

M.Sc. Zoology (Wild Life Biology)

Syllabus

AFFILIATED COLLEGES

Program Code:

2020 – 2021 onwards



BHARATHIAR UNIVERSITY

(A State University, Accredited with “A” Grade by NAAC,
Ranked 13th among Indian Universities by MHRD-NIRF,
World Ranking: Times -801-1000, Shanghai -901-1000, URAP - 982)

Coimbatore - 641 046, Tamil Nadu, India

Program Educational Objectives (PEOs)	
The M. Sc. Zoology (Wildlife Biology) program describe accomplishments that graduates are expected to attain within five to seven years after graduation	
PEO1	M.Sc., graduates can work as teaching faculty, researchers, scientists, Forest service & Biologists. They can also become teachers or animal trainers in all fields of biology.
PEO2	They can find jobs in any field of biological science including Forest Ecologist and biomedical related labs and field works.
PEO3	They can enter into environment, forest ecosystems and pollution control sectors.
PEO4	They can find employment in Zoos, Museums, Zoological Parks, Tiger Reserves, Sanctuaries and National Parks.
PEO5	They can fit into Wildlife Forensic labs
PEO6	They can earn and shine in Forest department& Research institutions
PEO7	They can work in Veterinary sector
PEO8	They are eligible to serve as Biologist & Scientist in wildlife institutions
PEO9	Appear exams to become forest officials
PEO10	Higher studies as Ph.D in Zoology and Wildlife Biology



Program Specific Outcomes (PSOs)	
After the successful completion of Zoology(Wildlife Biology) program, the students are expected to	
PSO1	Elucidate animal-animal, animal-plant, animal-microbe interactions and their consequences to animals, humans and the environment.
PSO2	Develop deeper understanding of key concepts of biology at biochemical, molecular and cellular level, physiology and reproduction at organismal level, and ecological impact on animal behavior.
PSO3	Strengthen knowledge of genetics and cytogenetic principle in light of advancements in understanding animal genome and other model organisms.
PSO4	Describe the expression of genome revealing multiple levels of regulation and strategies to manipulate the same in the benefit of animal life.
PSO5	Learn handling DNA sequence data and its analysis which equip students to get employed in R&D in the industry involved in DNA sequencing services, forensic analysis.
PSO6	Understand relationships of variations in phenotypic expression of genome.
PSO7	Develop an understanding of zoological science for its application in animal classification forest entomology and wildlife science.
PSO8	Develop theoretical and practical knowledge in handling the animals and using them as model organism.
PSO9	Maintain high standards of learning in animal sciences especially in wildlife.
PSO10	Focus to prepare them with research-oriented approach in frontier areas of research in Wildlife Biology and preparing them for carrying out advance research.

Program Outcomes (POs)	
On successful completion of the M. Sc. Zoology(Wildlife Biology) program	
PO1	Expected to attain written skills via assignment, reports , seminar & projects
PO2	To develop presentation & communication skills through research
PO3	To attain analytical skills like understanding & interpreting the results
PO4	To know the basics of instrumentation
PO5	To develop taxonomical skills in identifying the animal species
PO6	To learn about animal biodiversity, forest ecosystems
PO7	To understand animal by studying the biology, anatomy, physiology etc.,
PO8	To create an awareness of the impact of Zoology on the environment, forestry and development outside the scientific community.
PO9	To study and understand the classification of whole phyla includes in Non chordates with the help of charts/models/pictures/videos
PO10	To inculcate the scientific temperament in the students and creating interest in research.



BHARATHIAR UNIVERSITY : COIMBATORE 641 046
M.Sc., ZOOLOGY(Wildlife Biology) DEGREE COURSE (COLLEGES - CBCS PATTERN)
MODIFIED SCHEME OF EXAMINATION
(For the students admitted during the academic year 2020 – 21 onwards)

Course Code	Paper	Title of the Course	Credits	Hours		Maximum Marks		
				Theory	Practical	CIA	ES E	Total
FIRST SEMESTER								
13A	Core I	Structure and functions of Invertebrates	4	6	-	25	75	100
13B	Core II	Comparative anatomy of Chordates	4	6	-	25	75	100
13C	Core III	Environmental Biology	4	6	-	25	75	100
13D	Core IV	Animal Biodiversity & Conservation	4	6	-	25	75	100
23P	Practical I	(Comprises of Papers I,II&III)	-	-	2	-	-	-
23Q	Practical II	(Comprises of Papers IV&V)	-	-	2	-	-	-
23R	Practical III	(Comprises of Papers VI,VII&VIII)	-	-	2	-	-	-
Total			16					400
SECOND SEMESTER								
23A	Core V	Biochemistry	4	6	-	25	75	100
23B	Core VI	Cell & Molecular Biology	4	6	-	25	75	100
23C	Core VII	Developmental Biology	4	6	-	25	75	100
23D	Elective I	Vertebrate biology & conservation	4	6	-	25	75	100
23P	Practical I	(Comprises of Papers I,II&III)	4	-	2	40	60	100
23Q	Practical II	(Comprises of Papers IV&V)	4	-	2	40	60	100
23R	Practical III	(Comprises of Papers VI,VII&VIII)	4	-	2	40	60	100
Total			28					700
THIRD SEMESTER								
33A	Core IX	Comparative Animal Physiology	4	6	-	25	75	100
33B	Core X	Evolution	4	6	-	25	75	100
3EC	Core XI	Genetics	4	5	-	25	75	100
3EB	Elective II	Forestry, Silviculture and Entomology	4	5	-	25	75	100
43P	Practical IV	(Comprises of Papers IX&XI)	-	-	2	-	-	-
43Q	Practical V	(Comprises of Papers X&XII)	-	-	2	-	-	-
43R	Practical VI	Wildlife management techniques (Paper XIII)	-	-	2	-	-	-
4EQ	Practical VII	Ethology (Paper XIV)	-	-	2	-	-	-
Total			16					400

FOURTH SEMESTER								
43A	Elective III	Wildlife management techniques	4	6	-	25	75	100
43B	Elective IV	Ethology	4	6	-	25	75	100
4EC	Paper XV	Project & viva – voce	12	-		40	160*	200
43P	Practical IV	(Comprises of Papers IX&XI)	4	-	2	40	60	100
43Q	Practical V	(Comprises of Papers X&XII)	4	-	2	40	60	100
43R	Practical VI	Wildlife management techniques (Paper XIII)	4	-	2	40	60	100
43S	Practical VII	Ethology (Paper XIV)	4	-	2	40	60	100
		Total	36					800
		Grand Total	90					2300

*For Project 200 marks (Project work =160 marks and Viva-voce =40 marks).

Project Guidelines:

1. Internal and external examiners will evaluate the project work and award marks out of 160.
2. Internal and external examiners will conduct viva-voce examination and award marks out of 40.



First Semester

Course code	13A	STRUCTURE AND FUNCTIONS OF INVERTEBRATES	L	T	P	C
Core/Elective/Supportive	Core Paper I		6	0	0	4
Pre-requisite	Basic knowledge about Invertebrate forms and their functions		Syllabus Version	2020 - 2021		
Course Objectives:						
The main objectives of this course are:						
1. To understand about the procedures and trends in taxonomy.						
2. To understand important physiological functions in various Invertebrate forms.						
3. To know about the larval forms of Invertebrates.						
4. To know about the organization of Minor Phyla and its characters.						
Expected Course Outcomes:						
On the successful completion of the course, student will be able to:						
1	Understand concepts of taxonomy, its procedures, methods in collection and preservation of animals as well as classification of animals based on coelom.					K1
2	Attain knowledge about locomotory organs, locomotion, feeding and digestion in various Invertebrates.					K2
3	Gain knowledge about organs of respiration, respiratory pigments, their mechanism, organs and products of excretion, mechanism and its relation to osmoregulation.					K3
4	Understand the organization and function of nervous system in various Invertebrates and its evolutionary advances.					K4
5	Integrate the strategies and evolutionary significance of free living and parasitic larval forms of Invertebrates as well as organization and characters of Minor Phyla groups.					K5
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create						
Unit:1	PRINCIPLES OF ANIMAL TAXONOMY				18-- hours	
Species concept; International code of zoological nomenclature - Taxonomic procedures. New trends in taxonomy - Animal collection, handling and preservation - Organization of coelom – Acoelomates – Pseudocoelomates - Coelomates: Protostomia and Deuterostomia.						
Unit:2	LOCOMOTION, NUTRITION AND DIGESTION				18 hours	
Locomotion: Pseudopodia - Flagella and ciliary movement in protozoa - Hydrostatic movement in Coelenterata, Annelida and Echinodermata - Nutrition and Digestion: Patterns of feeding and digestion in lower metazoan - Filter feeding in polychaeta, Mollusca and Echinodermata.						
Unit:3	RESPIRATION AND EXCRETION				18 hours	
Respiration: Organs of respiration: gills, lungs and trachea - Respiratory pigments - Mechanism of respiration – Excretion: Organs and products of excretion - coelom, coelomducts, nephridia and Malpighian tubules - Mechanisms of excretion - Excretion and osmoregulation.						
Unit:4	NERVOUS SYSTEM				16 hours	
Nervous system: Primitive nervous system: Coelenterata and Echinodermata - Advanced nervous system: Annelida, Arthropoda (crustacean and insecta) and Mollusca (cephalopoda) - Trends in neural evolution.						

Unit:5	LARVAL FORMS AND MINOR PHYLA	18 hours
Invertebrata larvae: Larval forms of free living invertebrates - Larval forms of parasites - Strategies and evolutionary significance of larval forms - Minor Phyla - Organization and general characters, morphology, anatomy and affinities of Rotifera, Phoronida and Chaetognatha.		
Unit:6	Contemporary Issues	2 hours
Expert lectures, online seminars – webinars, Conferences and Workshops		
Total Lecture hours		90 hours
Text Book(s)		
1	Parker, T.J., Haswell, W.A. Text Book of Zoology (1962), Macmillan Co., London	
2	Barnes, R.D. Invertebrate Zoology (1968), III edition. W.B. Saunders Co., Philadelphia	
3	Barrington, E.J.W. Invertebrate structure and function (1967). Thomas Nelson and Sons Ltd., London	
4	Young, J.Z. Life of Invertebrates (2004), Clarendon Press, Oxford.	
Reference Books		
1	Hyman, L.H. The invertebrates (1951). Vol. 1 Protozoa through Ctenophora, McGraw Hill Co., New York	
2	Hyman, L.H. The Invertebrates (1951). Vol.2. McGraw Hill Co., New York.	
3	Hyman, L.H. The Invertebrate smaller coelomate groups, (1951). Vol.5. McGraw Hill Co., New York	
4	Hyman, L.H. The Invertebrates (1951). Vol.8. McGraw Hill Co., New York and London	
5	Russel-Hunter, W.D. A biology of higher Invertebrates (1969), the Macmillan Co. Ltd., London	
6	Jagerstein, G. Evolution of Metazoan life cycle (1972), Academic Press, New York & London.	
7	Narendran, T.C. An Introduction to Taxonomy (2009), Zoological Survey of India.	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	Systems Biology (NPTEL) web https://nptel.ac.in/courses/102/106/102106035/	
Course Designed By: Dr. S. Vidya		

Mapping with Programme Outcomes										
Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	S	S	L	S	M	S	S	M	L
CO2	S	M	M	L	S	S	S	M	S	M
CO3	S	M	M	L	S	S	S	M	S	M
CO4	L	L	L	L	S	M	S	M	S	S
CO5	M	M	S	L	S	S	S	S	S	S

*S-Strong; M-Medium; L-Low

Course code	13B	COMPARATIVE ANATOMY OF CHORDATES	L	T	P	C
Core/Elective/Supportive	Core Paper II		6	0	0	4
Pre-requisite	Basic knowledge about vertebrate anatomy and physiology		Syllabus Version		2020 - 2021	
Course Objectives:						
The main objectives of this course are						
<ol style="list-style-type: none"> To understand about vertebrate morphology and its origin. To study about structure and function of Protochordate types. To study about vertebrate classification and development, structure and function of integument types. To understand the flow of blood and evolution of circulatory organs and process of respiration. To know about the various aspects of skeletal system and evolution of urinogenital system To understand the working of nervous system and sense organs. 						
Expected Course Outcomes:						
On the successful completion of the course, student will be able to:						
1	Understand the origin of Chordata, concept of Protochordata, importance of Vertebrate morphology and biology of some Protochordates.					K1
2	Gain knowledge about Vertebrate classification, as well as structure and function of integument and its derivatives.					K2
3	Analyze the evolution of heart, aortic arches and portal systems, blood components as well as respiratory mechanisms and organs in various Vertebrates.					K4
4	Understand the comparative form and function of skeletal system and its parts and analyze the evolution of urinogenital system in different Vertebrates.					K2&K5
5	Gain knowledge about comparative anatomy of nervous system and its components as well as receptors of olfaction, taste and hearing and other organs.					K2
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 – Create						
Unit:1	PROTOCHORDATA AND CHORDATE MORPHOLOGY				18 hours	
Origin of Chordata: Concept of Protochordata - The nature of vertebrate morphology - Definition, scope and relation to other disciplines - Importance of the study of vertebrate morphology, Biology of Cephalochordata, Hemichordata and Urochordata.						
Unit:2	VERTEBRATE CLASSIFICATION AND INTEGUMENT				18 hours	
Origin and classification of vertebrates. Vertebrate integument and its derivatives - Development, general structure and functions of skin and its derivatives - Glands, scales, horns, claws, nail, hoofs, feathers and hairs.						
Unit:3	CIRCULATION AND RESPIRATION				18 hours	
Blood - Evolution of heart - Evolution of aortic arches and portal systems - Respiratory system - Characters of respiratory tissue - Internal and external respiration - Comparative account of respiratory organs in Vertebrate classes.						

Unit:4	SKELETAL SYSTEM AND URINOGENITAL SYSTEM	16 hours
Skeletal system: Form, function, body size and skeletal elements of the body - Comparative account of jaw suspensorium, vertebral column - Limbs and girdles - Evolution of urinogenital system in different vertebrates (Pisces, Amphibians, Reptiles, Birds and Mammals).		
Unit:5	NERVOUS SYSTEM AND SENSE ORGANS	18 hours
Nervous system - Comparative anatomy of the brain in relation to its functions - Comparative anatomy of spinal cord – Nerves-Cranial, Peripheral and Autonomous nervous system. Sense organs: Simple receptors - Organs of olfaction, taste and hearing - Lateral line system- Electroreception		
Unit:6	Contemporary Issues	2 hours
Expert lectures, online seminars – webinars		
Total Lecture hours		90 hours
Text Book(s)		
1	Kingsley J S. Outline of Comparative Anatomy of Vertebrates (1974). Central Book Depot, Allahabad.	
2	Kent, George C & Carr, Robert K. Comparative Anatomy of Vertebrates(2009), Mc Graw-Hill Science.	
3	Young, J.Z. Life of vertebrates (1950). The Oxford University Press, London.	
4	Weichert, C.K. and Presch, W. Elements of chordate anatomy (1977), 4th Edn. McGraw Hall Books Co., New York	
5	Malcom Jollie, Chordata morphology. East-West Press Pvt. Ltd., New Delhi.	
Reference Books		
1	Smith, H.S. Evolution of chordate structure (1960). Hold Rinehart and Winstoin Inc., New York	
2	MilltonHilderbrand. Analysis of vertebrate structure(1988). IV. Ed. John Wiley and Sons Inc., New York.	
3	Romer, A.S. Vertebrate body (1949), IIIrd Ed. W.B. Saunders Co., Philadelphia.	
4	Montagna, W. Comparative anatomy (1960). John Wiley and Sons Inc.	
5	Walters, H.E. and Sayles, L.D. Biology of vertebrates (1959). Macmillan & Co., New York	
6	Torrey, T.W. Morphogenesis of vertebrates (1963), John Wiley and Sons Inc., New York and London	
7	Colbert, E.H. Evolution of the vertebrates (1969), John Wiley and Sons Inc., New York.	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	General Human Anatomy (WMA): https://www.mooc-list.com/course/general-human-anatomy-wma	
2	Evolutionary Biology: https://onlinecourses.swayam2.ac.in/cec20_bt06/preview	
Course Designed By: Dr. J. Ebanasar		

Mapping with Programme Outcomes										
Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	M	M	L	S	S	S	L	S	M
CO2	S	M	L	L	S	S	S	S	S	M
CO3	M	L	M	L	S	S	S	S	S	M
CO4	S	M	M	L	S	S	S	S	S	M
CO5	S	M	M	L	S	S	S	S	S	M

*S-Strong; M-Medium; L-Low



Course code	13C	ANIMAL BIODIVERSITY AND CONSERVATION	L	T	P	C
Core/Elective/Supportive		Core Paper III	6	0	0	4
Pre-requisite		Basic knowledge about animal biodiversity and conservation	Syllabus Version		2020-2021	
Course Objectives:						
The main objectives of this course are to:						
1. Acquire the knowledge of biodiversity in different geographical areas.						
2. Understand the strategies evolved to conserve biodiversities and their habitats.						
3. Know the measures in vogue to restore the biodiversity and environment.						
4. Levels of organization in animals.						
5. Analyze the evolutionary affinities of vertebrates.						
6. Create awareness against wildlife crimes and Laws in conserving biodiversity.						
Expected Course Outcomes:						
On the successful completion of the course, student will be able to:						
1.	Understand the significance of conservation of biodiversity.					K2
2.	Appreciate the various conservation strategies to protect biodiversity.					K4
3.	Know the comparative anatomy and evolutionary affinities of vertebrates.					K2
4.	Admire the values of ethical committee in animal research					K3
5.	Develop awareness against wildlife crimes and wildlife degradation					K5
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 – Create						
Unit:1	BIODIVERSITY					18 hour
Biodiversity –terrestrial, marine and agro ecosystems.						
Hotspots – significance of Western Ghats and Indo-Burma region.						
Biosphere reserves in India and their prospects.						
Rare endemic and endangered species – IUCN Red list category – CITES						
Unit:2	CONSERVATION BIOLOGY					18 hour
In-situ and Ex-situ conservation						
Project Tiger and Project Elephant						
Human animal conflicts – Deforestation, Afforestation and Forest fire.						
Animal ethics – Ethical committee						
Discontinuation of dissection in educational institutions.						
Unit:3	SYSTEMATIC ZOOLOGY					16 hour
Species concept – levels of structural organization – Unicellular – Multicellular forms – Colonial.						
Levels of organization: Kingdom Animalia – salient features of all phylum – classification up to class for invertebrates and up to orders for vertebrates with examples						
Unit:4	SCOPE AND IMPORTANCE OF WILDLIFE OF INDIA					18 hour
Depletion of wildlife: Causes of wildlife depletion.						
Economic importance of wildlife.						
Need for wildlife conservation.						
India - the country of Mega biodiversity.						

Unit:5	MODERN CONCEPTS IN WILDLIFE CONSERVATION	18 hour
Wildlife Crimes: Wildlife forensics and its applications in detecting wildlife crimes. Wildlife toxicology: Types of contaminants - methods of toxicity evaluation. Bio concentration, bio accumulation and bio magnifications. Impacts of pesticides and heavy metals on amphibia, reptilia, aves and mammals. CAMP and PHVA-Analysis and reports.		
Unit:6	Contemporary Issues	2 hour
Expert lectures, online seminars – webinars, Conferences and Workshops		
	Total Lecture hours	90 hours
Text Book(s)		
1.	Textbook of Biodiversity - K V Krishnamurthy, by Science Publishers (2003).	
2.	Glimpses of Biodiversity (2002)- B.Blosetti.	
3.	Biodiversity: An Introduction (2004), 2nd Edition- Kevin J. Gaston, John I. Spicer, Wiley-Blackwell.	
4.	Comparative Anatomy, Function, Evolution (1994) – Kenneth V.Kardong	
5.	The life of vertebrates (2004)– J.Z.Young	
6.	Comparative anatomy (2016) – Nigam	
7.	Manual of Zoology (1964)– Egambaranathar Iyyer	
Reference Books		
1.	Minor Phyla (1990) – Kotpal	
2.	Agrobiodiversity -David Wood (1999), Jillian M. Lenné, CABI Pub., Nature	
3.	WILLIAM MN (2019) Biodiversity , CBS Publishers	
4.	Anne Elizabeth Maczulak (2010) Biodiversity – Infobase publication	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	Ecology and Wildlife Conservation (FutureLearn): https://www.mooc-list.com/course/ecology-and-wildlife-conservation-futurelearn	
2	Wildlife Conservation: https://nptel.ac.in/courses/102/104/102104068/	
	Wildlife Ecology: https://swayam.gov.in/nd1_noc20_bt38/preview	
Course Designed By: Dr. S. Vidya		

Mapping with Programme Outcomes										
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	L	S	S	M	M	M	S
CO2	S	S	S	L	S	S	M	M	M	S
CO3	S	S	S	L	S	S	S	S	S	S
CO4	S	S	S	L	S	M	M	M	S	S
CO5	S	S	S	L	S	S	S	S	S	S

*S-Strong; M-Medium; L-Low

Course code	13D	ENVIRONMENTAL BIOLOGY		L	T	P	C
Core/Elective/Supportive	Core Paper IV			6	0	0	4
Pre-requisite	Basic understanding about our own environment			Syllabus Version	2020-2021		
Course Objectives:							
The main objectives of this course are to:							
<ol style="list-style-type: none"> 1. Explain core concepts in ecology, and summarize our ecological understanding of environmental problems. 2. Describe how humans need nature to survive. 3. Summarize the ways in which sustainability has been defined. 							
Expected Course Outcomes:							
On the successful completion of the course, student will be able to:							
1	Describe and debate various global and regional environmental concerns that affect various forms of life					K3	
2	Appreciate the impact of human activities on other life and the environment.					K4	
3	Argue the significance of native biodiversity and need for its conservation					K2	
4	Investigate specific cases of environmental pollution or natural challenges, and their impact					K5	
5	Apply chemistry, biology, molecular biology and microbiology skill to environment issues					K3	
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create							
Unit:1	THE ENVIRONMENT					18 hours	
The Environment: Physical environment; biotic environment; biotic and abiotic interactions. Habitat and Niche: Concept of habitat and niche; niche width and overlap; fundamental and realized niche; resource partitioning; character displacement.							
Unit:2	POPULATION ECOLOGY					18 hours	
Population Ecology: Characteristics of a population; population growth curves; population regulation; life history strategies (r and K selection); concept of metapopulation – demes and dispersal, interdemec extinctions, age structured populations. Species Interactions: Types of interactions, interspecific competition, herbivory, carnivory, pollination, symbiosis.							
Unit:3	COMMUNITY ECOLOGY					16 hours	
Community Ecology: Nature of communities; community structure and attributes; levels of species diversity and its measurement; edges and ecotones. Ecological Succession: Types; mechanisms; changes involved in succession; concept of climax.							
Unit:4	ECOLOGY OF ECOSYSTEM					18 hours	
Ecology of Ecosystem: Ecosystem structure; ecosystem function; energy flow and mineral cycling (C,N,P); primary production and decomposition; structure and function of some Indian ecosystems: terrestrial (forest, grassland) and aquatic (fresh water, marine, estuarine). Biogeography: Major terrestrial biomes; theory of island biogeography; biogeographical zones of India.							

Unit:5	APPLIED ECOLOGY	18 hours
Applied Ecology: Environmental pollution and Bioremediation; global environmental change; biodiversity: status, monitoring and documentation; major drivers of biodiversity change; biodiversity management approaches. Conservation Biology: Principles of conservation, major approaches to management, Indian case studies on conservation/management strategy. (Biosphere reserves in India).		
Unit:6	Contemporary Issues	2 hours
Expert lectures, online seminars – webinars, Workshop		
Total Lecture hours		90 hours
Text Book(s)		
1	Odum: Fundamentals of Ecology (1953)	
2	Odum: Basic Ecology (1983)	
3	Turk and Turk: Environmental Science	
Reference Books		
1	Primark: A Primer of Conservation Biology (1995)	
2	Calabrese: Pollutants and High-Risk Groups (1978)	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	Ecology and Environment: https://www.classcentral.com/course/swayam-ecology-and-environment-14021	
2	Environmental Studies: https://onlinecourses.swayam2.ac.in/cec19_bt03/preview	
3	Ecology and Environment, Prof. Abhijit Deshpande and Prof. R. Ravi Krishna , IIT Madras, https://swayam.gov.in/nd1_noc19_ge23/preview	
Course Designed By: Dr. J. Ebanasar		

Mapping with Programme Outcomes										
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	L	S	S	S	S	S	S
CO2	S	S	S	L	S	S	M	S	L	S
CO3	S	S	S	L	S	S	M	S	L	S
CO4	S	S	S	L	S	M	L	M	S	S
CO5	S	S	S	L	S	S	S	S	S	S

*S-Strong; M-Medium; L-Low



Second Semester

Course code	23A	BIOCHEMISTRY		L	T	P	C
Core/Elective/Supportive	Core Paper VI		6	0	0	4	
Pre-requisite	Basic knowledge about Biochemistry		Syllabus Version	2020-2021			
Course Objectives:							
The main objectives of this course are to:							
<ol style="list-style-type: none"> To understand the basics of molecules To elucidate its interaction & biomolecular bonding To understand the basic metabolism. 							
Expected Course Outcomes:							
On the successful completion of the course, student will be able to:							
1	Understand the physical and chemical concepts in Wildlife biology.					K2	
2	Learn the structure, properties and functions of biomolecules of Wild Animals.					K2	
3	Analyze enzymes and concepts of bioenergetics.					K4	
4	Appreciate the various carbohydrate metabolic pathways in various Wild animals.					K5	
5	Understand metabolism of nucleic acid, amino acid and lipid.					K2	
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create							
Unit:1	BASIC PRINCIPLE					16 hours	
Structure of atoms, molecules and chemical bonds Principles of biophysical chemistry (pH, buffer, reaction kinetics, thermodynamics, colligative properties).							
Unit:2	STABILIZING INTERACTION					18 hours	
Stabilizing interactions (Van der Waals, electrostatic, hydrogen bonding, hydrophobic interaction, etc.). Composition, nature of bonds/linkages, structure of biomolecules (carbohydrates, lipids, proteins, nucleic acids and vitamins).							
Unit:3	BIOENERGETICS					18 hours	
Bioenergetics, glycolysis, oxidative phosphorylation, coupled reaction, group transfer, biological energy transducers. Principles of catalysis, classification of enzymes and enzyme kinetics, enzyme regulation, inhibitors of enzymes - mechanism of enzyme catalysis, isozymes							
Unit:4	CONFORMATION OF PROTEINS					18 hours	
Conformation of proteins (Ramachandran plot, primary, secondary, tertiary and quaternary structures, domains, motif and folds). Conformation of nucleic acids (helix (A, B, Z), t-RNA, micro-RNA).							
Unit:5	METABOLISM					18 hours	
Stability of proteins and nucleic acids. Metabolism of amino acids, carbohydrates, lipids, nucleotides and vitamins.							
Unit:6	Contemporary Issues					2 hours	
Expert lectures, online seminars – webinars							
Total Lecture hours					90 hours		

Text Book(s)	
1	I.H. Segal, Biochemical calculations, John Wiley & sons (1976)
2	T.E. Creighton, Proteins-structure and Molecular Properties (1992), W.H. Freeman & Company.
Reference Books	
1	D.Voet and J.G. Voet. Biochemistry (1990), John Wiley & sons.
2	D.Freifelder, Physical Biochemistry (1982), W.H. Freeman & Company
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	Biochemistry: https://swayam.gov.in/nd1_noc20_cy10/preview
2	Biochemistry & Molecular Biology: https://swayam.gov.in/nd2_cec19_bt02/preview
3	Biochemistry: Biomolecules, Methods, and Mechanisms (edX): https://www.mooc-list.com/course/biochemistry-biomolecules-methods-and-mechanisms-edx
Course Designed By: Dr. J. Ebanasar	

Mapping with Programme Outcomes										
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	M	L	L	M	M	L	S
CO2	S	S	S	M	L	L	M	M	L	S
CO3	S	S	S	M	L	L	M	M	L	S
CO4	S	S	S	M	L	L	M	M	L	S
CO5	S	S	S	M	L	L	M	M	L	S

*S-Strong; M-Medium; L-Low

Course code	23B	CELL AND MOLECULAR BIOLOGY	L	T	P	C
Core/Elective/Supportive	Core Paper VII		6	0	0	4
Pre-requisite	Basic knowledge about Cell and Molecular Biology		Syllabus Version		2020-2021	
Course Objectives:						
1. To provide an overview of cell structure, basic components of cells and their function..						
2. To learn the fundamental concepts of cell structure, dynamic character of cellular organelles function and relationship between molecular levels.						
3. To make aware of how cellular components generate and utilize energy inside the cells.						
Expected Course Outcomes:						
On the successful completion of the course, student will be able to:						
1	Understand and apply the principles and techniques of molecular biology in basic research, or in the health professions.					K3
2	Gain knowledge about molecular level regulation of cellular processes, cell signalling, transportation and proliferation in cells.					K2
3	Analyze the picture of the cellular environment and regulation of cellular process at the molecular level.					K4
4	Students will learn about the mechanisms and regulation of cell communication, gene expression, genome maintenance and regulation involved in the flow of genetic information.					K4
5	Ensuring accurate macromolecular biosynthesis, unity and diversity at the molecular and cellular levels and the relationship.					K5
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create						
Unit:1	INTRODUCTION OF BIOMEMBRANE				16 hours	
Introduction – experimental systems in Cell Biology Biomembranes - Molecular composition and arrangement functional consequences - Transport across cell membrane- Diffusion, active transport and pumps and uniports, symports and antiport - Membrane potential - Co-transport by symports or antiporters - Transport across epithelia.						
Unit:2	CYTOSKELETON				18 hours	
Microfilaments and microtubules-structure and dynamics - Microtubules and mitosis - Cell movements-intracellular transport, role and kinesin and dynein, signal transduction mechanisms Cilia and flagella - Cell-cell signalling - Cell surface receptors - Second messenger system - MAP kinase pathways - Signalling from plasma membrane to nucleus.						
Unit:3	CELL- CELL ADHESION AND COMMUNICATION				18 hours	
Ca ⁺⁺ dependent homophilic cell-cell adhesion - Ca ⁺⁺ independent homophilic cell-cell adhesion Gap junctions and connexions - Cell matrix adhesion – Integrins – Collagen - Non-collagen components - Cell cycle - cyclins and cyclin dependent kinases - Regulation of CDK- cyclin activity.						
Unit:4	GENOME ORGANIZATION				18 hours	
Hierarchy in organization - Chromosomal organization of coding and non-coding DNA – Regulation of gene expression - Mobile DNA - Morphological and functional elements of eukaryotic chromosomes - Genetic analysis in Cell Biology.						

Unit:5	INTRACELLULAR PROTEIN TRAFFIC	18 hours
Protein synthesis on free and bound polysomes - Uptake into ER - Membrane proteins, Golgi sorting, post-translational modifications - Biogenesis of mitochondria, and nuclei - Trafficking mechanisms - Biology of cancer - Biology of aging - Apoptosis-definition, mechanism and significance.		
Unit:6	Contemporary Issues	2 hours
Expert lectures, online seminars – webinars		
Total Lecture hours		90-- hours
Text Book(s)		
1	Arumugam N, (2007) 6 th edition. <i>CellBiology</i> , Saras Publications, Nagercoil.	
2	Meyyan RP. (2005). <i>Cell Biology</i> , Saras Publications, Nagercoil.	
3	Singh SP and Thomas BS. (2012). <i>Cellbiology</i> . Rastogi Publications, Meerut - 02,	
4	Verma, PS and Agarwal VK (2004). <i>Cell biology, Genetics, Molecular Biology, Evolution and Ecology</i> . S.Chand & Company Ltd. New Delhi.	
Reference Books		
1	Chariotte J. Averse. (1995). <i>MolecularCellBiology</i> . Addison Wesley Publ. Co.	
2	De Robertis EDP and De Robertis EMF, (1987). <i>Cell and Molecular Biology</i> , Lippincott Williams & Wilkins., India.	
3	Gupta PK., (2008). <i>Cell and molecular biology</i> , Rastogi publications, Shivaji Road, Meerut	
4	Power CB. (2009). <i>Cell Biology</i> , Himalaya Publishing House, Mumbai.	
5	Tomar and Singh, (1999). <i>Cell Biology</i> . Rastogi Publication, Meerut.	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	https://www.classcentral.com/course/swayam-cell-biology-13937	
2	https://www.universalclass.com/i/course/cell_molecular_biology_101.htm	
3	https://www.edx.org/learn/cellular-biology	
Course Designed By: Dr. S. Vidya		

Mapping with Programme Outcomes										
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	S	L	L	M	M	L	M
CO2	S	S	S	S	L	L	M	M	L	M
CO3	S	S	S	S	L	L	M	M	L	M
CO4	S	S	S	S	L	L	L	L	L	M
CO5	S	S	S	S	L	L	L	L	L	M

*S-Strong; M-Medium; L-Low

Course code	23C	DEVELOPMENTAL BIOLOGY		L	T	P	C
Core/Elective/Supportive	Core Paper VIII		6	0	0	4	
Pre-requisite	Basic information on animal embryology		Syllabus Version		2020-2021		
Course Objectives:							
The main objectives of this course are to:							
1. To make aware of the students about the theories, concepts and basics of Developmental Biology.							
2. To provide students the idea of sex cells, fertilization, cleavage, differentiation and development of organs.							
3. To make aware of the induction, organizers and development of extra embryonic structures.							
Expected Course Outcomes:							
On the successful completion of the course, student will be able to:							
1	The learner will be able to understand methodological approaches to the study of embryonic development and the characteristics of the principle experimental models.					K2	
2	The students will be able to identify embryonic structures in preparations, photographs and diagrams					K5	
3	The students will be able to develop an idea, how to arrange sequences in developmental processes in order.					K4	
4	The learner will be able to understand the derivatives of embryonic structures.					K2	
5	The students will attain a basic conceptual knowledge of the principle cellular mechanisms of development and identify the genetic and molecular elements that are involved.					K4	
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create							
Unit:1	BASIC CONCEPTS OF DEVELOPMENT					18 hours	
Potency, commitment, specification, induction, competence, determination and differentiation; morphogenetic gradients; cell fate and cell lineages; stem cells; genomic equivalence and the cytoplasmic determinants; imprinting; mutants and transgenics in analysis of development							
Unit:2	GAMETOGENESIS, FERTILIZATION AND EARLY DEVELOPMENT					16 hours	
Production of gametes, cell surface molecules in sperm-egg recognition in animals; zygote formation, cleavage, blastula formation, embryonic fields, gastrulation and formation of germ layers in animals; embryogenesis, establishment of symmetry.							
Unit:3	MORPHOGENESIS AND ORGANOGENESIS IN ANIMALS					18 hours	
Cell aggregation and differentiation in Dictyostelium; axes and pattern formation in Drosophila, amphibia and chick; organogenesis – vulva formation in Caenorhabditis elegans, eye lens induction, limb development and regeneration in vertebrates; differentiation of neurons, post embryonic development- larval formation, metamorphosis; environmental regulation of normal development; sex determination.							
Unit:4	NEOTENY AND REGENERATION					18 hours	
Neoteny: Occurrence and significance – Regeneration: Regenerative capacity in the Animal Kingdom – Factors influencing regeneration – Stimulation and Suppression – Polarity and Gradients – Development of immune system in vertebrates.							

Unit:5	AGING AND ASSISTED REPRODUCTIVE TECHNOLOGY	18 hours
Programmed cell death, aging and senescence - Asexual reproduction - Assisted Reproductive Technology (ART) – Male infertility – Sperm abnormalities – Superovulation – IVF, ICSI, GIFT – Screening of genetic disorders.		
Unit:6	Contemporary Issues	2 hours
Expert lectures, online seminars – webinars		
Total Lecture hours		90 hours
Text Book(s)		
1	Balinsky., Introduction to Embryology (1960)	
2	Grant, Biology of Developing System (1978)	
Reference Books		
1	Austen, C.R. and short, R.V., Reproduction in animals (1989).	
2	Schatten and Schatten. Molecular biology of fertilization (2012).	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	NOC: Introduction to Developmental Biology, Prof. Subramaniam K, IIT Madras, https://nptel.ac.in/courses/102/106/102106084/	
Course Designed By: Dr. S Vidya		

Mapping with Programme Outcomes										
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	S	M	L	M	M	L	S
CO2	S	S	S	S	M	L	M	M	L	S
CO3	S	S	S	S	M	L	M	M	L	S
CO4	S	S	S	S	M	L	M	M	L	S
CO5	S	S	S	S	M	L	M	M	L	S

*S-Strong; M-Medium; L-Low

Course code	23D	VERTEBRATE BIOLOGY AND CONSERVATION		L	T	P	C
Core/Elective/Supportive	Core Paper VIII			6	0	0	4
Pre-requisite	Basic information on animal embryology			Syllabus Version	2020-2021		
Course Objectives:							
The main objectives of this course are to:							
1. To develop awareness about the application of vertebrate biology and application in wildlife biology.							
2. To learn the taxonomy and classification of animals.							
3. To study about economic importance of animals and health care of wild animals.							
Expected Course Outcomes:							
On the successful completion of the course, student will be able to:							
1	Understanding the beneficial role of animals.						K2
2	To elucidate various reason for infectious and non-infectious diseases among wild animals.						K5
3	The course will give an idea about ex-situ management of animals.						K4
4	The students will be capable of interpreting and understanding wildlife administration and legislation of wild animals.						K2
5	The learners will be trained in animal keeping, Handling, Feeding, Transport and Captive breeding.						K4
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create							
Unit:1	TAXONOMY AND IDENTIFYING CHARACTER						18 hours
Taxonomy & Identifying Characters of Fishes, Amphibians and Reptiles (upto orders). Fish migration- Hill stream adaptations. Parental care in amphibians& Fishes – Venomous, mildly-venomous & Non venomous snakes – Economic importance of Reptiles & fishes.							
Unit:2	TAXONOMY AND IDENTIFYING CHARACTER OF BIRDS and MAMMALS						18 hours
Taxonomy& Identifying Characters of Birds (upto orders) and Mammals (upto family) with examples. Migration of birds – Bird watching – Feet and beak modifications – Nesting behavior –Endemic birds of Western Ghats- Economic value of birds and mammals							
Unit:3	HEATH CARE OF WILDLIFE						16 hours
Infectious wildlife diseases: viral (rabies, rinder pest, foot and mouth, viral-encephalities, yellow fever) bacterial (anthrax, brucellosis, clostridiosis, listeriosis), protozoan (trypanosomiasis-toxoplasmosis-babesiosis-coccidiosis) helminth diseases: (Fasciolopsis-schistosomiasis-taeniosis-hydatidosis). Non infectious diseases of wild animals: diseases of the digestive syytem; stomatitis-catarrhal, gastroenteritis-haemorrhagic gastrocenteritis; respiratory system; catarrhal, brochopnemonia-exudative pleurishy, excretory system, paralysis of urinary bladder-urolithiasis.							

Unit:4	WILDLIFE ADMINISTRATION AND LEGISTRATION	18 hours
Administrative set up - Advisory bodies - National Board for Wildlife, Wildlife Protection Act 1972 & amendments, Wildlife trade and regulations; biodiversity act (2000) Eco-development, Eco-restoration and Eco-tourism programmes; Anti-poaching operations; Village forest council; Role of Government and Non-Governmental organizations in wildlife conservation.		
Unit:5	FORMATION AND MANAGEMENT OF ZOOS	18 hours
Zoo Management - Animal exhibits design & signage - Animal handling, transport & training - food and feeding - National zoo policy - Diseases of zoo animals- their prevention and cure- zoo sanitation; Marketing. Central Zoo Authority, Captive breeding (aims, principles and methods).		
Unit:6	Contemporary Issues	2 hours
Expert lectures, online seminars – webinars, Conferences and Workshop and internship programmes		
Total Lecture hours		90 hours
Text Book(s)		
1	Modern Text Book of Zoology – Vertebrates(2007) by R.L. Kotpal	
2	Book of Indian Animals(1971) by SH Prater	
Reference Books		
1	A Field Guide to mammals of India (2003) – Vivek menon	
2	A Book of Indian Reptiles (2002)– JC Daniel	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	https://canterbury.libguides.com/biol	
Course Designed By: Dr. J. Ebanasar		

Mapping with Programme Outcomes										
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	S	M	L	M	M	L	S
CO2	S	S	S	S	M	L	M	M	L	S
CO3	S	S	S	S	M	L	M	M	L	S
CO4	S	S	S	S	M	L	M	M	L	S
CO5	S	S	S	S	M	L	M	M	L	S

*S-Strong; M-Medium; L-Low

Course code	23P	STRUCTURE AND FUNCTION OF INVERTEBRATES, COMPARATIVE ANATOMY OF CHORDATES AND ANIMAL BIODIVERSITY & ORGANIZATION	L	T	P	C
Core/Elective/Supportive	PRACTICAL – I		0	0	2	4
Pre-requisite	Fundamental knowledge on animal anatomy and biodiversity		Syllabus Version		2020-2021	
Course Objectives:						
The main objectives of this course are to:						
<ol style="list-style-type: none"> To understand important physiological functions in various Invertebrate forms. To understand the working of nervous system and sense organs. Acquire the knowledge of biodiversity in different geographical areas. 						
Expected Course Outcomes:						
On the successful completion of the course, student will be able to:						
1	Attain knowledge about locomotory organs, locomotion, feeding and digestion in various Invertebrates.					K2
2	Integrate the strategies and evolutionary significance of free living and parasitic larval forms of Invertebrates as well as organization and characters of Minor Phyla groups.					K5
3	Understand the origin of Chordata, concept of Protochordata, importance of Vertebrate morphology and biology of some Protochordates.					K1
4	Gain knowledge about Vertebrate classification, as well as structure and function of integument and its derivatives.					K2
5	Appreciate the various conservation strategies to protect biodiversity.					K4
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create						
STRUCTURE AND FUNCTIONS OF INVERTEBRATA						12 hours
<ol style="list-style-type: none"> Comparative study of system: Invertebrata (any two animals) Appendages, external morphology, digestive system, nervous system and reproductive system. Culture of earthworm in laboratory to identify the stages. Culture and identification of morphology of <i>Drosophila</i>. 						
COMPARATIVE ANATOMY OF CHORDATES						12 hours
<ol style="list-style-type: none"> Comparative study of system: chordate (any two animals) External morphology, digestive and reproductive system. Identification of Beck and feet in different birds (any locally available birds) Photography of Beck and feet. Comparative study of scales of any preserved fish Cycloid, ctenoid, placoid and ganoid scales. Comparative study of different types of chordate bones (any four animals) Skull, fore limb, hind limb. Morphological modification of limb in fish, amphibia, reptiles, birds and mammals. 						
ANIMAL BIODIVERSITY AND ORGANIZATION						12 hours
<ol style="list-style-type: none"> Plankton identification of from fresh/marine water (5 slides preparation). Quantitative estimation of plankton using haemocytometer. 						

SPOTTERS (Non-chordate and chordate) (each any five specimens)		12 hours
1. Biological importance 2. Medical importance 3. Beneficial pests 4. Evolutionary significance 5. Economic importance		
FIELD STUDY AND FIELD TRIP – Zoological visit, biodiversity area		
Submission at the time of Practical Examination		
1. Plankton: 5 slides 2. Report on the Field study and Field trip 3. Bonafide Record		
Total Lecture hours		88 hours
Text Book(s)		
1	Advanced Practical Zoology by Sinha, J., Chatterjee A.K., Chattopadhyay P. 2011. Arunabha Sen Publishers.	
2	Practical Zoology Invertebrate by H.S. Bhamrah. 2003. Dominant Publishers.	
Reference Books		
1	Modern Experimental Zoology by Preeti Gupta and Mridula Chaturvedi. 2000	
2	Manual of Practical Zoology: Chordates by Verma.(2000). S. Chand Publishing	
Course Designed By: Dr. J. Ebanasar		

Mapping with Programme Outcomes										
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	S	S	L	S	M	S	S	M	L
CO2	S	M	M	L	S	S	S	M	S	M
CO3	S	M	M	L	S	S	S	M	S	M
CO4	L	L	L	L	S	M	S	M	S	S
CO5	M	M	S	L	S	S	S	S	S	S

*S-Strong; M-Medium; L-Low

Course code	23Q	ENVIRONMENTAL BIOLOGY, BIOCHEMISTRY, CELL AND MOLECULAR BIOLOGY	L	T	P	C
Core/Elective/Supportive		PRACTICAL - II	0	0	2	4
Pre-requisite		Basic information on ecology, biochemistry, cell and molecular biology	Syllabus Version		2020-2021	
Course Objectives:						
The main objectives of this course are to:						
<ol style="list-style-type: none"> 1. Explain core concepts in ecology, and summarize our ecological understanding of environmental problems. 2. To train how the biological data are processed and interpretations are made. 3. To develop skill in understanding & handling molecular science & instrumentation. 4. To elucidate its interaction of molecules. 5. To provide an overview of cell structure, basic components of cells and their function. 6. To provide students the idea of sex cells, fertilization, cleavage, differentiation and development of organs. 						
Expected Course Outcomes:						
On the successful completion of the course, student will be able to:						
1	Investigate specific cases of environmental pollution or natural challenges & their impact molecular issues					K5
2	The students will be capable of interpreting and understanding the basis of molecular biology and will be trained in preparing solutions and handling instruments at basic level.					K2 & K4
3	Understand the physical and chemical concepts in biology.					K2
4	Understand metabolism of nucleic acid, amino acid and lipid.					K2
5	Understand and apply the principles and techniques of molecular biology in basic research and ensuring accurate unity and diversity at the molecular and cellular levels					K3
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create						
I. ANALYSIS OF WATER						12 hours
Determination of:						
<ol style="list-style-type: none"> 1. pH 2. Total dissolved solids 3. Turbidity / light penetration 4. CO₂ and O₂ 5. Hardness (Temporary and permanent) 6. Calcium and Magnesium 						
II. BIOCHEMISTRY						12 hours
<ol style="list-style-type: none"> 1. Qualitative and quantitative estimation of Carbohydrates, Proteins and Lipids from the given samples. 2. Preparation of Haemin crystals. 3. Quantitative estimation of Haemoglobin. 4. Separation of plasma, Serum and cells from blood. 5. Colorimetric estimation of glucose from blood 6. Estimation of cholesterol in the blood 7. Estimation of alkaline and acid phosphatases 						

III. CELL AND MOLECULAR BIOLOGY		12 hours
1. Mounting of Polytene chromosome from the salivary gland of a <i>Chironomus</i> larva. 2. Squash preparation of onion root tip to study the stages of Mitosis. 3. Isolation of DNA and RNA from an animal tissue (Demonstration only) 4. Study of different cells from the vertebrate animal (Brain, Liver, Gonad, Kidney and Muscle)		
FIELD TRIPS 1. Visit to – Drinking water treatment plant; Industrial effluent treatment plant; Pollution control lab.		
Submission at the time of Practical Examination 1. Report on the Field study and Field trips 2. Bonafide Record		
		Total Lecture hours
		88 hours
Text Book(s)		
1	Advanced Practical Zoology by Sinha, J., Chatterjee A.K., Chattopadhyay P. 2011. Arunabha Sen Publishers.	
2	Environmental biology and ecology laboratory manual by Lynn. (2003). Kendall Hunt Publishing	
Reference Books		
1	Modern Experimental Zoology by Preeti Guptha and Mridula Chaturvedi. 2000	
2	Fundamentals of Biochemistry by Jain J.L, Sunjay Jain, Nitin Jain. 2007.	
3	Toxicology Laboratory Lab Manual by 5. Oberdorster Eva. 2009. Kendall Hunt Publishing	
Course Designed By: Dr. J. Ebanasar		

Mapping with Programme Outcomes										
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	L	S	S	S	S	S	S
CO2	S	S	S	L	S	S	M	S	L	S
CO3	S	S	S	L	S	S	M	S	L	S
CO4	S	S	S	L	L	M	L	M	S	S
CO5	S	S	S	L	S	S	S	S	S	S

*S-Strong; M-Medium; L-Low

Course code	23R	DEVELOPMENTAL BIOLOGY VERTEBRATE BIOLOGY AND CONSERVATION		L	T	P	C
Core/Elective/Supportive	PRACTICAL - III		0	0	2	4	
Pre-requisite	Basic understanding on and developmental biology and vertebrate biology and conservation		Syllabus Version		2020-2021		
Course Objectives:							
The main objectives of this course are to:							
<ol style="list-style-type: none"> To provide students the idea of sex cells, fertilization, cleavage, differentiation and development of organs. To understand the taxonomy, health care, administration, legislation and management of Zoos. 							
Expected Course Outcomes:							
On the successful completion of the course, student will be able to:							
1	The learner will able to understand methodological approaches to the study of embryonic development and the characteristics of the principle experimental models.					K2	
2	Understand venomous and non-venomous snakes of India.					K2	
3	To make understand the students about faecal load of wild animals.					K3	
4	The learner will be able to gain knowledge on ex-situ conservation and captive breeding of wild animals .					K5	
5	Mapping of Zoos across the country.					K4	
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create							
DEVELOPMENTAL BIOLOGY:						12 hours	
<ol style="list-style-type: none"> Regeneration study in Tadpole/Earth-worm Study the life cycle of <i>Drosophila melanogaster</i>. Patterning of the adult wing and <i>Drosophila</i> and demonstration of the effect of cell death on the patterning of the adult wing. Effect of Thyroxin on the growth of tadpoles (Demonstration only) Study of Embryonic developmental stages (Frog and Chick) Blastoderm mounting of chick embryo using vital stains 							
VERTEBRATE BIOLOGY AND CONSERVATION						12 hours	
<ol style="list-style-type: none"> Identification of vertebrates for its taxonomical classifications through virtual models. Identification of endo- parasites through faecal analysis. Identification of birds nest using abandoned nests. Designing of animal cages. Preparing food schedules for Zoo animals. Marking the locations of various Zoos using Indian outline map. 							

SUBMISSION AT THE TIME PRACTICAL EXAMINATION		12 hours
(Should not exceed 20% of total marks)		
<ol style="list-style-type: none"> 1. Training report of Zoo management. 2. Study report of eco-tourism. 3. Study report of eco-development programme. 4. Study report of interpretation centre. 		
		Total Lecture hours
		88 hours
Text Book(s)		
1	Wildlife management techniques by Rejesh Gopal.	
2	A Manual of Practical Zoology by Verma P. S., 2000. S. Chand Publication.	
Reference Books		
1	Clinical Embryology: A Practical Guide by 1. Zsolt Peter Nagy, Alex C. Varghese, Ashok Agarwal. 2013. Springer-Verlag New York Inc	
2	Modern Text Book of Zoology: Vertebrates, 2007. R. L. Kotpal.	
3		
Course Designed By: Dr. J. Ebanasar		

Mapping with Programme Outcomes										
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	M	L	L	M	M	L	S
CO2	S	S	S	M	L	L	M	M	L	S
CO3	S	S	S	M	L	L	M	M	L	S
CO4	S	S	S	M	L	L	M	M	L	S
CO5	S	S	S	M	L	L	M	M	L	S

*S-Strong; M-Medium; L-Low



Third Semester

Course code	33A	COMPARATIVE ANIMAL PHYSIOLOGY	L	T	P	C
Core/Elective/Supportive	Core Paper IX		6	0	0	5
Pre-requisite	Basic knowledge about the organ and organ systems of invertebrates and vertebrate animals.		Syllabus Version		2020-2021	
Course Objectives:						
The main objectives of this course are to: To make the students,						
<ol style="list-style-type: none"> To understand the significance and various types of adaptation in wild animals. To acquire the knowledge of the adaptive changes in organs and organ system of different animals to suite their environment and ecosystem. To analyze the effects different environments in physiology. To learn the functionalities of different organ systems in wild animals. To understand the gastrointestinal hormones and sex hormones To understand the role of hormones in pregnancy, lactation and pheromones animal communication. 						
Expected Course Outcomes:						
On the successful completion of the course, student will be able to:						
1	Acquire the knowledge of organisms surviving in various environments and ecosystem.					K1
2	Learn the significance of thermo and osmo regulations to cope well with the ecological stress.					K4
3	Understand the physiological responses of various animal groups.					K3
4	Appreciate the mechanism of respiratory, excretory physiology, neural and muscular physiology and the influence of hormones and pheromones in reproduction.					K2
5	Evaluate the various mode of life and adaptive modification of their organ and organ systems in wild animals.					K5
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 – Create						
Unit: I	ADAPTATION AND HOMEOSTASIS				18 hours	
Adaptation - Levels and Mechanism of adaptation - Significance of body size – Adaptation, acclimation and acclimatization - Concepts of homeostasis. Physiological adaptations of different environments: Marine - Shores and Estuaries – Freshwater - Extreme aquatic environments - Terrestrial life. Extreme terrestrial environments - Parasitic habitats. Stress Physiology - Basic concept of environmental stress and strain; concept of elastic and plastic strain; stress resistance, stress avoidance and stress tolerance.						
Unit: II	MECHANISM OF THERMO AND OSMO REGULATIONS				18 hours	
Physiological mechanism of thermo regulation. Physiological adaptation to osmotic and ionic stress; mechanism of cell volume regulation. Osmoregulation in aquatic and terrestrial environments. Physiological response to oxygen deficient stress. Physiological effects of physical exercises in animals.						

Unit: III	RESPIRATORY PHYSIOLOGY	16 hours
Respiratory physiology – Respiratory organs - Structure and function. Respiratory gases – uptake – respiratory pigments – O ₂ & CO ₂ dissociation curves – transport of respiratory gases.		
Unit: IV	EXCRETORY PHYSIOLOGY AND ENDOCRINOLOGY	18 hours
Excretory physiology – Excretory organs – mechanism of excretion – physiology – adaptations of excretion to environment – Excretory products: synthesis and elimination. Endocrine glands – Feedback regulation – Pituitary – gonadal axis. Role of reproductive hormones - gamete formation – fertilization - embryonic development – parturition – lactation -neuroendocrine regulation.		
Unit: V	NEURAL AND MUSCULAR PHYSIOLOGY	18 hours
Neural physiology – Neurons structure and types. Nerve impulse transmission - resting and action potential — neurotransmitters – mechanism of neural transmission. Neuro-degenerative diseases. Muscular physiology - Muscle contraction – theories – molecular mechanism of muscle contraction.		
Unit: VI	Contemporary Issues	2 hours
Expert lectures, online seminars – webinars, workshops and conferences.		
	Total Lecture hours	90 hours
Text Book(s)		
1	Knut Schmidt Nielsen (1997) Animal physiology – adaptation and environment by -, Duke University. Fifth Edition.	
2	Clifford Ladd Prosser Saunders, (1973)Comparative Animal Physiology: Environmental physiology.	
3	Hoar, W.S. General and Comparative Animal Physiology, 1975, Prentice Hall of India.	
4	Schiemdt Nielsen. Animal Physiology: Adaptation and Environment, 1997. Cambridge.	
5	Strand, F.L. Physiology: A regulation System Approach, 1978. Macmillan Publishing Co., New York.	
6	Pummer, L. Practical Biochemistry, 2004. Tata McGraw-Hill	
7	Prosser, C.L. (1973) Environmental and Metabolic Animal Physiology. Wiley-Liss Inc., New York.	
8	<u>Philip Carew Withers (1992) Comparative Animal Physiology.</u>	
Reference Books		
1	Wilson K. and Walker. J. Practical Biochemistry	
2	R. W. Hill (1978): “Comparative Physiology of Animals – An Environmental Approach” Harper & Row Publication.	
3	Hochachka, P.W. and Somero, G. N. Biochemical Adaptation. Princeton, New York.	
4	Eckert, R. Animal Physiology: Mechanisms and Adaptations. W.H. Freeman and Company, New York.	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	Animal Physiology : https://swayam.gov.in/nd1_noc20_bt42/preview	
2	Physiology and Biochemistry: https://swayam.gov.in/nd2_cec20_bt19/preview	

3	Animal Physiology : https://www.classcentral.com/course/swayam-animal-physiology-12894
Course Designed By: Dr. J. Ebanasar	

Mapping with Programme Outcomes										
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	S	M	M	S	S	L	S
CO2	S	S	S	S	M	M	S	S	L	S
CO3	S	S	S	S	M	M	S	S	L	S
CO4	S	S	S	S	M	M	S	S	L	S
CO5	S	S	S	S	M	M	S	S	L	S

*S-Strong; M-Medium; L-Low



Course code	33B	EVOLUTION		L	T	P	C
Core/Elective/Supportive	Core Paper XII			6	0	0	4
Pre-requisite	Basic information about animal evolution			Syllabus Version	2020-2021		
Course Objectives:							
The main objectives of this course are to:							
<ol style="list-style-type: none"> To introduce the evolutionary concepts among various animal groups. To make them understand how life originated. To realize the current working of evolution. 							
Expected Course Outcomes:							
On the successful completion of the course, student will be able to:							
1	To understand the prehistoric life and its origin of animals.					K2	
2	To evaluate the impact of evolution on animals.					K4	
3	To analyze how the higher animals evolved.					K5	
4	To understand the evolution of genes among animals.					K2	
5	To imagine how the future evolution will be					K6	
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create							
Unit:1	EMERGENCE OF EVOLUTIONARY THEORIES					18 hours	
Lamarck – Darwin – Concepts – evolutionary synthesis – evolutionary time scale – eras – periods – epoch. Human evolution: Stages of primate evolution including Homo sapiens. Behavioral Evolution: Altruism and evolution – Group selection and kin selection.							
Unit:2	MOLECULAR EVOLUTION					16 hours	
Role of gene in evolution - Evolution of gene families, Molecular drive - Assessment of molecular variation Origin of higher categories Phylogenetic gradualism and punctuated equilibrium - Major trends in the origin of higher categories - Micro- and Macro-evolution – speciation.							
Unit:3	MOLECULAR PHYLOGENETICS					18 hours	
Construction of phylogenetic trees - Phylogenetic inference –Distance methods, parsimony methods, maximum likelihood method - Immunological techniques.							
Unit:4	MOLECULAR PHYLOGENETICS					18 hours	
Amino acid sequences and phylogeny - Nucleic acid phylogeny-DNA-DNA hybridizations, Restriction Enzyme sites, Nucleotide sequence comparisons and homologies - Molecular clocks.							
Unit:5	POPULATION GENETICS AND ECOLOGY					18 hours	
Metapopulations - Monitoring natural populations - Why small populations become extinct? - Loss of genetic variations - Conservation of genetic resources in diverse taxa – Artificial evolution (in vitro).							
Unit:6	Contemporary Issues					2 hours	
Expert lectures, online seminars – webinars, workshops and conferences.							
Total Lecture hours					90 hours		

Text Book(s)	
1	Dobzhansky, Th. Genetic and Origin of Species. Columbia University Press.
2	Dobzhansky, Th., F.J. Ayala, G.L. Stebbins and J.M Valentine. Evolution. Surjeet Publication, Delhi
3	Jha, A.P. Genes and Evolution. John Publication, New Delhi.
Reference Books	
1	Futuyama, D.J. Evolution Biology, 1986, Sinauer Associates, INC Publishers, Dunderland.
2	Hartl, D.L. A Primer of Population Genetics. Sinauer Associates, 2001. Inc, Massachusetts.
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	Paleontology: Theropod Dinosaurs and the Origin of Birds: https://www.classcentral.com/course/theropods-birds-5236
2	Evolutionary Biology: https://swayam.gov.in/nd2_cec20_bt06/preview
Course Designed By: Dr.J. Ebanasar	

Mapping with Programme Outcomes										
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	L	L	L	M	M	M	S
CO2	S	S	S	L	L	L	M	M	M	S
CO3	S	S	S	L	L	L	M	M	M	S
CO4	S	S	S	L	L	L	M	M	M	S
CO5	S	S	S	L	L	L	M	M	M	S

*S-Strong; M-Medium; L-Low

Course code	23C	GENETICS		L	T	P	C
Core/Elective/Supportive	Core Paper XI			6	0	0	4
Pre-requisite	Basic knowledge about Genes and Chromosomes which have learned in undergraduate course			Syllabus Version	2020-2021		
Course Objectives:							
The main objectives of this course are to:							
<ol style="list-style-type: none"> To study the nature and function of Genes and Chromosomes To acquire knowledge on the structure of Mendel and principles, Gene Concepts, Gene mapping methods, Microbial genetics, Human genetics, Mutation and Molecular Genetics. To acquire knowledge on the Gene concepts and their role in inheritance. To Understand the Chromosomes and their nature To understand the role of DNA, RNA and Nucleotides and their functions 							
Expected Course Outcomes:							
On the successful completion of the course, student will be able to:							
1	Acquire knowledge on the Nature and functions of Genes and learn the mechanism of their action					K4	
2	Learn the structure and functions of Gene mapping and Mutations and familiarize on their functions					K3	
3	Understand the Microbial genetics and Molecular Genetics and their role in molecular biology					K2	
4	Able to learn the Structure and functions of the Nucleotides					K2	
5	Know the factors about genes and their role in the development of an organism					K6	
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 – Create							
Unit:1	BASIC CONCEPTS OF GENETICS					18 hours	
Mendelian principles: Dominance, segregation, independent monohybrid and dihybrid experiments assortment. Concept of gene: Allele, multiple alleles, pseudoallele, complementation tests Extensions of Mendelian principles: Co-dominance, incomplete dominance, gene interactions, pleiotropy, genomic imprinting, penetrance and expressivity, phenocopy, linkage and crossing over, sex linkage, sex limited and sex influenced characters.							
Unit:2	GENE MAPPING METHODS					16 hours	
Linkage maps, tetrad analysis, mapping with molecular markers, mapping by using somatic cell hybrids, DNA foot printing. Extra chromosomal inheritance: Inheritance of Mitochondrial genes, maternal inheritance							
Unit:3	MICROBIAL GENETICS AND HUMAN GENETICS					18 hours	
Methods of genetic transfers – transformation, conjugation, transduction and sexduction, mapping genes by interrupted mating, fine structure analysis of genes Pedigree analysis, lod score for linkage testing, karyotypes, genetic disorders - Human Genome Project. Quantitative genetics: Polygenic inheritance, heritability and its measurements, QTL mapping							

Unit:4	MUTATION, POPULATION GENETICS	18 hours
Types, causes and detection, mutant types – lethal, conditional, biochemical, loss of function, gain of function, germinal versus somatic mutants, insertional mutagenesis. Structural and numerical alterations of chromosomes: Deletion, duplication, inversion, translocation, ploidy and their genetic implications; Recombination: Homologous and non-homologous recombination including transposition. Population Genetics: Genetic equilibrium – distinguishing forces – natural selection – mutation and genetic drift.		
Unit:5	MOLECULAR GENETICS	18 hours
. Structure of gene – genetic code – gene regulation – genome analysis – functional genomics – RNA processing – Transcription: factors and regulation – Translation: control and regulation; Patterns of change in nucleotide and amino acid sequences.		
Unit:6	Contemporary Issues	2 hours
Expert lectures, online seminars – webinars, workshops and conferences		
	Total Lecture hours	90 hours
Text Book(s)		
1	Brooker: Genetics: Analysis and Principles 2018	
2	Principles of Genetics, 2006; Gardener	
3	Basics of Human Genetics, 2017-Versha Katira	
4	Russell, 2009: Genetics	
Reference Books		
1	Recombinant DNA technology –James.D.Watson,	
2	Emery's Elements of Medical Genetics	
3	Concepts of Genetics. -Klug W.S	
4	The Gene-Siddhartha Mukherjee	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	https://swayam.gov.in/	
2	https://www.mooc.org/	
4	https://nptel.ac.in/	
Course Designed By: Dr. S. Vidya		

Mapping with Programme Outcomes										
Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	L	S	S	M	S	S	S
CO2	S	S	S	L	S	S	M	S	S	S
CO3	S	S	S	L	S	S	M	S	S	S
CO4	S	S	S	L	S	S	M	S	S	S
CO5	S	S	S	L	S	S	M	S	S	S

*S-Strong; M-Medium; L-Low

Course code	33D	FORESTRY, SILVICULTURE AND ENTOMOLOGY	L	T	P	C
Core/Elective/Supportive	Core Paper XI		6	0	0	4
Pre-requisite	Basic knowledge about Genes and Chromosomes which have learned in undergraduate course		Syllabus Version	2020-2021		
Course Objectives:						
The main objectives of this course are to:						
1. To make the students to understand forestry, silviculture practice and insect pest.						
2. To study forest working plan, forest management techniques.						
3. To identify various forest types in India.						
Expected Course Outcomes:						
On the successful completion of the course, student will be able to:						
1	To learn about natural and artificial regeneration of forest.					K4
2	To understand various working plans of forest					K3
3	To learn about forest management techniques					K2
4	To know basic classification of insects					K2
5	To learn the feeding behavior of various forest insects.					K6
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 – Create						
Unit:1	REGENERATION OF FORESTS				18 hours	
Natural and artificial regeneration of forests - nursery and planting techniques. Clear felling, uniform shelter wood selection, coppice and conversion systems. Silviculture management - Mangroves- Cold desert & Plantation . Tree improvement & Seed Technology (collection, storage, pre-treatment and germination, establishment and tendings) –Non timber forest products – Wood seasoning and preservation - Anatomical structure of wood, defects and abnormalities of wood, timber identification.						
Unit:2	FOREST WORKING PLAN				18 hours	
Forest working Plan –Planning, evaluation, monitoring and forest industries. Silvicultural systems - Clear felling, uniform shelter wood selection, coppice and conversion systems; Indian forest act 91927); forest conservation act (1980); Role of Forest in soil Conservation: – erosion-reclamation – role of microorganisms – Watershed – forest hydrology – river channel stabilization – avalanche and landslide control –ground water recharge.						
Unit:3	FOREST MANAGEMENT TECHNIQUES				18 hours	
Forest management techniques - Methods of measuring - diameter, girth, height and volume of trees - form-factor - volume estimation of stand Sampling methods and sample plots. Yield calculation - forest cover monitoring through remote sensing - GIS management and modeling - Forest survey - map reading.						
Unit:4	TYPES OF FORESTS				16 hours	
Forest types in India, identification - dendrology, Establishment of herbaria and arboreta. Agro forestry systems - Social/Urban Forestry – Joint Forest Management. Watershed management - Deforestation & Impacts. Forest Inventory.						

Unit:5	INSECTS AND THEIR CLASSIFICATIONS	18 hours
Classification of insects up to order with example. Feeding and reproductive behaviour of insects, Forecasting, assesses risk of insect outbreaks. Insect Management- Insect Plant interaction.		
Unit:6	Contemporary Issues	2 hours
Expert lectures, online seminars – webinars, workshops and conferences		
Total Lecture hours		90 hours
Text Book(s)		
1	Agarwala V P, 1980. Forests in India. Oxford and IBH Publishing Co., New Delhi.	
2	Puri G S, Meher V M, Gupta R K and Puri S, 1981. Forest Ecology. Oxford and IBH Publishing Co., New York.	
3	Stebbin E P, 1977. A Manual of Elementary Forest Zoology For India. International Book Distributors, Dehra Dun.	
4	Tiwari K M and Singh R V, 1980. Social Forestry Plantations. Oxford and IBH Publishing Co., New Delhi.	
Reference Books		
1	Tiwari K M and Singh R V, 1980. Social Forestry Plantations. Oxford and IBH Publishing Co., New Delhi.	
2	Warning R H and Schlesinger W H, 1985. Forest Ecosystems: Concepts and Management. Academic Press, New York.	
3	Imms A D, 1965. A General Textbook of Entomology, ELBS, London.	
4	Metcalf C L and Flint W P, 1973. Destructive and Useful Insects, McGraw-Hill, New York.	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	https://swayam.gov.in/	
2	https://www.mooc.org/	
4	https://nptel.ac.in/	
Course Designed By: Dr. S. Vidya		

Mapping with Programme Outcomes										
Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	L	S	S	M	S	S	S
CO2	S	S	S	L	S	S	M	S	S	S
CO3	S	S	S	L	S	S	M	S	S	S
CO4	S	S	S	L	S	S	M	S	S	S
CO5	S	S	S	L	S	S	M	S	S	S

*S-Strong; M-Medium; L-Low





Fourth Semester

Course code	43A	WILDLIFE MANAGEMENT TECHNIQUES		L	T	P	C
Core/Elective/Supportive	Core Paper XI			6	0	0	4
Pre-requisite	Basic knowledge about Techniques used in Management of Wildlife			Syllabus Version	2020-2021		
Course Objectives:							
The main objectives of this course are to:							
1. To make understand the applications and basic wildlife equipments.							
2. To acquire the knowledge on handling the equipment related to wildlife.							
3. To learn GIS and Remote sensing uses and its applications on wildlife management.							
4. To sensitize the students on wildlife population estimation techniques.							
5. To understand drugs related to chemical restraints the animals.							
Expected Course Outcomes:							
On the successful completion of the course, student will be able to:							
1	Acquire the knowledge in wildlife and equipments usage in the field						K4
2	Learn the significance of various field equipments						K3
3	Understanding molecular methods in wildlife						K2
4	Appreciate the mechanism of GIS, Remote sensing and Radio Collaring methods in wildlife						K2
5	Evaluate various types of population estimation, mapping techniques and wild animals health monitoring and postmortem techniques						K6
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 – Create							
Unit:1	EQUIPMENT IN WILDLIFE					18 hours	
Making observations and records – field notes & datasheets - Planning wildlife management Investigations and projects – funding agencies. Wildlife Photography - types of cameras & binoculars - camera traps – altimeter – pedometer - field compass. Sound recording & Media players - activity recording - weight measurement.							
Unit:2	TRACKING OF ANIMALS					18 hours	
Radio isotopes - radio collaring – GPS – GIS & Remote sensing. Q GIS – Map Info –Arch view (outlines only). Molecular methods in Wildlife; Impact and removal of invasive alien species; Habitat manipulation: food, water and shade improvement.							
Unit:3	ESTIMATION OF POPULATION					16 hours	
Planning census – sample counts – Block counts – Roadside counts – Dung count – Pugmark & waterhole census – Identifying animals based on indirect signs – Capture recapture techniques – tiger, co-predator monitoring census methods. – Distance software – Creation of capture matrix and softwares used in wildlife sciences.							
Unit:4	CONSERVATION OF FOREST					18 hours	
Survey & mapping water sources – rain gauge setting – supplementary water source – providing access to natural & artificial water sources –Fire as a tool. Wildlife damage control – assessment methods – reasons for conflicts – Fences – trenches & other methods – Human pressure classification – Trail survey in boundary – Forest product collection – Village survey – Anti poaching operations –VFC.							

Unit:5	INSECTS AND THEIR ECONOMIC IMPORTANCE	18 hours
Classification of insects up to order with example. Feeding and reproductive behaviour of insects, Forecasting, assesses risk of insect outbreaks. Insect Management- Insect Plant interaction.		
Unit:6	Contemporary Issues	2 hours
Expert lectures, online seminars – webinars, workshops and conferences		
Total Lecture hours		90 hours
Text Book(s)		
1	Agarwala V P, 1980. Forests in India. Oxford and IBH Publishing Co., New Delhi.	
2	Puri G S, Meher V M, Gupta R K and Puri S, 1981. Forest Ecology. Oxford and IBH Publishing Co., New York.	
3	Stebbin E P, 1977. A Manual of Elementary Forest Zoology For India. International Book Distributors, Dehra Dun.	
4	Tiwari K M and Singh R V, 1980. Social Forestry Plantations. Oxford and IBH Publishing Co., New Delhi.	
Reference Books		
1	Tiwari K M and Singh R V, 1980. Social Forestry Plantations. Oxford and IBH Publishing Co., New Delhi.	
2	Warning R H and Schlesinger W H, 1985. Forest Ecosystems: Concepts and Management. Academic Press, New York.	
3	Imms A D, 1965. A General Textbook of Entomology, ELBS, London.	
4	Metcalf C L and Flint W P, 1973. Destructive and Useful Insects, McGraw-Hill, New York.	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	https://swayam.gov.in/	
2	https://www.mooc.org/	
4	https://nptel.ac.in/	
Course Designed By: Dr. S. Vidya		

Mapping with Programme Outcomes										
Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	L	S	S	M	S	S	S
CO2	S	S	S	L	S	S	M	S	S	S
CO3	S	S	S	L	S	S	M	S	S	S
CO4	S	S	S	L	S	S	M	S	S	S
CO5	S	S	S	L	S	S	M	S	S	S

*S-Strong; M-Medium; L-Low

Course code	43B	ETHOLOGY	L	T	P	C
Core/Elective/Supportive	Core Paper XI		6	0	0	4
Pre-requisite	Basic knowledge about behavior of animals		Syllabus Version		2020-2021	
Course Objectives:						
The main objectives of this course are to:						
<ol style="list-style-type: none"> To understand behavior pattern of animals. To acquire the knowledge on animal communications. To learn the methodology of studying animal behaviour. To understand parental care of animals. To sensitize the students to study social behavior of animals. 						
Expected Course Outcomes:						
On the successful completion of the course, student will be able to:						
1	Acquire the knowledge on behaviour of various wild animals.					K4
2	Learn significance of wild animals behaviour for their management.					K3
3	Understanding behavior pattern, hormones and pheromones of wild animals					K2
4	Evaluate various biological rhythms, foraging and courtship behaviour of various wild animals					K2
5	Understand the seasonal breeding behaviour of animals					K6
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create						
Unit:1	BEHAVIOUR PATTERN					18 hours
Instinctive behaviour-classical and modern concepts-fixed action pattern and ritualization. Learning-Imprinting-habituation. Analysis of behaviour pattern- taxis, kinesis and reflexes.						
Unit:2	HORMONES AND PHEROMONES					16 hours
Physiological mechanism of behaviour – Perceptual mechanism - Role of hormones - pheromones -predator detection, predator tactics. Altruism and evolution- Methods of studying behavior.						
Unit:3	FORAGING BEHAVIOUR					18 hours
Biological rhythms. Animal communication in Mammals, Birds and Insects. Foraging behaviour. Origin and significance of play.						
Unit:4	BREEDING BEHAVIOUR OF ANIMALS					18 hours
Courtship, display - sexual selection - pair bond - sexual dimorphism - polymorphism - polyandry, polygamy - promiscuity - cooperative breeding - brood parasites – parental care in Mammals & Birds.						
Unit:5	COMMUNICATION IN ANIMALS					18 hours
Aggression – Competition – Social spacing – Territory – Dominance. Social commensalism – mutualism – Parasitism . Social behaviour of elephants and lion.						

Unit:6	Contemporary Issues	2 hours
Expert lectures, online seminars – webinars, workshops and conferences		
Total Lecture hours		90 hours
Text Book(s)		
1	Leshner A I, 1978. An Introduction to Behavioural Endocrinology, Oxford University Press, New York	
2	McFarland D (ed.), 1981. The Oxford Companion to Animal Behaviour, Oxford University Press, Oxford.	
3	Ridley M, 1968. Animal Behaviour - A concise Introduction, Blackwell Scientific Publications, Oxford.	
4	Slater P J B, 1985. An Introduction to Ethology, Cambridge University Press, Cambridge.	
Reference Books		
1	Wallace R A, 1979. The Ecology and Evolution of Animal Behaviour, Goodyear Publishing Company Inc., Santa Monica, California.	
2	Wilson E O, 1978. Sociobiology, The Belknap Press, Harvard University Press, Cambridge, MA.	
3	Devayani Khemka, Animal Behaviour, Dominant publishers.	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	https://student.societyforscience.org/international-rules-pre-college-science-research	
2	https://www.etho-ges.de/wordpress/	
Course Designed By: Dr. S. Vidya		

Mapping with Programme Outcomes										
Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	L	S	S	M	S	S	S
CO2	S	S	S	L	S	S	M	S	S	S
CO3	S	S	S	L	S	S	M	S	S	S
CO4	S	S	S	L	S	S	M	S	S	S
CO5	S	S	S	L	S	S	M	S	S	S

*S-Strong; M-Medium; L-Low

Course code	43P	COMPARATIVE ANIMAL PHYSIOLOGY AND EVOLUTION	L	T	P	C
Core/Elective/Supportive	PRACTICAL-IV		0	0	2	4
Pre-requisite	Basic information on physiology and evolution of animals		Syllabus Version	2020-2021		
Course Objectives:						
The main objectives of this course are to:						
<ol style="list-style-type: none"> To make them understand physiology through practicals To equip them to do the experiments individually To understand the basics of evolution 						
Expected Course Outcomes:						
On the successful completion of the course, student will be able to:						
1	To understand the physiological mechanisms.					K1
2	To evaluate the experimental design					K4
3	To interact their result.					K3
4	To analyze how the higher animals evolved.					K4
5	To understand the evolution of genes.					K5
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 – Create						
COMPARATIVE ANIMAL PHYSIOLOGY (Use any two cultured species which are not in endangered list)						12 hours
<ol style="list-style-type: none"> Determination of the rate of activity of salivary amylase(Human Saliva) <ol style="list-style-type: none"> Ptyalin activity in relation to temperature and calculation of Q10. Ptyalin activity in relation to pH and calculation of Q10 Recording of diastolic and systolic pressure during standing, sitting and lying posture Biological responses of animals to various osmotic concentrations and their effect. <ol style="list-style-type: none"> Change in weight of Earthworm in hetero osmotic media Pattern of osmotic responses of Crab in hetero osmotic media Active uptake of Na^+ and Cl^- of a fish from the environmental water and change in salinity Determination of the specific gravity of the blood of a vertebrate animal by copper sulphate method Effect of temperature on the opercular movement of fish and calculation of Q10 Determination of the median threshold concentration of sucrose for housefly population Effect of drugs on the heart beat of Cockroach (Result with graphical representation corresponding to different concentration and time intervals expected) Determination of the rate of ammonia and urea excretion in Fish Determination of the Haemoglobin content in Fish blood 						
EVOLUTION						12 hours
<ol style="list-style-type: none"> Evolutionary significances: Any five Fossils from five Non-Chordate and Chordates Analogous and Homologous organs of Vertebrate animals(Frog, Calotes, Pigeon and Rabbit) Mimicry and colouration of animals 						
Total Lecture hours						86 hours

TEXT BOOK	
1	Advanced Practical Zoology by Sinha, J., Chatterjee A.K., Chattopadhyay P. 2011. Arunabha Sen Publishers.
2	
Reference Books	
1	Manual of practical Zoology: Chordatas by Verma. 2000. S Chand publication
2	Manual of practical Zoology: Invertebrates by Verma. 2000. S Chand publication
3	Modern experimental Zoology by Preethi Gupta and Mirdula Chaturvedi. 2000.

Mapping with Programme Outcomes										
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	M	S	L	M	S	S	S
CO2	S	S	S	M	S	L	M	S	S	S
CO3	S	S	S	M	S	L	M	S	S	S
CO4	S	S	S	M	S	L	M	S	S	S
CO5	S	S	S	M	S	L	M	S	S	S

*S-Strong; M-Medium; L-Low

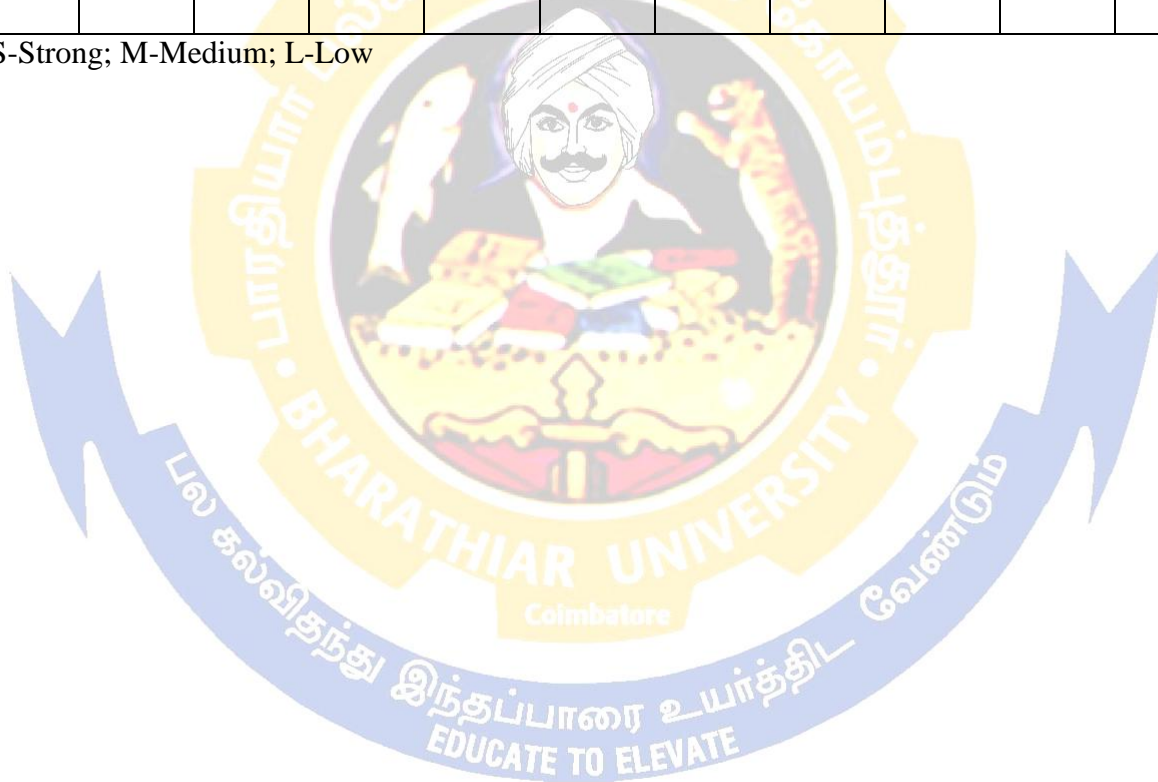


Course code	43Q	GENETICS	L	T	P	C
Core/Elective/Supportive	ELECTIVE II PRACTICAL		0	0	2	4
Pre-requisite	Basic knowledge about Genetics in Animals		Syllabus Version		2020-2021	
Course Objectives:						
The main objectives of this course are to:						
<ol style="list-style-type: none"> To study the nature and function of genes and Chromosomes. To acquire knowledge on the structure of Mendelian principles, Gene mapping methods, Microbial Genetics, Human Genetics, Mutation and Molecular Genetics. To realize the importance of molecular genetics. 						
Expected Course Outcomes:						
On the successful completion of the course, student will be able to:						
1	Acquire knowledge on the Nature and Functions of genes and chromosomes and learn their mechanism and actions.					K1
2	Learn the structure and functions of gene mapping and mutations and familiarize on their functions					K4
3	Able to learn the structure and function of the Nucleotides					K3
4	To analyse the causes of genetic disorders.					K4
5	To understand the recombination techniques					K5
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 – Create						
GENETICS:						12 hours
<ol style="list-style-type: none"> Genetic characteristics of a classroom sample <ol style="list-style-type: none"> Dermatoglyphic pattern(Finger Print) Ear lobe Rolling of tongue Mid digital Hair Widow's peak Inward bending of little finger. Study of morphology of <i>Drosophilla melanogaster</i> Culture of <i>Drosophilla melanogaster</i> Identification of sex and mutant characters <i>Drosophilla melanogaster</i> Demonstration of dosage compensation in <i>Drosophilla</i> males and females Preparation of genital plate of <i>Drosophilla melanogaster</i> Estimation of allelic Frequency based on ABO Blood Group Identification of Rh factor in blood groups Preparation of Buccal smear to show squamous epithelial cells Study of Barr body using buccal smear of volunteers Study of stages of mitosis and meiotic chromosomes of Grasshopper by observation of permanent slides and calculations of chiasma frequency 						
Total Lecture hours						36 hours
TEXT BOOK						
1	Advanced Practical Zoology by Sinha, J., Chatterjee A.K., Chattopadhyay P. 2011. Arunabha Sen Publishers.					
2	Manual of practical Zoology: Chordatas by Verma. 2000. S Chand publication					

Reference Books	
1	Genetics Book by Gardner
2	Manual of practical Zoology: Invertebrates by Verma. 2000. S Chand publication
3	Manual of practical Zoology: Chordatas by Verma. 2000. S Chand publication

Mapping with Programme Outcomes										
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	M	S	L	M	S	S	S
CO2	S	S	S	M	S	L	M	S	S	S
CO3	S	S	S	M	S	L	M	S	S	S
CO4	S	S	S	M	S	L	M	S	S	S
CO5	S	S	S	M	S	L	M	S	S	S

*S-Strong; M-Medium; L-Low



Course code	43R	WILDLIFE MANAGEMENT TECHNIQUES AND FORESTRY, SILVICULTURE AND ENTOMOLOGY	L	T	P	C
Core/Elective/Supportive	CORE PRACTICAL		0	0	2	4
Pre-requisite	Understanding recent developments in Wildlife Management Techniques		Syllabus Version	2020-2021		
Course Objectives:						
The main objectives of this course are to:						
<ol style="list-style-type: none"> To make the students understand planning and usage of various field equipments including GPS, GIS and Remote Sensing To know the principle of wild animal population estimation techniques and methods applied in animal capturing To know the principles of survey and mapping techniques To make the students to understand Forestry, Silvicultural practices and insect pests in forest To learn about sampling techniques involved in vegetation analysis 						
Expected Course Outcomes:						
On the successful completion of the course, student will be able to:						
1	To obtain knowledge on field equipment used in wildlife management.					K1
2	Integrate the strategies involved in various population estimation techniques including molecular methods					K4
3	To gain knowledge on survey and mapping techniques					K3
4	To learn about current forest management practices					K4
5	To understand about Forest Insects and its management					K5
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 – Create						
WILDLIFE MANAGEMENT TECHNIQUES:						12 hours
<ol style="list-style-type: none"> Estimation of diversity and species richness of an area Estimation of carrying capacity of an area Population Viability Analysis(PVA) and Population Habitat Viability Analysis(PHVA) Geo-referencing of an image file to create better image using Q-GIS/Map-Info/ARC-GIS Estimating herbivore population using Distance Software Estimating Tiger population using M-STRIPE software Identification of an Elephant Corridor Preparation of EIA of an area 						
FORESTRY, SILVICULTURE AND FOREST ENTOMOLOGY						
<ol style="list-style-type: none"> Identification of important insects and butterflies (Any Five) Identification of plants of silviculture importance (Any Five) Preparation of Quadarts and Transects to estimate vegetative analysis in an area Identification of various forest types Estimation of tree height Estimation of log volume Estimation of Canopy volume Forest cover monitoring, map reading and surveying techniques of forest area 						

SUBMISSIONS AT THE TIME OF PRACTICAL EXAMINATIONS	
1. Report on the field study and field trips 2. Bonafied record 3. A report on GIS training 4. A report on various softwares used in wildlife management 5. Report on the participation of Tiger / Wildlife census 6. Report of visit to a Nursery 7. Report of visit to a Timber depot 8. Report of visit to different Forest types	
Total Lecture hours	86 hours
TEXT BOOK	
1	Dasmann R F, 1964. Wildlife Biology, John Wiley & Sons, New York,
2	Gilas R H Jr.(ed.), 1984. Wildlife Management Techniques, 3rd ed. The Wildlife Society, Washington D.C., Nataraj Publishers, Dehra Dun.
3	Robinson W L and Eric G Bolen, 1984. Wildlife Ecology and Management, Maxmillan Publishing Company, New York
4	Rodgers W A, 1991. Techniques for Wildlife Census in India - A Field Manual: Technical Manual - T M - 2. WII.
5	Silviculture by S S Negi
Reference Books	
1	Saharia V B, 1982. Wildlife of India, Nataraj Publishers, Dehra Dun
2	Teague R D (ed.), 1987. A Manual of Wildlife Conservation (The Wildlife Society, Washington D.C.). Nataraj Publishers, Dehra Dun
3	WII. A Guide to Chemical Restraint of Animals.

Mapping with Programme Outcomes										
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	M	S	L	M	S	S	S
CO2	S	S	S	M	S	L	M	S	S	S
CO3	S	S	S	M	S	L	M	S	S	S
CO4	S	S	S	M	S	L	M	S	S	S
CO5	S	S	S	M	S	L	M	S	S	S

Course code	43S	ETHOLOGY	L	T	P	C
Core/Elective/Supportive	CORE PRACTICAL		0	0	2	4
Pre-requisite	Basic information on Behaviour of animals		Syllabus Version		2020-2021	
Course Objectives:						
The main objectives of this course are to:						
<ol style="list-style-type: none"> To make the students understand behaviours and animal communication To study on the influence of hormones and pheromones in animals To know the influence of various biological rhythms on the behaviour of animals To understand the courtship and display behaviour of animals 						
Expected Course Outcomes:						
On the successful completion of the course, student will be able to:						
1	To identify various behaviour pattern of animals					K1
2	To understand the physiological mechanism involved in behaviour of animals					K4
3	To analyse the significance of courtship for breeding behaviour					K3
4	To know the principles of social behaviour of animals					K4
5	To recognize the calls and songs of different types of Birds					K5
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 – Create						
ETHOLOGY:						12 hours
<ol style="list-style-type: none"> Focal animal sampling method- video clippings Courtship and display – peacock, Monkey and Elephant Social behaviour – Lion and Elephant Animal communications – Recording Bird Call and Identifying Identification of sexual dimorphism in birds and mammals Aggression behaviour of Macaques Territory marking in Carnivores Identification of Commensalism, Mutualism and Parasitism Brood parasite Significance of play in animals 						
Total Lecture hours						90 hours
TEXT BOOK						
1	Leshner A I, 1978. An Introduction to Behavioural Endocrinology, Oxford University Press, New York					
2	McFarland D (ed.), 1981. The Oxford Companion to Animal Behaviour, Oxford University Press, Oxford					
3	Ridley M, 1968. Animal Behaviour - A concise Introduction, Blackwell Scientific Publications, Oxford					
4	Animal Behaviour – A.K Agarwal					
Reference Books						
1	Slater P J B, 1985. An Introduction to Ethology, Cambridge University Press, Cambridge.					
2	Wallace R A, 1979. The Ecology and Evolution of Animal Behaviour, Goodyear Publishing Company Inc., Santa Monica, California					

3	Wilson E O, 1978. Sociobiology, The Belknap Press, Harvard University Press, Cambridge, MA Revised edition.
4	DevayaniKhemka, Animal Behaviour, Dominant publishers

Mapping with Programme Outcomes										
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	M	S	L	M	S	S	S
CO2	S	S	S	M	S	L	M	S	S	S
CO3	S	S	S	M	S	L	M	S	S	S
CO4	S	S	S	M	S	L	M	S	S	S
CO5	S	S	S	M	S	L	M	S	S	S





**Supportive -
Certificate
Course**

Course code	GIS AND FIELD TRAINING ON WILDLIFE MANAGEMENT		L	T	P	C
Core/Elective/Supportive	Supportive – Certificate Course		6	0	0	4
Pre-requisite	Basic knowledge on GIS and Techniques involved in Wildlife Management		Syllabus Version		2020-2021	
Course Objectives:						
The main objectives of this course are to:						
<ol style="list-style-type: none"> To make understand the students application of wildlife management. To equip the students to handle various GIS softwares and instruments. To learn various techniques involved on recent trends of wildlife management. To sensitize the students use various equipments and softwares on wildlife management. To understand extent of use of GIS and Wildlife Techniques in the Field. 						
Expected Course Outcomes:						
On the successful completion of the course, student will be able to:						
1	Acquire the knowledge on application of GIS in the field					K4
2	Learn the significance of various field equipments and softwares					K3
3	Understanding about various techniques involved in Wildlife Management					K2
4	Appreciate the mechanism of GIS and its usages in Remote sensing and Radio Collaring					K2
5	Evaluate and depict various types of population estimation, mapping techniques and wildlife conflicts through GIS					K6
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 – Create						
Unit:1	BASIC ON GIS				18 hours	
Training in usage of Computer and internet - various browsers – Networking – accessing data – collection of literature and relevant data – Google earth – various GIS softwares						
Unit:2	HANDLING OF GPS				18 hours	
Training in usage of GPS, export and import of data from GPS, conversion of Geo co-ordinates						
Unit:3	GIS SOFTWARES				16 hours	
Training in QGIS, ARC- GIS, Map-info, Map-source and its applications						
Unit:4	FIELD TRAINING PROGRAMMES				18 hours	
Training in handling of basic wildlife instruments, conducting population estimation survey and Vegetative analysis using DISTANCE, CAPTURE, MARK AND M-STRIPES softwares.						
Unit:5	DATA ANALYSIS AND PREDICTION				18 hours	
Training in Analysis of data and preparation of report – Writing reports – presentation – Analysis of data – Ecological statistics – Boolean Algebra – Boot strapping – Convex Polygons – Distribution analysis – Home range prediction – Habitat modeling – Prediction models & Projection of Data.						
(At the end of the semester the candidate should submit the certificate undergone for the above said training programmes. Internal presentation should be done by the students to the department in front of Wildlife PG students and All Faculty members. Marks allocation Report: 20, Attendance:20, Performance in training: 20, Presentation and Student evaluation: 50)						

Unit:6	Contemporary Issues	2 hours
Expert lectures, workshops and field implications		
Total Lecture hours		90 hours
Text Book(s)		
1	Remote Sensing and GIS Hardcover (2008), Basudeb Bhatta, Oxford Publishers.	
2	Discovering GIS and ArcGIS (2017), Bradley A.Shellito, Macmalian Learning.	
Reference Books		
1	Historical GIS: technologies, methodologies and scholarship (2007), Ian, N.Gregory, Paul S. Cambridge University Press.	
2	Integration of GIS and remote sensing (2007), Mesev, Victor. Wiley.	
3	Making maps: a visual guide to map design for GIS ()	
4	Indian Forestry (2018), Prabhu and Manigandan, Jain Brother	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	www.esri.com	
2	www.g2.com	
4	www.usgs.gov	
Course Designed By: Dr. S. Vidya		





Annexure

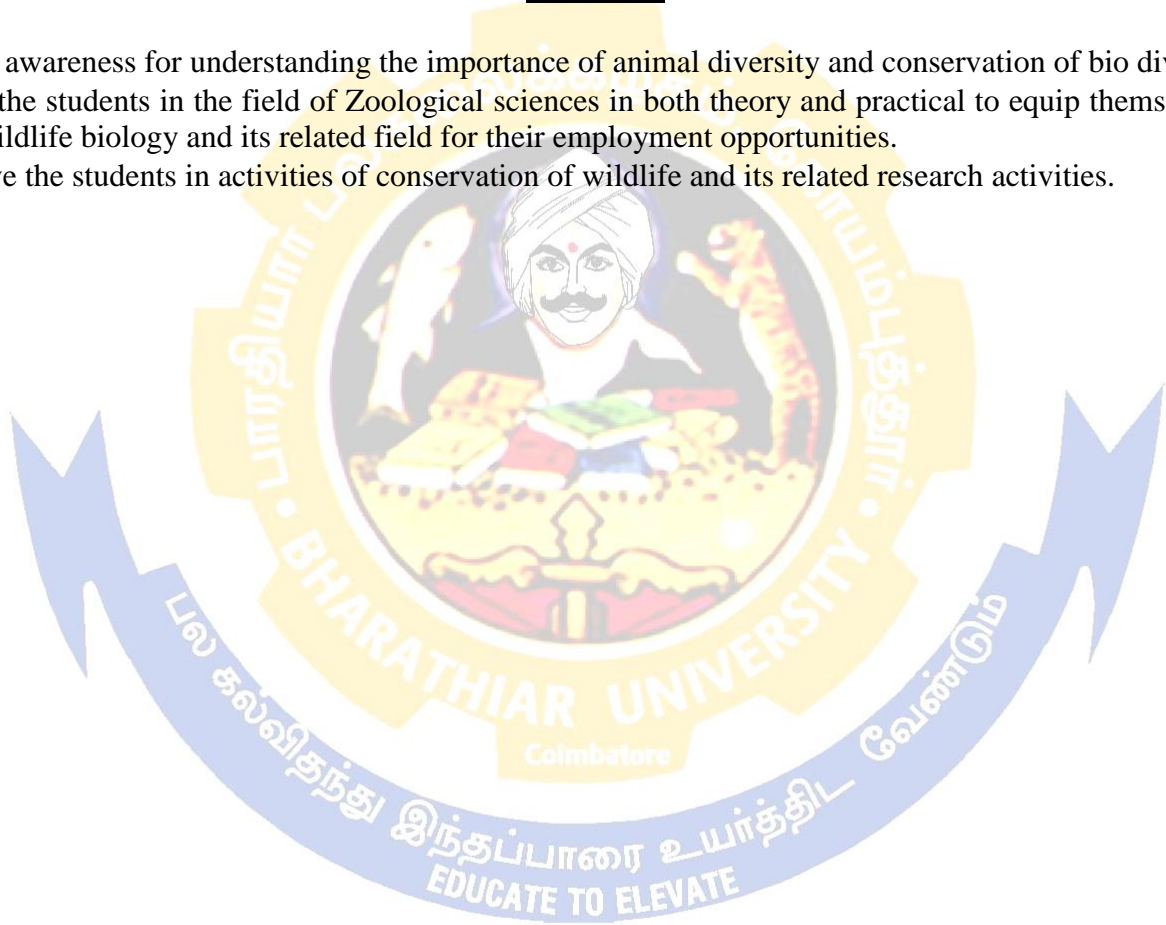
BHARATHIAR UNIVERSITY: COIMBATORE 641046
POST GRADUATE PROGRAM IN
ZOOLOGY (WILDLIFE BIOLOGY)

VISION

To increase the knowledge in the area of Animal Science for understanding the value of wildlife biology and conservation of ecosystem and societal oriented applied research using ecosystem management by students through high-quality education and research.

MISSION

- To create awareness for understanding the importance of animal diversity and conservation of bio diversity.
- To mold the students in the field of Zoological sciences in both theory and practical to equip themselves in the area of wildlife biology and its related field for their employment opportunities.
- To involve the students in activities of conservation of wildlife and its related research activities.



General Instructions:

1. **Elective Courses:** Minimum Two for Each Semester.
2. **Supportive Courses:** Minimum One for first three Semesters.
3. **Value Added Courses:** Minimum 2 and maximum 5 for Each Department for Entire Program
4. **Job Oriented Certificate Courses:** Two Courses (Each one on First and Second Year)
5. All the Board of Studies are requested to follow the same template and use the TIMES NEW ROMAN FONT with the Size of 12.
6. The Course Designer should be mentioned in each of the courses.

Details for the Certificate Course

1	Name of the Course	
2	Name of the Department	
3	Name of the Faculty Member	
4	Inter/Intra Department	
5	Objectives of the Course	
6	Topics to be Covered	
7	Duration of the Course	
8	Eligibility	
9	Registration	
10	Description of the Course	
11	Job Opportunities	
12	Number of Candidates	
13	Course Fee	