

RAJAH SERFOJI GOVERNMENT COLLEGE (Autonomous) THANJAVUR 613005

July 2026

LEARNING OUTCOMES-BASED CURRICULUM FRAMEWORK GUIDELINES BASED REGULATIONS FOR UNDER GRADUATE PROGRAMME	
Programme:	B.Sc. Zoology
Programme Code:	BZOE1/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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RAJAH SERFOJI GOVT COLLEGE (Autonomous), THANJAVUR-5
COURSE STRUCTURE FOR UNDER GRADUATE SCIENCE
 (Applicable to the Candidates admitted from the academic year 2026-2027 onwards)
B.Sc. ZOOLOGY

PART	CODE	COURSE	TITLE	HRS	MARKS		TOTAL	CREDIT
			I SEMESTER		IA	WE		
I	B1T1	LT	Tamil	6	30	70	100	3
II	B1E1	LE	English	6	30	70	100	3
III	B1ZO1	CC1	Invertebrata	6	30	70	100	5
III	B1ZO2P	CC2	Laboratory Course I	3	40	60	100	3
III	B1ACH1	Allied 1	Chemistry I	4	30	70	100	4
III	B2ACHP	Allied 2	Chemistry Practical	3	40	60	-	-
IV	B1VE	VE	Value Education	2	30	70	100	2
			TOTAL	30			600	20
II SEMESTER								
I	B2T2	LT	Tamil	6	30	70	100	3
II	B2E2	LE	English	6	30	70	100	3
III	B2ZO3	CC3	Chordata	6	30	70	100	5
III	B2ZO4P	CC4	Laboratory Course II	3	40	60	100	3
III	B2ACHP	Allied 2	Chemistry Laboratory Course	3	40	60	100	4
III	B2ACH3	Allied 3	Chemistry II	4	30	70	100	4
IV	B2ES	ES	Environmental Studies	2	30	70	100	2
			TOTAL	30			700	24
III SEMESTER								
I	B3T3	LT	Tamil	6	30	70	100	3
II	B3E3	LE	English	6	30	70	100	3
III	B3ZO5	CC5	Cell Biology	6	30	70	100	5

III	B3ZO6P	CC6	Laboratory Course III	3	40	60	100	3
III	B3ABO1	Allied 4	Botany I	4	30	70	100	4
III	B4ABOP	Allied 5	Botany II: Laboratory Course	3	-	-	-	-
IV	B3ZOSE1	SEC1	Skill Enhancement course-I	2	30	70	100	2
IV	BSHW	HW	Health and Wellness	-	-	-	-	1
IV		NCC-1	Introduction to NCC (for NCC Students only)	2			100	2
			TOTAL	30			600	21
IV SEMESTER								
I	B4T4	LT	Tamil	6	30	70	100	3
II	B4E4	LE	English	6	30	70	100	3
III	B4ZO7	CC7	Ecology	6	30	70	100	5
III	B4ZO8P	CC8	Laboratory Course IV	3	40	60	100	3
III	B4ABOP	Allied 5	Botany II: Laboratory Course	3	40	60	100	4
III	B4ABO2	Allied 6	Botany III	4	30	70	100	4
IV	B4ZOSE2	SEC2	Skill Enhancement course-II	2	30	70	100	2
IV		NCC-2	Specialized Subjects-ARMY (for NCC Students Only)	2			100	2
			TOTAL	30			700	24
V SEMESTER								
III	B5ZO9	CC9	Genetics	5	30	70	100	5
III	B5ZO10	CC10	Animal Physiology	5	30	70	100	5
III	B5ZO11	CC11	Developmental Biology	5	30	70	100	4
III	B5ZO12P	CC12	Laboratory Course V	5	40	60	100	4
III		EC1	Will be Chosen from the List of Electives by the students	5	30	70	100	4
IV		NMEC1	Will be Chosen from the List of Electives by the students	3	30	70	100	2
IV	B5ZOSE3	SEC3	Skill Enhancement course - III	2	30	70	100	2

IV	BSDM	DM	Disaster Management	-	-	-	-	2
IV		Internship	Internship	-	-	-	-	2
TOTAL				30			700	30
VI SEMESTER								
III	B6ZO13	CC13	Evolutionary Biology	6	30	70	100	5
III	B6ZO14	CC14	Biostatistics and Computer Applications	6	30	70	100	5
III	B6ZO15P	CC15	Laboratory Course VI	6	40	60	100	4
III		EC2	Will be Chosen from the List of Electives by the students	5	30	70	100	4
III		NMEC1	Will be Chosen from the List of non-major electives	3	30	70	100	2
IV	B6ZOSE4	SEC4	Skill Enhancement course - IV	2	30	70	100	2
IV	B6GS	GS	Gender Studies	2	30	70	100	2
V		EXT. ACTIVITIES	EXTRA CURRICULAR ACTIVITIES	-	-	-	-	1
TOTAL				30			700	25
GRAND TOTAL							4000	144

PART-I	TAMIL	4x3	12	12	400	
PART-II	ENGLISH	4x3	12	12	400	
PART-III	CORE	8x5=40; 3x4=12; 4x3=12	64	96	1500	
	ELECTIVE	2x4	8		300	
	ALLIED	6x4	24		600	
PART - IV	NON-MAJOR	2X2	4	23	100	
	ES, VE	2X2	4		200	
	SKILL BASED	4X2	8		400	
	GS	1x2	2		100	
	DM		2			
	Internship		2			
	HW		1			
PART - V	EXT. ACTIVITIES		1	1		
TOTAL PAPERS		40	TOTAL CREDIT	144	144	4000

Elective Courses

Sl. No	Course Title
01	BIOTECHNOLOGY
02	ANIMAL BEHAVIOUR
03	HUMAN REPRODUCTIVE BIOLOGY
04	BASICS OF MARINE BIOLOGY
05	AGRICULTURAL ENTOMOLOGY
06	MICROBIOLOGY

Skill Enhancement Courses

Sl. No	Course Title
01	AQUACULTURE
02	ENVIRONMENTAL IMPACT ANALYSIS
03	APICULTURE
04	WILDLIFE CONSERVATION AND MANAGEMENT
05	SERICULTURE
06	AQUARIUM KEEPING
07	POULTRY FARMING
08	MEDICAL LABORATORY TECHNIQUES

Non-Major Elective Courses

Code	Course Title
B6ZEL1	Commercial Zoology
B6ZEL2	Public Health and Hygiene

B1ZO1		CC1: INVERTEBRATA				
Credit		5		Teaching Hours		6/Week
Marks	CIA	30	Ext	70	Total	100
Learning Objectives						
LO1	To understand the basic concepts of lower animals and observe the structure and functions.					
LO2	To illustrate and examine the systemic and functional morphology of various groups of animal modes of life and to estimate the biodiversity.					
LO3	To compare and distinguish the general characteristics of reproduction in lower animals and parasitic adaptations in invertebrates.					
LO4	To infer and integrate the structures and distinct features of invertebrate phyla.					
LO5	To understand and distinguish the characteristic features of phylum and economic importance of invertebrate animals					
UNIT	Details				No. of Hours	Course Objectives
I	Invertebrate Taxonomy: Principles and outline classification of Invertebrates. Protozoa: General characters and classification up to classes with examples. Type study: <i>Paramecium</i> -external features, nutrition, locomotion and reproduction. General Topics (GT): Protozoan Parasites, 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. GT: Canal system in sponges. Coelenterata: General characters and classification up to classes with examples - Type study: <i>Obelia</i> -Structure of polyp, medusa and life history of Obelia. GT: Corals and Coral reefs and its importance.				15	CO2
III	Platyhelminthes: General characters and classification up to classes with examples. Type Study: <i>Taenia solium</i> (Tape worm) - external structure, excretion, reproduction and life cycle. GT: Parasitic adaptations of Liver fluke. Aschelminthes: General characters and classification up to classes with examples - Type Study: <i>Ascaris lumbricoides</i> : External structure, Digestive system, Reproductive system and Life cycle. GT: Parasitic adaptations in nematodes.				15	CO3
IV	Annelida: General characters and classification up to classes with examples. Type study: <i>Earthworm</i> -external structure, digestive system, nervous system, reproductive system. GT: Adaptive radiation in Annelida. Arthropoda: General characters and classification up to classes with examples. Type Study: <i>Cockroach</i> -external structure, respiratory system, digestive system, circulatory system, reproductive system. GT: 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. GT: 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. GT: Larval forms of Echinoderms	15	CO5
Total		75	
Course Outcomes			
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			
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 Function. II Edition, E.L.B.S. and Nelson		
Web Resources			
https://www.nationalgeographic.com/animals/invertebrates/			
https://bit.ly/3kABzKa			
https://www.nio.org/			
https://greatbarrierreef.org/			
Methods of Evaluation			
Internal Evaluation	Continuous Internal Assessment Test		30 Marks
	Assignments, Field and Industrial Visits, Specimen Collection		
	Seminars		
	Attendance and Class Participation		

External Evaluation	End Semester Examination	70 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)

B1ZO2P		CC2: Laboratory Course: INVERTEBRATA				
Credit		3		Teaching Hours		3/Week
Marks	CIA	40	Ext	60	Total	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 gain knowledge about the different modes of life and their adaptations to the environment.					
CO4	Able to dissect and display the internal organs and mount the mouthparts of invertebrates.					
UNIT	Details				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, Taenia solium -scolex, Taenia solium -proglottid. v). Nematelminthes: Ascaris lumbricoides (Male & Female), Dracunculus medinensis, Ancylostoma duodenale, Wuchereria bancrofti				9	CO5

	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.		
	Field and Lab visit to study specimen of different phylum		
	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			
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	40 Marks
	Assignments	
	Observation, Record, Model	
	Attendance and Class Participation	
External Evaluation	End Semester Examination	60 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)

B2ZO3		CC3: CHORDATA					
Credit		5		Teaching Hours		6/Week	
Marks	CIA	30	Ext	70	Total	100	
Learning Objectives							
LO1	To understand the structures and distinct features of Phylum Chordata.						
LO2	To understand and distinguish the characteristic features of each subphylum and class.						
LO3	To understand the economic importance of vertebrates						
LO4	To know the adaptations of vertebrates						
LO5	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 and classification 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>).				18	CO1 CO2	
II	Pisces: General characters and classification up to order. Type study: <i>Scoliodon sorrakowah</i> (external features, digestive, respiratory, blood vascular, reproductive systems) GT: 1) Types of scales and fins 2) Accessory respiratory organs 3) Migration of fishes				18	CO1 CO2 CO4 CO5	
III	Amphibia: General characters and classification up to orders with examples. Type study - <i>Rana hexadactyla</i> (external features, digestive, respiratory, blood vascular, nervous, reproductive systems). GT: Adaptive features of Anura, Urodela and Apoda. Parental care in Amphibia.				18	CO1 CO2 CO3 CO4, CO5	
IV	Reptilia: General characters and classification up to orders with examples. Type study – <i>Calotes versicolor</i> (external features, digestive, respiratory, blood vascular, reproductive systems). GT: Origin of reptiles and effects of terrestrialisation. Poisonous and non-poisonous snakes. Poison apparatus and biting mechanism of poisonous snakes. Evolution and adaptive radiation in reptiles.				18	CO1 CO2 CO4 CO5	
V	Aves and Mammalia: Aves: General characters and classification up to orders with suitable examples. Type study: <i>Columba livia</i> (external features, digestive, respiratory, circulatory, excretory and reproductive systems). GT: Origin of birds, Flight adaptations, Migration. Mammalia: General characters and classification. Type study: Rabbit (external features, digestive, respiratory, circulatory, excretory, reproductive systems). GT: Adaptive radiation in mammals. Dentition in Mammals				18	CO1 CO2 CO4 CO5	
	Total				90		

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		
1.	Darlington P. J. 2017. The Geographical Distribution of Animals, R.E. Krieger Pub. Co. ISBN-13 : 978-9383420957 pp687	
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. 1065pp	
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.	
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	30 Marks
	Assignments	

	Seminars	
	Attendance and Class Participation	
External Evaluation	End Semester Examination	70 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	

- **Field visit to ecologically important 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	S	S	S		S
CO 4			S	S	S	M		
CO 5			S		S			S

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

B2ZO4P		CC4: Laboratory Course- CHORDATA					
Credit		3		Teaching Hours		3/Week	
Marks	CIA	40	Ext	60	Total	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						
CO5	Have a knowledge on field identification of chordates						
UNIT	Details				No. of Hours	Course Objectives	
I	Dissections: Frog (virtual)/Fish: External features, Digestive system, Arterial system, Venous system, 5 th 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, Pelvic girdle, Forelimb, Hindlimb. Chelonia-Anapsid skull, Pigeon - skull and lower jaw, synsacrum.				12	CO3	
IV	Specimen and Slides: i) Hemichordata: Balanoglossus, Tornaria larva ii). Protochordata: Amphioxus, Amphioxus T.S. through pharynx iii). Cyclostomata: Petromyzon, Myxine, Ammocoetus larva iv). Pisces: Sphyrna Pristis, Torpedo, Channa, Pleuronectes, Hippocampus, Exocoetus, Echieneis, Labeo, Catla, Clarius, Anguilla, Protopterus, Scales: Placoid, Cycloid, Ctenoid v). Amphibia: Ichthyophis, Amblystoma, Siren, Hyla, Rachophous, Bufo, Rana, Axolotl larva vi). Reptilia: Draco, Chameleon, Gecko, Uromastix, Vipera russelli, Naja, Bungarus, Enhydrina, Typhlops, Testudo, Trionyx, Crocodilus, Ptyas.				12	CO4	
V	vii). Aves: Archaeopteryx, Passer, Psittacula, Bubo, Alcedo, Columba, Corvus, Pavo; 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> , Hedgehog				12	CO5	
	Field/institute/industry/lab visit						
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

Methods of Evaluation

Internal Evaluation	Continuous Internal Assessment Test	40 Marks
	Assignments	
	Observation, Record, Model	
	Attendance and Class Participation	
External Evaluation	End Semester Examination	60 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	PO 9	PO 10
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)

ENVIRONMENTAL STUDIES							
(for students admitted from the academic year 2026-2027)							
Credit	2	Hours/Week	1	Sub Code	B4ES	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, நீரோடைகள், 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, ஏ) அணு அபாயங்கள், ஏ) திடமான கழிவுகள்; மாசுபாட்டைத் தடுப்பதில் தனிநபரின் பங்கு; மாசு கள ஆய்வுகள்; பேரிடர் மேலாண்மை - வெள்ளம், பூகம்பம், குறாவளி 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 பிரச்சினைகள்; நீர் சேமிப்பு, மழை நீர் சேகரிப்பு, நீர்நிலை மேலாண்மை; மக்களின் மீள்குடியேற்றம் மற்றும் மறுவாழ்வு - பிரச்சினைகள், கவலைகள், வழக்கு ஆய்வுகள்; சுற்றுச்சூழல் நெறிமுறைகள்; பருவநிலை மாற்றம்; உலக வெப்பமயமாதல்; அமில மழை; ஓசோன் அடுக்கு சிதைவு; அணு விபத்துக்கள் மற்றும் மரணங்கள்; தரிசு நில மீட்டி; 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 of Environmental Studies for Undergraduate Courses, UGC, New Delhi.
2. Townsend C.R., Harper, J.L., Begon, M., 2009. Essentials of Ecology, Wiley, 528p.
3. N. Arumugam, V. Kumaresan. 2014. Environmental Studies. Saras Publication

Reference books

1. Abbasi, S.A., 1998. Environmental Pollution and its Control, International Publications, Pondicherry.

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.

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)

SEMESTER – III

B3ZO5		CC5: CELL BIOLOGY					
Credit		5		Teaching Hours		6/Week	
Marks	CIA	30	Ext	70	Total	100	
Learning Objectives							
CO1	To understand the structures and functions 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 functions.						
CO5	To study the different types of cell divisions and cell death						
UNIT		Details				No. of Hours	Course Objectives
I	Tools of Cell Biology: Cell Fractionation, Homogenization, Centrifugation, Isolation of sub cellular components. Histological techniques - Staining - Vital Stains. Micro Technique Methods, Microscopes - Types – Simple and Compound microscope, SEM, TEM - Units of measurement.					12	CO1 CO2
II	The Cell: Cell theory - Types and Structure of Viruses and Bacteria. Ultra structure of Animal cell. Cytoplasm- Composition and Functions. Extra Cytoplasmic Structure - Cilia Flagella - Cytoplasmic Inclusions.					12	CO1 CO2 CO4 CO5
III	Cell components - Ultra Structure and Functions of Plasma Membrane, Endoplasmic reticulum, Ribosomes, Golgi Complex, Lysosomes, Centrioles and Mitochondria					12	CO1 CO2 CO3 CO4
IV	Nucleus: Ultrastructure, Composition and Functions of Nuclear Membrane - Nucleoplasm - Chromosomes - Heterochromatin and Euchromatin - Nucleolus - Nucleolus Cycle - DNA and RNAs - Protein Synthesis					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, causes, diagnostics and treatment. Ageing of Cells-Apoptosis. Applications of Stem cells.					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)		
Ambrose, E.J. and Dorothy, M. Easty. 1970. Cell Biology. Thomas Nelson & Sons Ltd. Pp500		
Kumar P. and Mina U. 2018. Life Sciences: Fundamentals and Practice, Part-I, 6th Edn., Pathfinder Publication. p.608.		
Verma, P.S. and V. K. Agarwal, 1995. Cell and Molecular Biology, 8th Edition, S. Chand & co., New Delhi - 110 055, 567 pp.		
Verma P.S. and Agarwal V.K. 2016. 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)		
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.		
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.		
Cooper G.M. (2019) The Cell – A Molecular Approach, 8th Edn., Sinauer Associates Inc., Oxford University Press p.813.		
DeRobertis, E.D.P. and E.M.F. De Robertis, 1988. Cell and Molecular Biology, 8th Edition, International Edition, Info med, Hong Kong, 734pp.		
Hardin J. and Bertoni G. (2017). Becker's World of the Cell. 9th Edn (Global Edition). Pearson Education Ltd., p. 923		
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.		
Powar, C.B., 1989. Essential of Cytology, Himalaya Publishing House, Bombay - 400 004, 368 pp.		
Web Resources		
1.	http://www.microscopemaster.com/organelles.html	
2.	https://bit.ly/3tXwDSB	
3.	https://bit.ly/3tWNpRX	
4.	https://rsscience.com/cell-organelles-and-their-functions/	
Methods of Evaluation		
Internal Evaluation	Continuous Internal Assessment Test	30 Marks
	Assignments	
	Seminars	
	Attendance and Class Participation	
External Evaluation	End Semester Examination	70 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	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)

B3ZO6P		CC6: Laboratory Course: CELL BIOLOGY					
Credit		3		Teaching Hours		3/Week	
Marks	CIA	40	Ext	60	Total	100	
Learning Objectives							
CO1	Master Cytological & Histological Slide Preparation: Perform essential practical techniques including tissue fixation, dehydration, clearing, embedding, microtomy, and smear/squash preparations to produce clear microscopic slides of plant, insect, and human tissues.						
CO2	Analyze Cell Division Mechanics: Identify and differentiate the distinct stages of mitosis in onion root tip squashes and meiosis in grasshopper testis preparations to understand chromatic behavior and nuclear division.						
CO3	Execute Microscopic Staining Protocols: Demonstrate proficiency in applying histological and cytochemical stains (such as Hematoxylin-Eosin and Leishman's stain) to differentiate cellular components, nuclear structures, and distinct leucocyte types in blood smears.						
CO4	Identify Micro-Anatomical Structures: Characterize key histological features of diverse cell types (erythrocytes, leucocytes, nerve cells, hepatocytes) and mammalian tissues (columnar, ciliated, and glandular epithelia; striated, non-striated, and cardiac muscles).						
CO5	Operate Laboratory Instrumentation safely: Operate and maintain core cytological equipment—including simple and compound light microscopes, microtomes, centrifuges, and dissection tools—following standard procedures for histological tissue processing.						
UNIT	Details					No. of Hours	Course Objectives
I	Squash preparation of onion root tips (study of mitosis). Preparation and Identification of different stages of Meiosis in Grasshopper testes.					9	CO1
II	Preparation of buccal smear and Identification of epithelial cells.					9	CO2
III	Squash preparation of giant chromosomes of Chironomus larva.					9	CO3
IV	Preparation of human blood smear and identification of different types of leucocytes. Histochemistry and Micro technique- Fixation and Fixatives; Tissue processing; Dehydration, Clearing and Embedding; Microtomy: microtomes, Sectioning of Paraffin blocks.					9	CO4
V	Staining of paraffin sections: Principle and methods of staining. Histological stains: Hematoxylin Eosin, and Leishman's stain. Epithelial cells: Columnar epithelium, Ciliated epithelium, Glandular epithelium. Muscles: Striated muscle, nonstriated muscle and Cardiac muscle. Types of cells: WBC, Erythrocytes, Hepatic cell, Nerve cell. Instruments: Simple and Compound microscope, Ultra Microtome, Centrifuge, Tissue knife, Lancet.					9	CO5
	Field visit						
		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 Dibner, James Battey, 2012. Basic Methods in Molecular Biology, Elsevier Science Pubilshing Co., NY, USA.	
7.	Robert F. Schleif, Pieter C. Wensink, 2012. Practical Methods in Molecular Biology, Springer-Verlag, NY, USA.	
8.	Ross, M.H., Kaye, G.I. & Pawlina, W. 2002. Histology: A text and atlas (4th ed). Lippincot Williams & Wilkins.	
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		
	Continuous Internal Assessment Test	40 Marks

Internal Evaluation	Assignments	
	Record, Observation, Model, Field Trip	
	Attendance and Class Participation	
External Evaluation	End Semester Examination	60 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)**

SEMESTER -IV

B4ZO7		CC7: ECOLOGY					
Credit		5		Teaching Hours		6/Week	
Marks	CIA	30	Ext	70	Total	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.						
CO5	To study the value of biodiversity, threats and conservation of biodiversity						
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 chain, food web and ecological pyramids.				18	CO1	
II	Population Ecology: Structure and distribution – Growth curves -groups, natality and mortality-density indices, Life study tables - factors affecting population growth - Population regulation and human population control.				18	CO2	
III	Biogeochemical Cycles: Definition, phases of biogeochemical cycles. Gaseous cycles (Carbon, nitrogen and Oxygen cycle) and Sedimentary cycle (Phosphorous and sulphur cycle). Environmental Stress and Management: Causes and effects of climatic changes - Global climatic pattern, global warming				18	CO3	
IV	Environmental Pollution: Definition, causes, effects and control of air pollution, water pollution, soil pollution, marine pollution, noise pollution, thermal pollution. Nuclear hazards. Role of central and state pollution control boards				18	CO4	
V	Biodiversity and Conservation: Biodiversity-definition, types, values of biodiversity. Biodiversity hotspots in India. Causes and consequences of biodiversity loss: 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				18	CO5	
Total					90		
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		
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	
4.	https://bit.ly/39rvvgt	
Methods of Evaluation		
Internal Evaluation	Continuous Internal Assessment Test	30 Marks
	Assignments	
	Seminars	
	Attendance and Class Participation	
External Evaluation	End Semester Examination	70 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)**

B4ZO8P		CC8: Laboratory Course: ECOLOGY				
Credit		5		Teaching Hours		3/Week
Marks	CIA	40	Ext	60	Total	100
Learning Objectives						
CO1	To explain the 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 Animal Association Hermite crab and sucker fish. Animal Adaptations Horse, Balanoglossus, Pigeon, Leech, <i>Taenia solium</i> Rocky shore fauna Star fish, Mytilus, Chiton, Balanus, Sea anemone, Ascidian, Patella Sandy shore fauna Arenicola, Albunea, Solen, Chaetopterus Amphioxus Muddy shore fauna Aplysia, Sea cucumber, Aphrodite, Nereis, Periophthalmus Planktons Mysis, Megalopa larva, Auricularia, Cyclops, Nauplius, Zoea, <i>Paramecium</i> . 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.	Rastogi, S.C., 2005. Experimental physiology, new age international publishers, New Delhi.	
3.	Ramesh, R and M, Anbu 1996. Chemical methods for environmental Analysis of water and sediment. Macmillan India Limited, Chennai.	
4.	Micheal, P, 1984. Ecological Methods for field visit and laboratory investigation. Tata McGraw Hill, New Delhi.	
5.	Agarwal, A. State of India’s Environment: A Citizens Report, Centre for Science and Environment, New Delhi.	
6.	Goel, P.K. Water Pollution: Causes, Effects and Control. New Age International, Publishers, New Delhi (2006).	
References Books		
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	
5.	https://www.ncbi.nlm.nih.gov/pubmed/2170158	
Methods of Evaluation		
Internal Evaluation	Continuous Internal Assessment Test	40 Marks
	Assignments	
	Record, Observations, Model Exam, Field Visit	
	Attendance and Class Participation	
External Evaluation	End Semester Examination	60 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)

Semester V

B5ZO9		CC9: GENETICS					
Credit		5		Teaching Hours		5/Week	
Marks	CIA	30	Ext	70	Total	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 variations 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: Mendel’s experiments, laws of Mendel (law of segregation and independent assortment). 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 haemophilia 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 in Drosophila - CIB method and Muller-5 method.				15	CO1 CO2 CO3 CO4 CO5	
IV	Human 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 equilibrium.				15	CO1, CO2, CO4, CO5	
V	Bacterial genetics: Conjugation, transformation, transduction and chromosome mapping Molecular Genetics: Insertion elements, transposable elements, retroelements; integrons. The lactose system and				15	CO1, CO2, CO4, CO5	

	operon model, tryptophan operon, role and relative positions of promoters and operators, feedback mechanism.		
Total		75	
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, P06	
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	Gupta P. 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, LWW.		
3	Dobzhansky T., 1982. Genetics and The Origin of Species, Columbia University.		
4	Fletcher H and Hickey I., 2015. Genetics, IV Edition. GS, Taylor and Francis Group, New York and London.		
5	Gardner, Anne. 2009. Human Genetics, Scion Publishing Ltd.		
6	Klug, W. S., Cummings, M. R., Spencer, C. A., 2012. Concepts of Genetics. X Edition. Benjamin Cummings.		
7	Lodish, Harvey, Arnold Berk <i>et al.</i> , 2007. Molecular cell biology. 6th edition, W. H. Freeman.		
8	Russel, Peter J. 2013. Genetics: A Molecular Approach, Pearson.		
9	Strickberger M. W. 1995. Genetics, Prentice Hall India Learning Private Limited.		
Web Resources			
1.	https://go.nature.com/2XE8V1q		
2.	https://bit.ly/3zoTt6B		
3.	https://bit.ly/2XAm7oa		
4.	https://bit.ly/2XEbhxi		
Methods of Evaluation			
	Continuous Internal Assessment Test		30 Marks

Internal Evaluation	Assignments	
	Seminars	
	Attendance and Class Participation	
External Evaluation	End Semester Examination	70 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)

B5ZO10		CC10: ANIMALPHYSIOLOGY					
Credit		5		Teaching Hours		5/Week	
Marks	CIA	30	Ext	70	Total	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. Ear: Structure of ear and mechanism of hearing, Hearing impairments, deafness, labyrinthine disease. Olfactory, gustatory and tactile sense organs					15	CO4
V	Endocrines and 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				75	
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	beabletolistthefunctionsofvariousorgansinrelationtophysiol					PO1	

	gicalprocess.	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., Pp 329.	
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.	
Web Resources		
1.	https://microbenotes.com/category/biochemistry/	
2.	https://www.stem.org.uk/resources/collection/3931/animal-physiology	
3.	https://animalphys4e.sinauer.com	
4.	https://nptel.ac.in/courses/102/104/102104042/	
5.	https://biochem.oregonstate.edu	
Methods of Evaluation		
Internal Evaluation	Continuous Internal Assessment Test	30
	Assignments	
	Seminars	
	Attendance and Class Participation	
External Evaluation	End Semester Examination	70
	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)

B5ZO11		CC11: DEVELOPMENTAL BIOLOGY					
Credit		4		Teaching Hours		4/Week	
Marks	CIA	30	Ext	70	Total	100	
Learning Objectives							
1	To create an idea to the students about the theories, concepts and basics of embryology						
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.					15	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.					15	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.					15	CO3
IV	Applied Embryology: Organizer concept. Structure, mechanism of induction, competence. Nuclear transplantation, teratogenesis. Regeneration: types - events and factors. Embryonic stem cells & significance. Methods of embryo culture					15	CO4
V	Human Embryology: Reproductive organs, Menstrual cycle and menopause. Pregnancy-trimesters-development. Erythroblastosis foetalis-Twins-types. Infertility-causes - Test tube baby (IVF) and Assisted Reproductive Technology-Embryo transfer- Amniocentesis.					15	CO5
						75	
Upon successful completion of this course, students will be able to:							
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						PO4

	in various organisms and appraise the species-based differences in development.	PO5 PO6
CO5	To justify and validate the role of environment and genetics in influencing embryonic development	PO3 PO8

Text Books

1	Lewis Wolpert 2007. Principles of development, 3rd edition, Oxford University Press, New Delhi, India
2	Subramoniam, T. 2003. Developmental Biology, Narosa Publishing House, New Delhi, India
3	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.

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

Methods of Evaluation

Internal Evaluation	Seminars Attendance and Class Participation	30 Marks
	Continuous Internal	
	Assessment Test Assignments	
External Evaluation	End Semester Examination	70 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)

B5ZO12P		CC12: Laboratory Course: Genetics/Animal Physiology/Developmental Biology					
Credit		4		Teaching Hours		5/Week	
Marks	CIA	40	Ext	60	Total	100	
Learning Objectives							
1	To demonstrate the core genetic principles, and to define scientific principles and concepts as related to genetics and its importance.						
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 developmental biology.						
UNIT	Details					No. of Hours	Course Objectives
I	Genetics: Drosophila culture for identification of male, female and mutant varieties. Fingerprint patterns and pedigree analysis					15	CO1
II	Animal Physiology: 1) Estimation of Haemoglobin by using haemoglobino meter 2) Total RBC count by using Neubauer chamber (haemocytes meter) 3) Total WBC count by using Neubauer chamber (haemocytes meter) 4) Identification of type of nitrogenous waste present in the given samples 5) Qualitative analysis of macromolecules (Carbohydrate, proteins and lipids)					15	CO2
III	Developmental Biology: Temporary mounting of chick embryo (24 – 48Hrs.) Observation of mammalian sperm (Bull sperm) motility					15	CO3
IV	Spotters: Drosophila male, female and mutant varieties 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.					15	CO4
V	Field Visit: Visit to local or outer areas related to the subject matters. It is to visit different industries and institutional facilities to acquire more knowledge on this subject and submit the field visit report.					15	CO5
Total						75	
Course Outcomes							
Course Outcomes	Upon successful completion of this practical course, students will be able to:						

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,
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.	Tortora G.J. & Derrickson B., 2016. Principles of Anatomy and Physiology, John Wiley and Sons, Inc. 1232 PP.	
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.	
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 Observation, Record, Model Examination, Field Visit, Attendance and Class Participation Assignments	40 Marks
External Evaluation	End Semester Examination	60 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)

B6ZO13		CC13: EVOLUTIONARY BIOLOGY						
Credit		5		Teaching Hours		6/Week		
Marks	CIA	30	Ext	70	Total	100		
Learning Objectives								
CO1	To appreciate 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 Lamarckism - Neo Lamarckism – Darwinism, 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	To apply the knowledge of human evolutionary history to simulate how genetic variations within human populations affects risk, diagnosis, and treatment of modern diseases.							
UNIT		Details				No. of Hours	Course Objectives	
I	Concepts and theories of evolution: History of evolutionary thoughts. Lamarckism-Neo Lamarckism. Darwinism-Neo Darwinism. Modern synthetic theory, DeVrie’s Mutation theory.				18	CO1		
II	Origin of biological molecules and first cell: origin of inorganic and organic molecule; Miller Urey Experiment; Evolution of coacervates, protocell and first cell; Origin of Prokaryotes and eukaryotes.				18	CO2		
III	Speciation: Isolating mechanisms; Modes of speciation- Allopatric and Sympatric speciation; Adaptive radiation in reptiles and mammals; Convergent evolution.				18	CO3		
IV	Evidences of Evolution: Morphological, physiological and biochemical, embryological, taxonomical and geographical, palaeontological evidences; Geological time scale; Fossil records of horse and man.				18	CO4		
V	Population genetics and patterns of evolution: Gene Pool and Gene frequency; Hardy Weinberg Law and evolution; Genetic drift. Colouration and Mimicry: types and their role in evolution. Evolution and ethics.				18	CO5		
		Total				90		
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 BarHett Publ. Boston.		
4.	Levine L. 1969. Biology of the Gene. Toppan.		
5.	Pedder IJ. 1972. Genetics as a Basic Guide. W. Norton & Company, Inc.		
6.	Rastogi VB. 1991. A Text Book of Genetics. Kedar Nath Ram Nath Publications, Meerut, Uttar Pradesh, India.		
7.	White MJD. 1973. Animal Cytology and Evolution. Cambridge Univ.Press.		
Web Resources			
1.	https://bit.ly/3nPD09m		
2.	https://bit.ly/3CHOdgL		
3.	https://bit.ly/2XvcCXl		
4.	https://bit.ly/2XAL1Vh		
5.	https://bit.ly/3zoU9Jl		
Methods of Evaluation			
Internal Evaluation	Continuous Internal Assessment Test		30 Marks
	Assignments		
	Seminars		
	Attendance and Class Participation		
External Evaluation	End Semester Examination		70 Marks
	Total		100 Marks
Methods of Assessment			
Recall (K1)	Simple definitions, MCO, 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)

B6ZO14		CC14: Biostatistics and Computer Applications					
Credit		5		Teaching Hours		6/Week	
Marks	CIA	30	Ext	70	Total	100	
Learning Objectives							
CO1	To understand the application of Biostatistics in Biology, data collection and processing						
CO2	To study and generate idea on Central Tendency						
CO3	To differentiate and understand the relationship between the variables						
CO4	To have a knowledge of computer and operating system						
CO5	To have a basic knowledge on Artificial intelligence and its uses in biology						
UNIT		Details				No. of Hours	Course Objectives
I	Introduction to Statistics in Biology. Data: Types (Primary and Secondary data), Classification, tabulation. Diagrammatic and graphical representation of data (bars, circles, rectangles, histogram, frequency polygon, frequency curve and cumulative frequency curves)				18	CO1	
II	Measures of central Tendency and Dispersion: Mean, Median, Mode. Calculation of mean, median, mode. Range, Quartile deviation, Mean deviation, Standard Deviation, Variance, coefficient of variation and standard error of mean.				18	CO2	
III	Correlation and Regression: Bivariate data, Simple correlation, Study of correlation-Karl Pearson’s correlation coefficient. Regression analysis.				18	CO3	
IV	Introduction to Computer: Definition, History, Generation of development, Characteristics of computers, benefits and application of computers Organization of Computer-Hardware: - Inputs devices, output devices, CPU, storage unit, Software, Types of software, application of software, system software, utility software, general purpose software.				18	CO4	
V	Artificial Intelligence: Definition and scope of Artificial Intelligence (AI), Historical development of AI applications in biological sciences, Synergy between AI and biology: Why biological sciences need AI, Introduction to biological big data (genomics, proteomics, etc.)				18	CO5	
Total					90		
Course Outcomes							
Course Outcomes		Upon successful completion of this course, students will be able to:					
CO1		Distinguish between primary and secondary biological data, classify and tabulate raw datasets, and construct appropriate diagrammatic and graphical representations (e.g., histograms, frequency curves, ogives).					PO1
CO2		Compute and interpret measures of central tendency (mean, median, mode) and dispersion (standard deviation, variance, coefficient of variation, standard error of the mean) to summarize biological variability.					PO1 PO2
CO3		Analyze bivariate biological datasets using Karl Pearson’s					PO4

	correlation coefficient and simple linear regression to quantify and evaluate relationships between variables	PO6
CO4	Explain the core architecture of computer systems (hardware, software, CPU, storage) and classify application, system, and utility software relevant to scientific and general computing.	PO4 PO5 PO6
CO5	Explain the synergy between biology and Artificial Intelligence, highlighting how AI techniques and computer systems process biological big data (genomics, proteomics, transcriptomics).	PO3 PO8

Text Books (Latest Editions)

1.	Statistics - SP Gupta 1996 S. Chand and Co., New Delhi
2.	Introduction to Biostatistics (A Textbook of Biometry). Pranab Kumar Banerjee. 2007. S. Chand and Co Ltd, New Delhi

References Books

1.	Zar, J.H. (1984) Biostatistical Analysis. 2nd Edition, Prentice-Hall, Inc., Englewood Cliffs, 718 p.
2.	Introduction of Biostatistics and Computer Science – Y.I Parkar & M.G Dhanyagude Nirali Prakashan Publishers, Pune.
3.	Textbook of Computer applications and biostatistics. 2011. In book: Textbook of Computer applications and biostatistics, Trinity Publishing House

Methods of Evaluation

Internal Evaluation	Continuous Internal Assessment Test	30 Marks
	Assignments	
	Seminars	
	Attendance and Class Participation	
External Evaluation	End Semester Examination	70 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)

B6ZO15P		CC15: Laboratory Course: Evolutionary Biology/Biostatistics and Computer Applications					
Credit		4		Teaching Hours		5/Week	
Marks	CIA	40	Ext	60	Total	100	
Learning Objectives							
LO1	Analyze adaptive morphological modifications, prebiotic chemistry models, and fossil records to evaluate key mechanics of macroevolution and diversification.						
LO2	Apply descriptive statistics, variability metrics, and correlation-regression techniques to analyze and interpret quantitative biological data.						
LO3	Utilize fundamental hardware systems and AI-driven digital tools to construct academic presentations, data visualizers, and scientific communication materials.						
LO4	Perform fundamental molecular isolation protocols and analyze electrophoretic separation techniques to understand modern biotechnology applications.						
LO5	Conduct field-based paleontological surveys to observe, document, and interpret fossilized remains within their local geological strata.						
UNIT	Details					Course Objectives	
I	Evolution: Homologus and analogous organs Mimicry and colorations: butter fly, stick insect, leaf insect, Lycodon, Lophius					CO1	
II	Urey Miller Experiment Model Study of fossils: Ammonite, Trilobite, Lingual, Limulus Modification of feet and beaks in birds.					CO2	
III	Biostatistics: Calculation of mean, median, mode Standard Deviation, Standard Error, Correlation and Regression by using biological samples.					CO3	
IV	Computer Applications. Spotters: input and output devices. Preparation of chart and ppt using AI tools					CO4	
V	Field Work: Visit to a local fossil sites and subject related organizations					CO5	
					Total	75	
Course Outcomes							
Course Outcomes		Upon successful completion of this practical course, students will be able to:					
CO1	Differentiate fundamental evolutionary mechanisms by analyzing anatomical homologies, adaptations, mimicry, fossil evidence, and prebiotic atmospheric models					PO1	
CO2	Compute and interpret descriptive statistics, measures of variability, and linear correlation/regression models on biological datasets					PO1, PO2	
CO3	Classify computer hardware interfaces and leverage modern AI digital tools to synthesize scientific data into academic charts and presentations					PO4, PO6	
CO4	Execute genomic DNA isolation protocols and evaluate the separation principles of Agarose and Polyacrylamide Gel Electrophoresis (AGE/PAGE)					PO4, PO5, PO6	
CO5	Apply field paleontology methods to document, map, and contextualize fossil specimens within local geological strata.					PO3, PO8	
Text Books (Latest Editions)							

1.	Jaspreet Kaur & Luni . 2026. Evolutionary Biology Practical Manual. Techsar Pvt Ltd
2.	Dr. N. G. Mahajan, Dr. M. C. Patil, Dr. Manojkumar Chopda, Dr. R. M. Chaudhari. Evolutionary Biology with Practicals. Pp 146. ISBN: 9789389492729
3.	Mendel Suchmacher and Mauro Geller. 2012. Practical Biostatistics. Academic Press. ISBN: 978-0-12-415794-1. DOI: 10.1016/C2011-0-04190-X
4.	Shubhi Lal. 2023. A Practical Book of Computer Application-I. ISBN: 9788181980182.

References Books

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

1.	Mendel Suchmacher, Mauro Geller. 2012. Practical Biostatistics: A Friendly Step-by-Step Approach for Evidence-based Medicine. Academic Press
2.	N. G. Mahajan, M. C. Patil, Manojkumar Chopda, R. M. Chaudhari. 2012. Evolutionary Biology with Practicals. Pp 146. ISBN: 9789389492729

Web Resources

https://www.veerashaivacollege.org/images/IQAC8524/iqac1/VI_Sem_LAB_MANUAL_Z-6.1_compressed_e83fc.pdf

Methods of Evaluation

Internal Evaluation	Continuous Internal Assessment Test Record, Model Exam, Attendance and Class Participation Assignments	40 Marks
External Evaluation	End Semester Examination	60 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)

BZOECA		EC: BIOTECHNOLOGY					
Credit		4		Teaching Hours		5/Week	
Marks	CIA	30	Ext	70	Total	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 analyse 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						75	
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.		
4. Dubey S. K. Bandana Ghosh, 2012. Fish biotechnology, Wisdom Press.		
5. Dubey R.C. 2014. Advanced Biotechnology, S. Chand Publication.		
6. Ramdoss P. 2009. Animal Biotechnology. Recent concepts and developments, MJP Publishers.		
7. Sathyanarayan U. 2008. Biotechnology, Books and Allied, Kolkata.		
8. Ignacimuthu, S. 2008. Basic Biotechnology, Tata McGraw hill, New Delhi.		
9. 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	30
	Assignments	
	Seminars	
	Attendance and Class Participation	
External Evaluation	End Semester Examination	70
	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)**

BZOECEB		EC: ANIMAL BEHAVIOUR				
Credit		4		Teaching Hours		5/Week
Marks	CIA	30	Ext	70	Total	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.

BZOECC		EC: HUMAN REPRODUCTIVE BIOLOGY				
Credit		4	Teaching Hours		5/Week	
Marks	CIA	30	Ext	70	Total	100
Learning Objectives						

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 their regulations
- 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 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
Unit 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
Unit 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
Unit IV	Ovum transport in the fallopian tubes; Sperm transport in the female tract, Fertilization; Hormonal control of implantation; Hormonal regulation of gestation, pregnancy diagnosis, foeto – maternal relationship; Mechanism of parturition and its hormonal regulation; Lactation and its regulation
Unit V	Infertility in male and female: causes, diagnosis and management; 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)*. NewYork: 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.

BZOECD		EC: BASICS OF MARINE BIOLOGY				
Credit		4	Teaching Hours		5/Week	
Marks	CIA	30	Ext	70	Total	100
Learning Objectives						

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
5. 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
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.

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.

BZOECE		EC: AGRICULTURAL ENTOMOLOGY				
Credit		4		Teaching Hours		5/Week
Marks	CIA	30	Ext	70	Total	100
Learning Objectives						
LO1	Explain the basic concepts of entomology and observe the pest status of agriculture					
LO2	Illustrate and examine the systemic and functional morphology of various group of agricultural insect pests					
LO3	Differentiate and classify the various groups of insect animals and estimate biodiversity					
LO4	To compare and distinguish the general and specific characteristics integrated pest management					
LO5	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.

BZOEFC		MICROBIOLOGY					
Credit		4		Teaching Hours		5/Week	
Marks	CIA	30	Ext	70	Total	100	
Learning Objectives							
CO1	To become familiar with the foundation concepts of history of Microbiology						
CO2	To understand the structure and functions of a typical prokaryotic cell						
CO3	To gain knowledge of microscopy and staining concepts						
CO4	To understand and implement disposal and safety measures						
CO5	To gain knowledge on different types of microorganism and their applications and disease caused by them						
UNIT	Details				No. of Hours	Course Objectives	
I	Introduction to microbiology: History, scope, Systematic position: 5 kingdom classification of Whittaker and 3 domain system of Carl Woese. Comparison of Bacteria, Archaea, Eukarya (tabular and diagrammatic). Physical and chemical methods of controlling microbes.				12	CO1	
II	Microscopy: Principles, parts, functioning and applications of Compound microscope (Monocular and Binocular), Dark field, Phase contrast, Fluorescence, Confocal, Atomic Force and Electron microscopes (TEM and SEM).				12	CO2	
III	Introductory Mycology: General characteristics and outline classification of fungi; Morphology of some common fungi – Phytophthora, Rhizopus, Saccharomyces, Aspergillus, Agaricus, Candida; General characteristics of Lichens and Mycorrhiza.				12	CO3	
IV	Introductory Bacteriology: Classification of bacteria; Bergey’s manual of systematic bacteriology; Morphology and fine structure of bacteria; bacterial growth curve; Types of staining – simple, negative and Gram staining; pathogenicity, clinical symptoms, diagnosis, prevention and treatment of Tuberculosis and Typhoid.				12	CO4	
V	Introductory Virology: Classification of virus; General structures of virus; Antiviral agents – Antiviral compounds, Interferons, genetically engineered vaccines, DNA vaccines; pathogenicity, clinical symptoms, diagnosis, prevention and treatment of SARS-CoV-2, Hepatitis B virus.				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.	
Web Resources		
1.	https://vlab.amrita.edu/?sub=3&brch=73	
2.	https://learn.chm.msu.edu/vibl/	
Methods of Evaluation		
Internal Evaluation	Continuous Internal Assessment Test Assignments Seminars Attendance and Class Participation	25
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	

Skill Enhancement Course

B3ZOSE1		AQUACULTURE				
Credit		2		Teaching Hours		2/Week
Marks	CIA	30	Ext	70	Total	100
Learning Objectives						
Provide a thorough understanding of the economic scope, global and national status, and fundamental design principles of modern aquaculture systems.						
Impart knowledge on the physiological, nutritional, and environmental parameters essential for maintaining healthy aquatic ecosystems and culture media.						
Detail practical culture methodologies for commercially important finfishes, crustaceans, shellfish, and algae.						
Train students in identifying common aquatic diseases, understanding their etiologies, and applying appropriate prophylactic and therapeutic controls.						
Introduce post-harvest technologies, preservation techniques, quality assurance standards, and marketing strategies for local and international markets						
Provide a thorough understanding of the economic scope, global and national status, and fundamental design principles of modern aquaculture systems.						

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. Fish-feed 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: *Penaeus* 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:

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

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.notesonzoology.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	Explain the scope and current trends of aquaculture in India and globally, and outline the engineering principles involved in designing fish farms, composite fish culture, and integrated farming systems	K1, K2
CO2	Analyze key water quality parameters and formulate balanced fish feeds incorporating live feeds and probiotics to ensure optimal growth and health of cultivable aquatic species.	K3
CO3	Demonstrate comprehensive knowledge of culture techniques for Indian Major Carps (<i>Catla</i> , <i>Rohu</i> , <i>Mrigal</i>), pearl oysters, and commercially viable penaeid prawns	K3
CO4	Diagnose clinical symptoms of common bacterial, viral, fungal, protozoan, and crustacean diseases in culture stock and evaluate appropriate treatment and biosecurity protocols.	K4
CO5	Apply post-harvest preservation methods (freezing, canning), assess fish by-product utilization, and design quality control frameworks adhering to MPEDA standards for export compliance.	K5

B3ZOSE2		ENVIRONMENTAL IMPACT ANALYSIS				
Credit		2		Teaching Hours		2/Week
Marks	CIA	30	Ext	70	Total	100
Learning Objectives						
CO1	To impart knowledge about Environmental Impact Assessment					
CO2	To identify methods and parameters to be included to EIA					
CO3	To learn about the methods and steps involved in EIA					
CO4	To report the EIA study report and post EIA management system					
CO5	To access the case studies of major developmental projects					

UNIT I	INTRODUCTION TO EIA EIA - Introduction-Concept of EIA- Scope and objectives of EIA - EMP - Historical perspectives of EIA. Organization responsible for EIA - Pre-project analysis - Site selection and Area classification - Sitting and Setting Criteria for EIA Projects
UNIT II	EIA ASSESSMENT PARAMETERS Environmental Indicators - Abiotic and Biotic factors - Socio and Economic aspects -Environmental quality - Air, Water, Soil, Flora and Fauna - Field survey and data Collection - Environmental auditing
UNIT III	EIA METHODOLOGIES Various Steps of EIA - Content of EIA - Analytical and Integrated Approach Assessment Methodology - Adhoc, Overlay Network, Matrix and Checklist - Environmental Values and Technique - Cost benefit Analysis - Environmental Clearance
UNIT IV	ENVIRONMENTAL IMPACT STATEMENT Environmental Impact Statement (EIS) and Environmental Management Plan (EMP). Environmental Management System Standards (ISO14000 series). EIA Notification, 2006 and 2020 amendments. Eco-labeling schemes
UNIT V	Case Studies for Major Developmental Projects: Hydro-electric and Thermal Power Plants, Mining, Highway Roads, Airport, Cement Industries

Course outcome

CO No	CO-Statement	Cognitive Level (K)
After completion of this course, students will be able to gain knowledge in		
CO1	The importance and principles of EIA processes.	K1, K2
CO2	The parameter to be evaluated in EIA	K3
CO3	The methods of EIA	K3
CO4	The EIA report and appropriate environmental management plan	K4
CO5	Analyze EIA cases studies	K5

Textbooks

1. EIA Manual. 2001. *Ministry of Environment, Forest and Climate Change*, New Delhi.
2. Barthwal, R.R. 2012. *Environmental Impact Assessment*, New Age International Publishers.
3. Khandeshwar, S.R., Raman, N.S. and Gajbhiye, A.R. 2019. *Environmental Impact Assessment*, I.K. International Publishing House Pvt.

B4ZOSE3		APICULTURE					
Credit		2		Teaching Hours		2/Week	
Marks	CIA	30	Ext	70	Total	100	
Learning Objectives							
LO1	To understand economic importance of honey bees and developments taking place in modern beekeeping.						
LO2	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						
LO3	To become familiar with important bee diseases, enemies and their management.						
LO4	To become familiar with different equipment used in modern beekeeping for domesticating hive bees						
LO5	To know the process of honey and bee hive products and their uses						
UNIT	Details						No. of Hours
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
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.	M. Tamil Selvi and Abdul Jaffar Ali. 2018. 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. Pp304						
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		30
	Continuous Internal		
	Assessment Test Assignments		
External Evaluation	End Semester Examination		70
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)

B4ZOSE4		WILDLIFE CONSERVATION AND MANAGEMENT				
Credit		2	Teaching Hours		2/Week	
Marks	CIA	30	Ext	70	Total	100
Learning Objectives						
Course Objectives:						
The main objectives of this course are:						
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.

Suggested Readings

4. Gilas R H Jr. 1984. Wildlife Management Techniques, 3rd ed. The Wildlife Society, Washington D.C., Nataraj Publishers, Dehra Dun, p 547.
5. Rodgers W.A. 1991. Techniques for Wildlife Census in India-A Field Manual: Technical Manual-2. WII.

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.

B5ZOSE5		SERICULTURE					
Credit		2		Teaching Hours		2/Week	
Marks	CIA	30	Ext	70	Total	100	
Learning Objectives							
LO1	recall the history of sericulture industry, types of silk worms and silkworm rearing						
LO2	interpret moriculture for supporting growing silkworms						
LO3	identify diseases of silkworm and their management						
LO4	Categorize different sericulture practices						
LO5	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 verities 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.

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
	PO 1	PO 2	PO 3	PO 4	PO 5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	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

B5ZOSE6		AQUARIUM KEEPING				
Credit		2	Teaching Hours		2/Week	
Marks	CIA	30	Ext	70	Total	100
Learning Objectives						
LO1	To promote Entrepreneurship and Economic Awareness					
LO2	To understand Fish Biology and Ornamental Diversity					
LO3	To master Aquarium Setup, Water Quality, and Farm Budgeting					
LO4	To develop Skills in Live Fish Transport and Disease Management					
LO5	To train in Breeding Techniques and Species Identification					

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. 1987. A manual of freshwater aquaculture, Reprint 1999, Oxford & IBH Publishing Company Pt., Ltd., New Delhi.
3. O'Connell, R. F. 1977. The freshwater aquarium. Arco Publishing Company, 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

Learning Outcomes:	
Upon successful completion of this course, students will be able to:	
LO1	Evaluate Market Opportunities & Bioentrepreneurship
LO2	Identify & Classify Ornamental Species
LO3	Design, Setup & Manage Aquaria Systems
LO4	Practice Safe Fish Handling & Disease Management
LO5	Master Breeding & Hatchery Techniques

B6ZOSE7		POULTRY FARMING				
Credit		2	Teaching Hours		2/Week	
Marks	CIA	30	Ext	70	Total	100
Learning Objectives						
LO1	Introduce the scope, economic significance, and production trends of the poultry sector in India, alongside fundamental breeds and housing design.					
LO2	Impart management skills for handling birds at different life stages (brooders, growers, layers, broilers) across seasonal variations.					
LO3	Examine poultry nutrition principles, feed additive roles, and stage-specific ration formulation techniques.					
LO4	Train students in recognizing major infectious and parasitic poultry diseases, understanding their transmission, and executing preventive biosecurity protocols.					
LO5	Analyze the nutritional value, preservation, processing, and marketing of poultry products while evaluating farm economics and industry challenges.					

Objectives:

To impart training to our students, both on site and off site on the techniques of poultry and dairy farming. To create interest in the young minds to become entrepreneurs after graduation.

Unit-I

Introduction to poultry science –poultry growth in India. Annual egg production in India. Nomenclature of breeds of fowl, - selection of breeds – Housing - equipment requirements for poultry sheds, deep litter system, laying cages.

Unit-II

Brooding and rearing –brood temperature, space and duration; feed, water and space allowance, debeaking – vaccination. Management of growers, layers, broilers – lighting of chicks, growers and layers. Summer and winter management - Culling.

Unit-III

Food stuffs for poultry in relation to protein, amino acids, minerals (Ca and P), vitamins and fibre content. Food Additives - Feed formulations for chicks, growers, Phase I to phase III layers and broilers.

Unit-IV

Poultry diseases and their management: Ranikhet (New Castle) disease, Fowl pox, Avian Leucosis, Tick fever, Tuberculosis, Fowl Cholera, Avian leucosis, Infectious coryza.

Unit-V

Nutritive values of eggs and meat: Quality, Preservation and Marketing of eggs, meat and poultry manure-Economics of Poultry farming. Problems in poultry production.

Reference Books:

Sunil Kumar Das (1994) – Poultry production, CBC Publishers and Distributors, Delhi – 110032.

Banerjee G.C. (1992) A textbook of animal husbandary, Oxford and IBM Publishing Co., New Delhi.

Course Outcomes:

After successful completion of this course the student will

- ✓ Classify poultry breeds based on standard nomenclature, explain production trends in India, and compare different housing systems (deep litter vs. cage system) with their equipment needs
- ✓ Apply optimal husbandry practices-including brooding parameters, debeaking, lighting schedules, and culling-to manage broilers, growers, and layers under varying seasonal conditions.
- ✓ Evaluate the nutritional requirements (proteins, minerals, vitamins) of birds and formulate balanced, cost-effective feeds tailored for different growth phases and production stages
- ✓ Diagnose clinical signs of major bacterial, viral, fungal, and parasitic diseases in poultry and formulate effective disease control and vaccination schedules.
- ✓ Assess the nutritive value and preservation techniques of egg and meat products, evaluate farm economics and manure management, and propose solutions to industry operational challenges

B6ZOSE8		MEDICAL LABORATORY TECHNIQUES					
Credit		2		Teaching Hours		2/Week	
Marks	CIA	30	Ext	70	Total	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
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. Tata McGraw-Hill Education Pvt. Ltd.,
3. Ochei. J., A. Kolhatkar (2000). Medical Laboratory science: Theory and practice, Tata McGraw-Hill Education Pvt. Ltd, First edition.

Web Resources

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

ELECTIVE ZOOLOGY FOR CHEMISTRY STUDENTS
(for students admitted from the academic year 2026-2027)
SEMESTER-I

B1AZO1		General Zoology I					
Credit		3		Teaching Hours		4/Week	
Marks	CIA	30	Ext	70	Total	100	
Learning Objectives							
LO1	To acquire a basic knowledge of taxonomy						
LO2	To study the diversity and organization of Protozoa, Coelenterata, Helminthes and Annelida						
LO3	To acquire a basic knowledge of diversity and organization of Arthropoda, Mollusca and Echinodermata						
LO4	To comprehend the taxonomic position and diversity among Protochordata, Pisces and Amphibia						
LO5	To comprehend the taxonomic position and diversity among Reptilia, Aves and Mammalia						
UNIT	Details					No. of Hours	CO
I	Unit 1: Invertebrate Diversity & Taxonomy Principles of Taxonomy: Binomial nomenclature and general outlines of the animal kingdom. General Characters: Protozoa, Porifera, Type Study: <i>Paramecium</i> -structural organization and reproduction. GT: Locomotion in Protozoa					12	CO1
II	Unit 2: Invertebrate Diversity General Characters: Coelenterata, Platyhelminthes, and Annelida. Type Study: <i>Earthworm</i> -structural organization and life cycle					12	CO2
III	Unit 3: Higher Invertebrates & Structural Organization General Characters: Arthropoda, Mollusca, and Echinodermata. Functional Morphology: Parasitic adaptations in Helminthes and the water vascular system in starfish. Type Study: <i>Cockroach</i>					12	CO3
IV	Unit 4: Chordate Diversity General Characters & Classification: Prochordata, Type Study: <i>Amphioxus</i> .					12	CO4
V	Unit 5: Chordate Diversity General Characters & Classification: Pisces, Amphibia, Reptilia, Aves, and Mammalia. Adaptations: Migration in fishes, flight adaptations in birds Type Study: <i>Rabbit</i> .					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
CO5	Analyse the taxonomic position of animals.	PO3 PO8

Text Books

1. Invertebrate Zoology. E. L. Jordon and P.S. Verma. 2005. S. Chand & co. New Delhi
2. Chordate Zoology. E.L. Jordon and P.S. Verma. 2006. S. Chand & co. New Delhi.

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. Ananthakrishnan. 2019. Manual Of Zoology Volume 2 Part 2 Chordata. Viswanathan Publishers.

Web Resources

1. www.sanctuaryasia.com
2. www.iaszoology.com

Methods of Evaluation

Internal Evaluation	Continuous Internal Assessment Test	30 Marks
	Assignments	
	Seminars	
	Attendance and Class Participation	
External Evaluation	End Semester Examination	70 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)**

SEMESTER-II

B2AZO3		General Zoology II (Commercial Zoology)					
Credit		3		Teaching Hours		4/Week	
Marks	CIA	30	Ext	70	Total	100	
Learning Objectives							
CO1	To acquire knowledge on culture and technical aspects and management of vermiculture						
CO2	Develop knowledge on bee keeping						
CO3	Develop skills on apiculture and commercial aspects sericulture						
CO4	Acquire skills on construction and management of fish farming						
CO5	Impart hands on training on management of poultry farming						
UNIT	Details					No. of Hours	CO
I	Vermiculture: Vermiculture and composting-types of earthworms-rearing technology and management-vermin cast					12	CO1
II	Apiculture: Introduction, Species of honey bees, hives- care and management–honey extraction–nutritive and medicinal value.					12	CO2
III	Sericulture: Mulberry and non-mulberry silk. Life cycle of Mulberry silkworm (<i>Bombyx mori</i>). Silk Gland. Silkworm rearing. Economic importance of silkworm and silk.					12	CO3
IV	Fish Culture: Fish culture-construction of ponds-management of pond-freshwater cultivable fishes-fish feed-fish diseases and management-brief study on prawn culture and pearl culture					12	CO4
V	Poultry Farming: Poultry farming type of poultry-management-poultry nutrition-diseases and their prevention-economics of poultry production					12	CO5
	Total					60	
Course Outcomes							
Course Outcomes	On completion of this course, students will						
CO1	Learn techniques of vermiculture					PO1	
CO2	Understand the concept of apiculture					PO1, PO2	
CO3	Start entrepreneurship in seri-industry					PO4, PO6	
CO4	Able to start business in aquaculture					PO4, PO5, PO6	
CO5	Have the idea of management of poultry farming					PO3, PO8	
Text Books (Latest Editions)							
1.	Verma P.S. & Agarwal. 2020. 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.						
Methods of Evaluation							

Internal Evaluation	Continuous Internal Assessment Test	30 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	70 Marks
	Longer essay/ Evaluation essay, Critique or justify with pros and cons	100 Marks

ALLIED ZOOLOGY- PRACTICAL (for students admitted from the academic year 2026-2027)											
Credit	3	Hours/Week		3	Sub Code	B2AZO2P			Semester		II
Medium of Instruction		English/ Tamil	Allied Course II			CIA	40	Ext	60	Total	100
CO-Statement											
Objective: To impart training on the techniques of dissecting the invertebrate/ vertebrate animals and understand the various systems present in the body. To train the students to discriminate the various external body parts of invertebrates. To observe the preserved invertebrate animals (Wet and dry)											
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	

I. Dissections and Experiments:

Earthworm: Digestive system and Nervous system.

Fish: Digestive system and Nervous system

II. Minor Practical

Earthworm: Body setae.

Honey bee/Cockroach: Mouth Parts.

Honey bee sting.

Shark: Placoid scale.

Honey adulteration test.

SPOTTERS

Amoeba, Paramecium (entire and conjugation), Obelia colony, Aurelia entire, Fasciola hepatica (W.M & T.S.), Redia, Cercaria, *Taenia solium*- entire and Scolex, Ascaris - male and female, Earthworm, Leach, Freshwater mussel, Star fish, Frog, Calotes, Pigeon and Rabbit. Species of animals used in vermiculture, apiculture, lac culture, sericulture, aquaculture and poultry farming.

Products: Honey, beeswax, lac, silk, cod liver oil, pearl, egg of different poultry birds.

Field visit:

Aquaculture/Ornamental Fish farm/Poultry farm/Vermiculture Places

Non-Major Electives

Course				NME 2				Code		B5ZONE1	
Credits	3	Semester	VI	Hours/Week	3	CIA	30	Ext	70	Total	100
COMMERCIAL ZOOLOGY (for students admitted from the academic year 2026-2027)											
Course Objectives:											
The learning objectives of this course are as follows:											
1	It deals with the application of zoological knowledge for the benefit of mankind by understanding the economy, health and welfare of humans.										
2	It includes culturing organisms for mass production for human use and to control or eradicate harmful ones.										
3	It will bring to the fore the multidisciplinary nature of Commercial Zoology as it includes sericulture, apiculture, aquaculture, pisciculture and insect pests of agriculture										
4	To know the importance and Role of World Health Organization in Health Care aspects										
5	To study the mental health conditions and role of national and international agency in health care										

Objectives:

The objective of the paper is to impart the knowledge on the commercially important animals and their farming to student community which will enable them to become an entrepreneur in areas like Vermiculture, Apiculture, Sericulture, Lac culture and Poultry farming

Unit-I

Vermiculture: Biocomposting, types of earthworms, rearing technology and management. Vermiwash vermin cast.

Unit-II

Apiculture: History, Species of honey bees. Hives-care and management. Honey extraction, Nutritive and Medicinal value.

Unit-III

Sericulture: History of Sericulture. Silk producing organisms. Mulberry and Non-mulberry Sericulture (Eri, Muga, Tussar), Sericulture techniques.

Unit-IV

Aquaculture: Definition, scope, and significance of Aquaculture, Prawn culture, Pearl culture, Edible Oyster culture.

Unit-V

Poultry farming: type of poultry, management, poultry nutrition, diseases and their prevention, economics of poultry production

Text Book

Shukla, G.S. and Upadhyay, V.B.: Economic Zoology, 4e, 2002, Rastogi.

D. B. Tembhare. 2017. Modern Entomology. Published by Himalaya Publishing House (ISO 9001: 2008 Certified).

Reference Books

Saradar Singh. 1962. Bee Keeping in India. Indian Council of Agriculture Research. Pp222.

Santhanam- Aquaculture

Ganga,G and J. Sulochana Chetty 2010. Introduction to Sericulture, 2nd Ed. Published by. Oxford & IBH Publishing Co.

Ram Praksh Singh. 2018. Modern Livestock and Poultry Production. Asral Publication. Pp 286

Course			NME 2				Code		B6ZONM2	
Credits	3	Semester	VI	Hours/Week	3	CIA	30	Ext	70	
PUBLIC HEALTH AND HYGIENE (for students admitted from the academic year 2026-2027)										
Course Objectives:										
The main objectives of this course are:										
1	To make the students to understand the history and characteristics of nutritional deficiency diseases among the peoples									
2	To understand and create the awareness of pollution and causes of pollution									
3	To study the communicable diseases and their causes symptoms treatment and prevention									
4	To know the importance and Role of World Health Organization in Health Care aspects									
5	To study the mental health conditions and role of national and international agency in health care									

Unit-I

Status of health care in India: History of public health in India, Health care system in India., brief introduction to Primary Health Care in India.

Nutrition and health: Classification of foods, Growth and development, Growth chart, nutritional deficiency diseases, nutritional requirements of special groups, Balanced diet.

Unit-II

Environment and Health Management: Water-Water standards and purification of water-Health effects of water pollution. Air: Ventilation, discomfort prevention, Health Effects of Air Pollution. Solid waste: Excreta disposal methods and sanitation. Noise Pollution: Effects and treatments

Unit-III

Communicable diseases: control and health care programs of national importance. Clinical features, diagnosis, treatment & resistance, immunization and prevention practices, health programmes of the following diseases: Respiratory infections - Tuberculosis. Intestinal infections - Cholera. Arthropod-borne infections - Malaria. Zoonosis - Rabies. Sexually transmitted infection - AIDS

Unit-IV

Non-communicable disease: control and health care programs for of national importance (extent of problem, diagnosis, treatment and control, health programmes (if applicable): Hypertension, stroke, diabetes, breast cancer.

Unit-V

Mental health: Introduction and scope. Features of mentally healthy person, signs of poor mental health, types of mental health (anxiety and depression), and prevention. National Mental Health Programme (NMHP). Infertility: Measures of fertility and factors affecting fertility. IVF and Assisted Reproductive Techniques.

Reference Books

Bauman, R, 2007. Microbiology with diseases by Taxonomy. Benjamin Cummings
Park, K. 2021. 26th Edition, Park's Textbook of Preventive and Social Medicine, 297 Banarsidas
Bhanot Publisher, ISBN-13: 978-9382219163.
Bonita, Ruth, Beaglehole, Robert, Kjellström, Tord & World Health Organization. 2006. 2nd edition.
Basic Epidemiology, World Health Organization, ISBN 9789241547079.