Internal Structure of the Bird; Adaptations to Flight							3			
III	Bird Behaviour: Foraging, Roosting, Vocalization, Imprinting, Feather care, Bird Intelligence, Social Behaviour, Mixed Species Flocks, Migration							3			
IV	Breeding Biology: Differential investment of sexes; territoriality, courtship and display behaviour, nesting, eggs, incubation and care of young, brood parasitism							3			
V	Studying bird populations and communities, sampling methods; Macro ecology; Molecular Techniques in Ornithology; Avian Disease; Citizen Science and Ornithology; Threats faced by birds; Bird Conservation with case studies							3			

COURSE LEARNING OUTCOME

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

- Recall the taxonomic position of birds, their external morphology and internal parts, types of bird behaviour, sampling methods and types of avian diseases.
- Identify the external parts of the bird, internal structures of the bird and different types of bird behaviour
- Differentiate birds based on their morphology, foraging strategies and other behaviour
- Explain and discuss how birds evolved, bird adaptations to flight, different aspects of


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- bird behaviour, threats to birds and the role of citizen science in ornithology
- Discuss and analyse case studies relating to bird conservation

BOOKS FOR REFERENCE

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.



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Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
TZOECL	BIOPHYSICS AND BIOSTATISTICS	SEC	Y	-	-	-	1	1	25	75	100
Learning Objectives											
CO1	To understand the concepts of diffusion, osmosis, centrifugal force, surface tension										
CO2	To understand the techniques for the separation of biomolecules										
CO3	To understand radiology, sonography, Laser techniques for biological and medical application										
CO4	To study different types of data collection methods and classification of data										
CO5	To know to calculate standard deviation, correlation coefficient, chi-square analysis and student 't' test using the formula										
UNIT	Details							No. of Hours	Course Objectives		
I	Biophysical Principles: Physical laws in living system: diffusion–Factors affecting diffusion- types of diffusion – Fick's law – Biological significance of diffusion– Osmosis–Osmotic pressure (endocytosis, pinocytosis, phagocytosis, exocytosis plasmolysis and haemolysis) Principles of viscosity–Brownian movement–surface tension–turgor pressure–Centrifugation: Principle–types–applications							18			
II	Applications of Biophysics: Principle and applications of colorimeter – electrophoresis –principle, instrumentation – applications of gel electrophoresis. Radioactivity: Types of radioactive decay – Radioactive isotopes – Autoradiography – biological impacts – Geiger-Muller counter: Principle – working procedure – advantages and disadvantages. Medical and biological uses of X-rays, Ultrasound and Laser							18			
III	Collection and Classification of Data: Introduction to biostatistics: Definition – characteristics, importance and applications of biostatistics. Collection of data: Primary – secondary data. Statistical population and sampling in biological studies. Types of Classification: Qualitative – quantitative. Variables: discrete – continuous. Frequency distributions.							18			
IV	Presentation of Data: Tabulation: Types – Components – advantages. Diagrammatic and graphical representations of data: Bar diagrams (Simple, multiple, subdivided and percentage) – Pie diagram – Frequency diagram: histograms – frequency polygon – frequency curve – line graphs							18			

V	Descriptive & Inferential Statistics: Measure of central tendency: Arithmetic mean – median– mode. Measures of dispersion: Standard deviation – Standard error– Coefficient of variance. Test of significance: Chi-square test for goodness of fit – Student ‘t’ test.	18	
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Text Books

1. Das, D. 1996. Biophysics and Biophysical Chemistry for Medical and Biology students, Academic, Calcutta. 302pp.
2. Subramanian, M.A. 2016. Biophysics–Principles and Techniques, MJP, Chennai. 324pp.
3. Gurumani, N. 2005. An introduction to Biostatistics, MJP, Chennai, 250pp.
4. Palanichamy, Sand M. Shanmugavelu. 1991. Principles of Biostatistics. Palani Paramount. India. 350pp
5. Roy, R.N. 1996. A Text Book of Biophysics, New Central Book Agency Ltd, Calcutta. 992pp.

Suggested Readings

1. Antonisamy, B., Solomon Christopher and P. Prasanna Samuel, 2011. Biostatistics: Principles and practices. Mac Graw Hill Education Pvt. Ltd. New Delhi. 349pp.
2. Betty Karasek. 2015. Advanced concepts of biophysics, Callistro Reference, 198pp.
3. Daniel, W.W. 2000. Biostatistics: A foundation for analysis in the health sciences, 7th Ed. John Wiley & Sons Ltd. New York. 328pp.
4. Edward, K. Yeagers. 2018. Basic Biophysics for Biology, CRC Press, USA. 195pp
5. Gurumani, N., 2006. Research methodology for biological sciences, MJP, Chennai. 753pp.
6. Harvey Motulsky, 2015. Essentials of Biostatistics. A non-mathematical approach. Oxford University Press. New York. 208pp.
7. Michael C., Whitlock and Dolph Schluter. 2009. The analysis of biological data, 2nd Ed. Mac Millan Publishers, New York, USA. 818pp.
8. Narayanan, R. 2010. Essentials of biophysics, II Ed., New age International publishers, Chennai. 546pp.
9. Pranab Kumar Banerjee, 2014. Introduction to biostatistics (A Text Book of Biometry, S. Chand & Company Ltd. New Delhi, India. 208pp.
10. Rodney M.J, Cotterill, 2002. Biophysics: An introduction, John Wiley & Sons Ltd. New York. 400pp.
11. Ronser, B. 2006. Fundamentals of Biostatistics, Thomson Brooks/Cole, 6th Ed. Duxbury Press, Singapore. 784pp
12. Sail Bose, 2000, Elementary Biophysics, Vijaya Printers, Madurai.
13. Tanford, C. 1961. Physical chemistry of macromolecules, John Wiley & Sons Ltd. England. 710pp.
14. Yadav, B.S. 2020. Text book of biophysics, Arjun Publishing House, New Delhi.

Web Resources:

1. <https://bit.ly/2XGFuML>
2. <http://www.life.uiuc.edu/molbio/geldigest/electro.html>
3. http://users.stat.ufl.edu/~winner/sta6934/st4170_int.pdf
4. <http://www.biostathandbook.com/analysissteps.html>
5. <https://bit.ly/3nXUlrD>
6. https://onlinecourses.nptel.ac.in/noc19_bt19

Course outcomes (COs)

1. Understand and recall the basic biophysical concepts, statistical data and formula.
2. Apply suitable physical techniques and statistical methods to solve biological problems.
3. Identify and relate the bioanalytical techniques and statistical principles for the application of biological experiments.
4. Select suitable biophysical techniques to study the biological process and statistical approach to assess the experimental results.
5. Integrate the bioanalytical techniques and statistical methods to validate research investigations.


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(For the candidates admitted from 2023 – 2024 onwards)

Course	PCS	Semester - VI	Course Code: T6PCS
Course Title	PROFESSIONAL COMPETENCY SKILL		
Credits	2	Instruction Hours - 2	Medium: English and Tamil
Course Objectives	To develop the personality development and to improve the skills needed for the employment opportunities		

UNITS	Course Details
Unit I	KNOW YOURSELF: Knowing yourself-Positive Thinking-Physical Fitness-Emotional Intelligence-Skills to develop emotional intelligence
Unit II	RESUME WRITING: Resume writing-purpose of a resume-How long should my resume job? Types of Resumes-Chronological Resume, Functional Resume, Combination Resume, Infographic Resume, resume with profile, Targeted Resume, mini-Resume, Non-traditional Resume-Things to do-Formats of Resume-Job Application or covering letter
Unit III	GROUP DISCUSSION: Introduction-Types of Group Discussions-Difference between group discussion and panel discussion debate-personality traits-Advantages of Group discussion-Dos and Don'ts
Unit IV	INTERVIEW SKILLS: Introduction-Types of interviews-Preparatory steps for job interview-Interview skills-punctuality-Think before you speak-clarity-being confident-Listening-Expressing optimism-Body Language-Showing Interest-Communication Skills-Expressing gratitude.
Unit V	PROFESSIONAL SKILLS: Creativity at work place-Ethical Values-Capacity building, developing interpersonal relationship-Leadership and team building-Decision Making-Stress and Time management
(SELF STUDY)	PROFESSIONAL COMPONENTS: Expert Lectures, Online Seminars - Webinars on Industrial Interactions/Visits, Competitive Examinations, Employable and Communication Skill Enhancement, Social Accountability and Patriotism
Text Books	1) ICTACT – Soft skills and Industry awareness – Tamil Nadu state council for Higher Education, Department of Higher Education – ICT Academy of Tamil Nadu, Chennai. 2) Soft Skills: An integrated approach to maximize personality, Gajendra Chauhan, Sangeetha Sharma, Wiley India.

COURSE OUTCOMES:

At the end of the course, the student will be able to:

CO1	Acquire the knowledge about the personality development.	K2
CO2	Gain the knowledge about various types of resumes and resume writing.	K2
CO3	Able to face the first step of interview on gaining the group discussion skills	K3
CO4	Acquire interview skills and understand about body language.	K4
CO5	Gain the professional skills for employability and leadership.	K3
K1 - Remember; K2 – Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate;		

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	2	2	2	2	2	3	3	3	3	2
CO2	2	3	2	2	3	3	2	3	2	2
CO3	3	2	3	3	3	2	3	2	3	2
CO4	3	2	3	3	2	3	3	3	3	2
CO5	2	2	2	2	3	3	2	2	2	2

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10
CO1	3	2	3	3	2	3	3	3	3	2
CO2	3	2	3	3	3	2	3	2	3	2
CO3	2	2	2	2	2	3	3	3	3	2
CO4	2	3	2	2	3	3	2	3	2	2
CO5	2	2	2	2	3	3	2	2	2	2

Question Paper Pattern

Maximum Marks: 75 Marks

Exam Duration: 3 Hrs

Part-A 5x6=30 Marks

Answer ALL Questions

(Either or Type-Two questions from each unit)

Part-B 3x15=45 Marks

Answer Any Three Questions

(Three out of Five-one question from each unit)


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ELECTIVE FOR CHEMISTRY SEMESTER – I

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
T1GZ1	Genera Zoology I	EC	Y	-	-	-	4	4	25	75	100

Learning Objectives			
CO1	To acquire a basic knowledge of diversity and organization of Protozoa, Coelenterata, Helminthes and Annelida		
CO2	To acquire a basic knowledge of diversity and organization of Arthropoda, Mollusca and Echinodermata		
CO3	To comprehend the taxonomic position and diversity among Protochordata, Pisces and Amphibia		
CO4	To comprehend the taxonomic position and diversity among Reptilia, Aves and Mammalia		
CO5	To acquire detailed knowledge of select invertebrate and chordate forms		
UNIT	Details	No. of Hours	CO
I	Diversity of Invertebrates I: Principles of taxonomy. Criteria for classification–Symmetry and Coelom–Binomial nomenclature. Classification of Protozoa, Coelenterata, Helminthes and Annelida up to classes with two examples.	12	CO1
II	Diversity of Invertebrates II: Classification of Arthropoda, Mollusca and Echinodermata up to class level with examples.	12	CO2
III	Diversity of Chordates I: Classification of Prochordata, Pisces and Amphibia up to orders giving two examples	12	CO3
IV	Diversity of Chordates II: Classification of Reptilia, Aves and Mammalia upto orders giving two examples.	12	CO4
V	Animal organization: Structure and organization of Earthworm, Rabbit/Rat, Prawn/Fish	12	CO5
	Total	60	
Course Outcomes			
Course Outcomes	On completion of this course, students will;		
CO1	Recall the characteristic features invertebrates and chordates.	PO1	
CO2	Classify invertebrates up to class level and chordates up to order level	PO1 PO2	
CO3	Explain and discuss the structural and functional organisation of some invertebrates and chordates	PO4 PO6	
CO4	Relate the adaptations and habits of animals to their habitat	PO4 PO5 PO6	
CO5	Analyse the taxonomic position of animals.	PO3	

		PO8
Text Books		
1.	Ekambaranatha Iyer, -Outlines of Zoology. Viswanathan Publication	
References Books (Latest editions, and the style as given below must be strictly adhered to)		
1.	Ekambaranatha Iyar and T. N. Anandakrishnan. 2019. Manual of Zoology Volume 1 Part 1 Invertebrata. Viswanathan Publishers.	
2.	Ekambaranatha Iyar and T. N. Anandakrishnan. 2019. Manual of Zoology Volume 1 Part 2 Invertebrata. Viswanathan Publishers.	
3.	Ekambaranatha Iyar and T.N. Ananthakrishnan. 2019. Manual Of Zoology Volume 2 Part 2 Chordata. Viswanathan Publishers.	
4.	Jordan E.L. and P.S. Verma. 2019. Invertebrate Zoology, S. Chand & Co. Pp1148	
Web Resources		
1.	www.sanctuaryasia.com	
2.	www.iaszoology.com	
Methods of Evaluation		
Internal Evaluation	Continuous Internal Assessment Test	25 Marks
	Assignments	
	Seminars	
	Attendance and Class Participation	
External Evaluation	End Semester Examination	75 Marks
Total		100 Marks
Methods 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	

Mapping with Programme Outcomes:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO 1	S							
CO 2	M	S						
CO 3				S		S		
CO 4				S	S	M		
CO 5			S					S

S-Strong (3)

M-Medium (2)

L-Low (1)

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SEMESTER – II

Course Code	Course Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
T1GZ2	General Zoology II	EC	Y	-	-	-	4	4	25	75	100

Learning Objectives			
CO1	To enable students to learn basic concepts relating to aspects of respiratory, circulatory, excretory nervous and sensory physiology.		
CO2	To enable students to comprehend the processes involved during development		
CO3	To enable students to learn basic concepts of immunity and the working of immune organs and familiarize them with the recommended vaccination schedule		
CO4	To enable students to comprehend the basic concepts of human genetics and patterns of inheritance		
CO5	To enable students to learn about aspects of animal behaviour such as foraging, courtship, nest construction, parental care and learning		
UNIT	Details	No. of Hours	CO
I	Respiration-Respiratory pigments and transport of gases. Mechanism of blood clotting. Types of excretory products–Ornithine cycle. Structure of neuron–Conduction of nerve impulse, Mechanism of vision and hearing.	12	CO1
II	Fertilization, cleavage, Gastrulation and Organogenesis of Frog; Placentation in mammals	12	CO2
III	Immunity: Innate and Acquired - Active and Passive; Antigens and Antibodies. Immunological organs: responses in humans; Vaccination schedule	12	CO3
IV	Human Genetics: Human Chromosomes – Sex Determination in Humans; Patterns of Inheritance: Autosomal Dominant, Autosomal Recessive, X-linked, Y-linked, Mitochondrial, Multiple Allelic and Polygenic; Genetic Counselling	12	CO4
V	Animal Behaviour: Foraging, Courtship Behaviour, Shelter and Nest Construction, Parental Care, Learning Behaviour	12	CO5
Total		60	
Course Outcomes			
Course Outcomes	On completion of this course, students will;		
CO1	Recall the parts and working of body organs and developmental stages, name the patterns of inheritance and list different types of animal behaviour	PO1	
CO2	Analyse the different developmental stages	PO1, PO2	
CO3	Analyse the working of body and immune systems	PO4, PO6	
CO4	Analyse the different patterns of inheritance	PO4, PO5, PO6	

CO5	Relate the behaviour of animals to physiology. Analyse the different types of behaviour	PO3, PO8
Text Books (Latest Editions)		
1.	Verma P.S. & Agarwal - Developmental Biology, Chordata embryology S. Chand & Co.	
References Books (Latest editions, and the style as given below must be strictly adhered to)		
1.	Owen, J. A., Punt, J. & Stranford, S. A. - Kuby Immunology. New York: W.H. Freeman & Company	
2.	Klug, W. S., Cummings, M. R. & Spencer, C - Concepts of Genetics. (12th ed.). New Jersey: Pearson Education	
3.	Mathur, R.- Animal Behaviour. Meerut: Rastogi.	
4.	Verma P.S. & Agarwal- Developmental Biology, Chordata embryology S. Chand & Co.	
Web Resources		
1.	Continuous Internal Assessment Test	
2.	Assignments	
3.	Seminars	
4.	Attendance and Class Participation	
5.	End Semester Examination	
Methods of Evaluation		
Internal Evaluation	Continuous Internal Assessment Test	25 Marks
	Simple definitions, MCQ, Recall steps, Concept definitions	
	MCQ, True/False, Short essays, Concept explanations, short summary or overview	
	Suggest idea/concept with examples, suggest formulae, solve problems, Observe, Explain	
External Evaluation	Problem-solving questions, finish a procedure in many steps, Differentiate between various ideas, Map knowledge	75 Marks
	Longer essay/ Evaluation essay, Critique or justify with pros and cons	100 Marks

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CO 1	S							
CO 2	M	S						
CO 3				S		S		
CO 4				S	S	M		
CO 5			S					S

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ZOOLOGY PRACTICAL (for students admitted from the academic year 2022-2023)						
Credit	3	Hours/Week	2	Sub Code	T2GZ3	Semester II
Medium of Instruction: English/Tamil					EC 3	

Course Outcomes:

CO	CO-Statement	Cognitive Level (K Level)
On successful completion of this course, students will be able to:		
CO1	Learn practical knowledge of certain selected functional systems on invertebrates and chordates and physiological changes	K1
CO2	Gain experience on standard mounting procedures of harmful and	K2
CO3	Familiarize and acquire basic knowledge on entire morphology of various invertebrate and chordate animals of the given (syllabus)families.	K3

Major Practical: Dissections:

Earthworm: Digestive system and Nervous system.

Cockroach: Digestive system and Nervous system

Frog: Pro-dissector software

Demonstration

Determination of Haemoglobin

Identification of blood grouping

Minor Practical:

Earthworm: Body setae, Penial setae.

Honey bee: Mouth Parts

Shark: Placoid scale.

Determination of pH

Red blood cell smear preparation

Spotters:**Invertabrates:**

Entamoeba, Euglena, Sponges, Obelia colony, Aurelia entire, Fasciola hepatica (WM), Taenia solium- entire and scolex, Ascaris - male and female, Scorpion, Leech, Freshwater mussel, Starfish,

Interlinks: Amphioxus, Balanoglossus, Ascidian**Chordates:** Sucker fish, Frog, Calotes, snakes, Rat and bat.**Physiology:** Nerve cell, connective tissue, eye, nephron, RBC and WBC**Embryology:** sperm cell, ovum cell, Frog 1st stage cleavage, blastula, Gastrula**Immunology:**

Primary Lymphoid organ (bone marrow, thymus), secondary lymphoid organs (spleen, tonsil, appendix)

Genetics:

Human karyotype

Field visit:

Aquaculture, Ornamental and Poultry farm, Vermiculture Places

Mapping with Programme Outcomes:

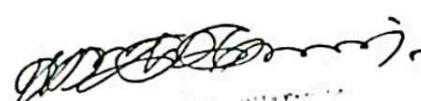
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO 1	S							
CO 2	M	S						
CO 3				S		S		
CO 4				S	S	M		
CO 5			S					S

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