

M.Sc. Zoology

Syllabus

AFFILIATED COLLEGES

Program Code: 32F

2023 – 2024 onwards



BHARATHIAR UNIVERSITY

(A State University, Accredited with “A++” Grade by NAAC,
Ranked 21st among Indian Universities by MHRD-NIRF)

Coimbatore - 641 046, Tamil Nadu, India

Program Educational Objectives (PEOs)	
The M. Sc. Zoology program describe accomplishments that graduates are expected to attain within five to seven years after graduation	
PEO1	M.Sc., graduates can take up teaching profession. They can teach biology to the undergraduates and school children
PEO2	They can involve in domestication of animals by keeping profitable petshops and they can become animal trainers too.
PEO3	They can equip themselves to work in the fields of aquaria, poultry, piggery, pisciculture, etc...
PEO4	They can create public awareness on environment, pollutions and ecosystem through social media, industrial sectors and pollution control boards and seek jobs in public concerns and NGOs.
PEO5	They can find employment in farms, zoological parks, museums and zoos by developing personal skills to conserve the animals and nature.
PEO6	They can enter into biotechnology and microbiology companies by acquiring laboratory skills.
PEO7	They can earn and shine in agriculture and farming through 'Integrated farming management' where animal wastes could be turned into wealth.
PEO8	They can get opportunity to work in veterinary sector, wild life conservator and forestry jobs.
PEO9	They can become medical laboratory technicians and find jobs in clinical labs and hospitals as health workers.
PEO10	They can become scientists & researchers by doing Ph.D. and they can compete for competitive examinations like TNPSC, NET, SET, IAS, IFS and any equivalent exams with strong knowledge of biology.

Program Specific Outcomes (PSOs)	
After the successful completion of Zoology 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 the genetics and cytogenetic principles in light of advancements by understanding human genome and genomes of other model organisms.
PSO4	Describe the expression of genome, revealing multiple levels of regulation and strategies to manipulate the same in the benefit of the mankind.
PSO5	Learn handling of DNA sequence, data and its analysis which equip students to get employed in R&D industry involved in DNA sequencing services, diagnostics, and micro biome analysis.
PSO6	Understand relationships of variations in phenotypic expression of genomes and their genome wide interaction with other organisms.
PSO7	Develop an understanding of zoological science for its application in medical entomology, apiculture, aquaculture, agriculture and modern medicine.
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
PSO10	Focus to prepare them with research-oriented approach in frontier areas of research in Zoology and preparing them for advancements

Program Outcomes (POs)	
On successful completion of the M. Sc. Zoology program	
PO1	Expected to attain written skills via assignment, projects, reports & seminar
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 by identifying the animal species
PO6	To learn about animal biodiversity, bioinformatics and ecosystem
PO7	To understand human beings by studying biology, anatomy, physiology etc.,
PO8	To create an awareness of the impact of Zoology on the environment, society, and development outside the scientific community.
PO9	To study and understand the classification of whole phyla included in Non chordates and Chordates with the help of charts/models/pictures.
PO10	To inculcate the scientific temperament in the students and outside the Scientific community.



BHARATHIAR UNIVERSITY: COIMBATORE 641 046
M.Sc., ZOOLOGY DEGREE COURSE (COLLEGES - CBCS PATTERN)
REVISED SCHEME OF EXAMINATION
(For the students admitted during the academic year 2023 – 24 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	Animal Biodiversity & Conservation	4	6	-	25	75	100
13D	Core IV	Environmental Biology	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	Biophysics & Biostatistics	4	6	-	25	75	100
23B	Core VI	Biochemistry	4	6	-	25	75	100
23C	Core VII	Cell & Molecular Biology	4	6	-	25	75	100
23D	Core VIII	Developmental Biology	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	Immunology	4	6	-	25	75	100
3EC	Elective I	Elective I: Entomology Paper I	4	5	-	25	75	100
3EA	Elective II	Elective II A: Microbiology (or)	4	5	-	25	75	100
3EB		Elective II B *Research Methodology	*4	5	-	25	75	100
43P	Practical IV	(Comprises of Papers IX&X)	-	-	2	-	-	-
43Q	Practical V	(Comprises of Papers XI&XII)	-	-	2	-	-	-
4EP	Elective Practical I	Elective I Practical (Comprises of Paper Elective I)	-	-	2	-	-	-
4EQ	Elective Practical II	Elective II Practical (Comprises of Paper Elective II) (or) * Project work	-	-	2	-	-	-
			-		*2	-	-	-
		Total	16					400

FOURTH SEMESTER								
43A	Core XI	Genetics	4	6	-	25	75	100
43B	Core XII	Evolution	4	6	-	25	75	100
4EC	Elective I	Elective I: Entomology Paper II	4	5	-	25	75	100
4EA	Elective II	Elective II A - Bioinstrumentation, Biological Techniques, Biotechnology & Genetic Engineering (or)	4	5	-	25	75	100
4EB		Elective II B *Project work	-	-	-	-	-	-
43P	Practical IV	(Comprises of Papers IX&X)	3	-	2	40	60	100
43Q	Practical V	(Comprises of Papers XI&XII)	3	-	2	40	60	100
4EP	Elective Practical I	Elective I Practical (Comprises of Paper Elective I)	4	-	2	35	40	75
4EQ	Elective Practical II	Elective II Practical (Comprises of Paper Elective II) (or) * Project work	4 *8	-	2	35 50	40 125	75 *175
		Total	30					750
		Grand Total	90					2250
ONLINE COURSES								

List of Elective Papers (opted by the colleges)		
Elective-II Choose A or B	A	1. Elective II A: Microbiology – IIISemester 2. Bioinstrumentation, Biological Techniques, Biotechnology & Genetic Engineering - IV Semester
	B	1. Elective II B: Research Methodology – IIISemester 2. Project work – IV Semester

* For Elective II, if *B is opted,

*Theory Paper – Research Methodology will carry 100 marks and

*For Project 175 marks (Project work =125 marks and Viva-voce =50 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		2023 - 2024	
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.					K2
2	Categorize locomotory organs, methods of locomotion, feeding and digestion in various Invertebrates.					K3
3	Understand about organs of respiration, respiratory pigments, their mechanism, organs and products of excretion, mechanism and its relation to osmoregulation.					K2
4	Discern 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				15 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				15 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				15 hours	
Respiration: Organs of respiration: gills, lungs and trachea - Respiratory pigments - Mechanism of respiration – Excretion: Organs and products of excretion - coelom, coelomoducts, nephridia and Malpighian tubules - Mechanisms of Excretion - Excretion and Osmoregulation.						
Unit:4	NERVOUS SYSTEM				15 hours	
Nervous system: Primitive nervous system: Coelenterata and Echinodermata - Advanced nervous system: Annelida, Arthropoda (Crustacea and Insecta) and Mollusca (Cephalopoda) - Trends in neural evolution.						
Unit:5	LARVAL FORMS AND MINOR PHYLA				15 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		
Total Lecture hours		77hours
Text Book(s)		
1	Parker, T.J., Haswell, W.A. Text Book of Zoology, Macmillan Co., London	
2	Barnes, R.D. Invertebrate Zoology, III edition. W.B. Saunders Co., Philadelphia	
3	Barrington, E.J.W. Invertebrate structure and function. Thomas Nelson and Sons Ltd., London	
4	Young, J.Z. Life of Invertebrates, Clarendon Press, Oxford.	
Reference Books		
1	Hyman, L.H. The invertebrates. Vol. 1 Protozoa through Ctenophora, McGrawHill Co., New York	
2	Hyman, L.H. The Invertebrates. Vol.2. McGraw Hill Co., New York.	
3	Hyman, L.H. The Invertebrate smaller coelomate groups, Vol.5. McGraw Hill Co., New York	
4	Hyman, L.H. The Invertebrates. Vol.8. McGraw Hill Co., New York and London	
5	Russel-Hunter, W.D. A biology of higher Invertebrates, the Macmillan Co. Ltd., London	
6	Jagerstein, G. Evolution of Metazoan life cycle, Academic Press, New York & London.	
7	Narendran, T.C. An Introduction to Taxonomy, 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/	

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		2023 - 2024	
Course Objectives:						
The main objectives of this course are						
<ol style="list-style-type: none"> 1. To understand about vertebrate morphology and its origin. 2. To study about structure and function of Protochordate types. 3. To study about vertebrate classification and development, structure and function of integument types. 4. To understand the flow of blood and evolution of circulatory organs and process of respiration. 5. To know about the various aspects of skeletal system and evolution of urinogenital system 6. 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.					K2
2	Comprehend 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	Distinguish the comparative form and function of skeletal system and its parts and analyze the evolution of urinogenital system in different Vertebrates.					K2 & K5
5	Analyze comparatively the anatomy of nervous system and its components in different Vertebrates as well as receptors of olfaction, taste and hearing and other organs.					K4
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create						
Unit:1	PROTOCHORDATA AND CHORDATE MORPHOLOGY					15hours
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					15hours
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					15hours
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					15hours
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	15hours
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		77hours
Text Book(s)		
1	Kingsley J S. Outline of Comparative Anatomy of Vertebrates. Central Book Depot, Allahabad.	
2	Kent, George C & Carr, Robert K. Comparative Anatomy of Vertebrates, Mc Graw-Hill Science.	
3	Young, J.Z. Life of vertebrates. The Oxford University Press, London.	
4	Weichert, C.K. and Presch, W. Elements of chordate anatomy, 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. Hold Rinehart and Winstoin Inc., NewYork	
2	MilltonHilderbrand. Analysis of vertebrate structure. IV. Ed. John Wiley and Sons Inc., New York.	
3	Romer, A.S. Vertebrate body, IIIrd Ed. W.B. Saunders Co., Philadelphia.	
4	Montagna, W. Comparative anatomy. John Wiley and Sons Inc.	
5	Walters, H.E. and Sayles, L.D. Biology of vertebrates. Macmillan & Co., New York	
6	Torrey, T.W. Morphogenesis of vertebrates, John Wiley and Sons Inc., New York and London	
7	Colbert, E.H. Evolution of the vertebrates, 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	

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	To know the distribution and about and abundance of organisms		Syllabus Version		2023-2024	
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 pollution 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 by pollution					K5
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6- Create						
Unit:1	BIODIVERSITY				15 hours	
Biodiversity – Types: Genetic, species and ecological diversities - Species – Endemic, Keystone, flagship and ecological indicator - Major Biomes of India and wildlife diversity - Tropical Humid Forests, Tropical Deciduous Forests, Tropical rain forests, Warm deserts and semi-deserts, Coniferous forests and Alpine meadows- Hotspots – significance of Western Ghats, Indo-Burma region and Gulf of Mannar - Biosphere reserves of India - Rare endemic and endangered species of India – IUCN Red list category.						
Unit:2	CONSERVATION BIOLOGY				15 hours	
In-situ and Ex-situ conservation - Project Tiger and Project Elephant - Population explosion - Deforestation, Human animal conflicts, Poaching, Forest fire and Afforestation - CITES - Convention on International Trade in Endangered Species of Wild Fauna and Flora - Animal ethics – Ethical committee Discontinuation of dissection in educational institutions - Biodiversity measurement – significance - Simpson’s diversity index.						
Unit:3	SYSTEMATIC ZOOLOGY				15 hours	
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				15 hours	
India - the country of mega wildlife biodiversity - Objectives of wildlife conservation - Biodiversity loss and causes of wildlife depletion - Biodiversity and climate change - Economic importance of wildlife.						

Unit:5	MODERN CONCEPTS IN WILDLIFE CONSERVATION	15 hours
Wildlife Crimes: Wildlife forensics and its applications in detecting wildlife crimes - Wildlife toxicology: Types of contaminants, concentration, bio accumulation and bio magnifications in wildlife populations - Environmental Impact Assessment (EIA) Methods and their role in wildlife conservation - Geographical information system - Biodiversity exploration & conservation - Artificial intelligence technology in conserving biodiversity-Environmental policy of India and legislations.		
Unit:6	Contemporary Issues	2 hours
Expert lectures, online seminars – webinars		
	Total Lecture hours	77 hours
Text Book(s)		
1	Textbook of Biodiversity - K V Krishnamurthy, by Science Publishers.	
2	The Biodiversity of India – ErachBarucha	
3	Biodiversity: An Introduction, 2nd Edition- Kevin J. Gaston, John I. Spicer, WileyBlackwell.	
4	Comparative Anatomy, Function, Evolution – Kenneth V.Kardong	
5	The life of vertebrates – J.Z.Young 6. Comparative anatomy – Nigam	
6	Manual of Zoology – EgambaranatharIyyer	
7	The life of vertebrates – J.Z.Young	
8	An advanced Text book on biodiversity: Principles and Practice – K.V. Krishnamurthy	
Reference Books		
1	Biodiversity loss in the 21 st Century – Griffin. N	
2	Glimpses of Biodiversity- B.Blosetti.	
3	Agrobiodiversity -David Wood, Jillian M. Lenné, CABI Pub., Nature	
4	Biodiversity -WILLIAM MN	
5	Biodiversity: Conserving Endangered Species - <u>Anne Elizabeth Maczulak</u>	
6	Conservation - <u>Clive Hambler</u> , <u>Susan M. Canney</u>	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	Ecology and Wildlife Conservation (Future Learn): https://www.mooclist.com/course/ecology-and-wildlife-conservation-	
2	Wildlife Conservation: https://nptel.ac.in/courses/102/104/102104068/	
3	Wildlife Ecology: https://swayam.gov.in/nd1_noc20_bt38/preview	

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		2023-2024	
Course Objectives:						
The main objectives of this course are,						
<ol style="list-style-type: none"> To explain the core concepts of ecology for a better understanding of the environment. To motivate, identify and solve environmental problems. To create awareness about the improvement and protection of the environment. To understand the need for conservation of biodiversity and natural resources. To help understand the concepts of exobiology. 						
Expected Course Outcomes:						
On the successful completion of the course, student will be able to:						
1	Understand the ecological dynamics and the significance of environmental integrity.					K2
2	Recognize various global and regional environmental concerns that affect the biosphere and analyze the impact of human activities on the environment.					K1
3	Appreciate the significance of the conservation of native biodiversity.					K4
4	Scrutinize specific cases of environmental pollution, challenges, and their impacts on ecology.					K5
5	Apply knowledge of chemistry, biology, molecular biology and microbiology to arrive at innovative solutions to environment issues and extra-terrestrial habitats					K3
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 – Create						
Unit:1	THE ENVIRONMENT				15 hours	
Scope of environmental biology - Physical and biotic components of environment and their interactions - Habitat and Niche – Concepts - niche width and overlap- fundamental and realized niche- resource partitioning; character displacement - Limiting factors: light and temperature - effect on organisms.						
Unit:2	POPULATION ECOLOGY				15 hours	
Characteristics of a population- population growth curves- population regulation - Life history strategies (r and K selection) - Concepts of metapopulation – demes and dispersal, interdemec extinctions and age structured populations - Species Interactions: Types of animal interactions – Neutralism, symbiosis and antagonism.						
Unit:3	COMMUNITY ECOLOGY				15 hours	
Nature of communities- community structure and attributes - Levels of species diversity and its measurement; edges and ecotones - Ecological Succession: Types- mechanisms- concept of climax - Animal migration: Fish, Bird and mammals.						
Unit:4	ECOLOGY OF ECOSYSTEM				15 hours	
Ecosystem: Typical structure - functions- energy flow - Primary production and decomposition – Ecological pyramids - Biogeochemical cycles (C, N, P) - Indian ecosystems: Structure and function - 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	15 hours
Biodiversity: status, monitoring and documentation - Global environmental issues and remedies: Pollution, climate change and global warming – solid waste management - Conservation biology: Principles of conservation and management of Indian biosphere reserves – Deforestation - Exobiology: Ecological conditions of space - Physiological changes in man during space travel - Concepts of Controlled Ecological Life Support System (CELSS).		
Unit:6	Contemporary Issues	2 hours
Expert lectures, online seminars – webinars		
Total Lecture hours		77hours
Text Book(s)		
1	Odum: Fundamentals of Ecology	
2	Odum: Basic Ecology	
3	Turk and Turk: Environmental Science	
4	Environmental biology – Dr.P.S. Verma & Dr. V.K. Agarwal	
Reference Books		
1	Controlled Ecological Life Support system – NASA conference publication (2378) (e-content)	
2	Environmental Science: Earth as a Living Planet by Daniel B. Botkin, Edward A. Keller	
3	Environmental Science: Systems and solutions – Michael L. McKinney & Robert M.Schoch.	
4	Ecology and Environment – P.D. Sharma	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	Primark: A Primer of Conservation Biology	
2	Calabrese: Pollutants and High-Risk Groups	
3	Controlled Ecological Life Support system – NASA conference publication (2378) (e-content)	

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

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



Second Semester

Course code	23A	BIOPHYSICS AND BIOSTATISTICS	L	T	P	C
Core/Elective/Supportive	Core Paper V		6	0	0	4
Pre-requisite	Basic knowledge about Biophysics and Biostatistics		Syllabus version	2023-2024		
Course Objectives:						
The main objectives of this course are to:						
<ol style="list-style-type: none"> To develop awareness about the application of statistics in Zoology. To train how the biological data are processed and interpretations are made. To develop skill in understanding & handling molecular science & instrumentation. 						
Expected Course Outcomes:						
On the successful completion of the course, student will be able to:						
1	Illustrate the basic concepts of probability and biostatistics.					K5
2	The course will give an idea how data should be managed & processed.					K2
3	The course will develop the research aptitude of the students.					K4
4	The students will be capable of interpreting and understanding the basis of molecular biology.					K2
5	The learner will be trained in preparing solutions and handling instruments at basic level.					K4
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create						
Unit:1	BIOELECTRICITY AND RADIATION				15hours	
<p>Bioelectricity Membrane, Resting and action potential. Ionic distribution and membrane potential, recording of action potential.</p> <p>Radiation Electromagnetic radiation. Laws of light absorption - Beer Lamberts law, Biological applications of X-rays, Infra-red rays, and Ultra violet rays.</p>						
Unit:2	BIOENERGETICS				15hours	
Laws of thermodynamics, concept of free energy, oxidation reduction (redox) reactions. Energy coupling reactions, energy rich compounds, ATP cycle, standard free energy and negative entropy changes in living systems, enzyme catalysis.						
Unit:3	BIOLOGICAL DATA, MEASUREMENTS AND VARIABLES				15hours	
<p>Biological data Source, Collection – Classification – Tabulation, Diagrammatic representation. Frequency curves, Frequency Polygon, Ogive</p> <p>Measurements and variables Central tendency - Arithmetic mean, Median and Mode Dispersions, Deviations, Co-efficient of variance. Standard Deviations and standard Error.</p>						
Unit:4	TEST OF SAMPLES				15hours	
Sampling, distribution of samples and sampling errors. Chi-square test, Student-t test, ANOVA one way and two way.						

Unit:5	PROBABILITY	15hours
Correlation – types, methods - Karl Pearson’s co-efficient, Regression–types and significance - calculation of regression co-efficient, Probability- Definition, Types, Additional and Multiplication theorems.		
Unit:6	Contemporary Issues	2 hours
Expert lectures, online seminars – webinars		
Total Lecture hours		77 hours
Text Book(s)		
1	Casey. 1993 Biophysics	
2	Shiv Kumar Practical Statistics <i>Chand & Sons</i> , Delhi.	
Reference Books		
1	Sokal R R&Rohlf F J Biostatistics <i>Freeman</i> , San Francisco	
2	Giese. A.C. 1969 Cell Physiology	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	Biophysical chemistry: https://onlinecourses.nptel.ac.in/noc20_cy33/preview	
2	Biostatistics and Mathematical Biology: https://swayam.gov.in/nd2_ugc19_ma03/preview	

Mapping with Programme Outcomes										
Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	S	L	L	L	L	L	S
CO3	S	S	S	S	L	L	L	L	L	S
CO3	S	S	S	S	L	L	L	L	L	S
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	23B	BIOCHEMISTRY	L	T	P	C
Core/Elective/Supportive	Core Paper VI		6	0	0	4
Pre-requisite	Basic knowledge about Biochemistry		Syllabus version	2023-2024		
Course Objectives:						
The main objectives of this course are to:						
1. To understand the fundamental principles that governs complex biological systems.						
2. To understand the molecular machinery of living cells and mechanisms of metabolic control.						
3. To demonstrate knowledge and understanding basic biological and chemical facts and to be familiar in the concepts in biochemistry.						
4. To gain knowledge about principles of chemical reactivity, bonding, thermodynamics and Kinetics.						
Expected Course Outcomes:						
On the successful completion of the course, student will be able to:						
1	The student will learn about structure of atoms, chemical bonds and get knowledge about principles of biophysical chemistry					K2
2	Learn about the chemical nature of biomolecule, their structural and metabolic role in cellular system.					K2
3	Gain knowledge about enzymes, mechanism of enzyme action and able to identify the enzyme kinetics.					K3
4	Understand the simple changes in molecules and interactions in biochemical process and cellular functions.					K4
5	Understand and analyze the structure and properties of Nucleosides and Nucleotides.					K4
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create						
Unit:1	BASIC PRINCIPLES				15hours	
Structure of atoms, molecules and chemical bonds, Principles of biophysical chemistry (pH, buffer, reaction kinetics, thermodynamics, colligative properties).						
Unit:2	STABILIZING INTERACTION				15hours	
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				15hours	
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				15hours	
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				15hours	
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		77hours
Text Book(s)		
1	Arumugam. (2016). <i>Fundamentals of Biochemistry</i> , Saras publication, Nagercoil, Tamilnadu	
2	Prasanna Kumar S, Arumugam N, Narayanan LM, Meyyan RP and Nallasingam K. (2019). <i>Biochemistry</i> , 6 th edition, Saras publication, Nagercoil, Tamilnadu.	
3	Satyanarayana, chakrapani. (2017). <i>Biochemistry</i> , 5 th edition, Elesvier Publication, India.	
4	Seema PavgiUpadhye. (2020). <i>Textbook of Biochemistry</i> , Publication, Dreamtech Press, India.	
Reference Books		
1	Appling Dean R, Anthony-Cahill Spencer J and Mathews Christopher K. (2017). 1 st edition, <i>Biochemistry</i> , Concepts and Connections, Pearson Education Publication, India.	
2	Naik P. (2012). <i>Essentials of Biochemistry</i> , 2 nd edition, Jaypee Brothers Medical Publication, New Delhi.	
3	VoetD andVoet JG. (2016). <i>Biochemistry</i> , 5 th edition, John wiley and Sons, New Jersey.	
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	



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

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

Course code	23C	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 its functions		Syllabus version	2023-2024		
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 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				15 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				15 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 signaling - Cell surface receptors - Second messenger system - MAP kinase pathways - Signaling from plasma membrane to nucleus.						
Unit:3	CELL- CELL ADHESION AND COMMUNICATION				15 hours	
Ca ⁺⁺ dependent homophilic cell-cell adhesion - Ca ⁺⁺ independent homophilic cell-cell adhesion, Gap junctions and connections - Cell matrix adhesion – Integrins – Collagen - Non-collagen components - Cell cycle - cyclins and cyclin dependent kinases - Regulation of CDK-cyclin activity.						
Unit:4	GENOME ORGANIZATION				15 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				15 hours	
Protein synthesis on free and bound polysomes - Uptake into ER - Membrane proteins, Golgisorting, post-translational modifications - 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		77hours
Text Book(s)		
1	Arumugam N, (2007) 6 th edition. <i>Cell Biology</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> . AddisonWesley Publ. Co.	
2	De RobertisEDP and De RobertisEMF, (1987). <i>CellandMolecularBiology</i> , Lippincott Williams &Wilkins., India.	
3	Gupta PK., (2008). <i>Cellandmolecularbiology</i> , Rastogi publications, Shivaji Road, Meerut	
4	Power CB. (2009). <i>CellBiology</i> , Himalaya Publishing House, Mumbai.	
5	Tomar and Singh, (1999). <i>CellBiology</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	

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	23D	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		2023-2024	
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					15hours
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					15hours
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					15hours
Cell aggregation and differentiation in <i>Dictyostelium</i> ; axes and pattern formation in <i>Drosophila</i> , amphibia and chick; organogenesis – vulva formation in <i>Caenorhabditis elegans</i> , eye lens induction, limb development and regeneration in vertebrates; differentiation of neurons, post embryonic development- Metamorphosis; environmental regulation of normal development; sex determination.						
Unit:4	NEOTENY AND REGENERATION					15hours
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	15hours
Programmed cell death, aging and senescence - 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		77hours
Text Book(s)		
1	Balinsky., Introduction to Embryology	
2	Grant, Biology of Developing System	
Reference Books		
1	Austen, C.R. and short, R.V., Reproduction in animals.	
2	Schatten and Schatten. Molecular biology of fertilization.	
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/	

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

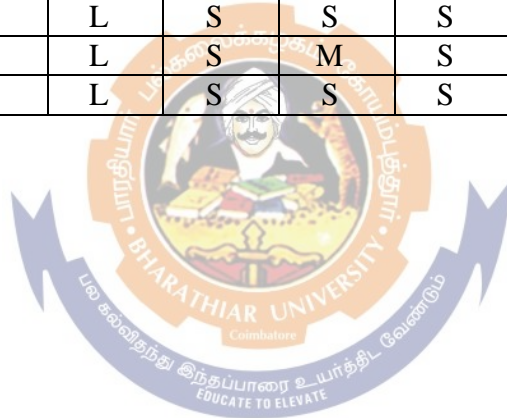
*S-Strong; M-Medium; L-Low

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	2023- 2024		
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: Invertebrates (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 Drosophila. 						
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 Beak and feet in different birds (any locally available birds) Photography of Beak 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	
<ol style="list-style-type: none"> Biological importance Medical importance Beneficial pests Evolutionary significance Economic importance 						

FIELD STUDY AND FIELD TRIP	
Submission at the time of Practical Examination	
1. Plankton: 5slides	
2. Report on the Field study and Fieldtrip	
3. Bonafide Record	
	Total Lecture hours
	48hours
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

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, BIOPHYSICS & BIOSTATISTICS	L	T	P	C
Core/Elective/Supportive	PRACTICAL – II		0	0	2	4
Pre-requisite	Basic information on ecology, biophysics and data analysis		Syllabus Version		2023 - 2024	
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. 						
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, and their impact					K5
2	Apply chemistry, biology, molecular biology and microbiology skill to environment issues					K3
3	The students will be capable of interpreting and understanding the basis of molecular biology.					K2
4	The learner will be trained in preparing solutions and handling instruments at basic level.					K4
5	The course will develop the research aptitude of the students.					K4
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 7. BOD and COD (Demonstration only) 8. All the above parameters in a) Pond/pool water b) Canal/River water c) Sewagewater 						
II. ANALYSIS OF SOIL (ANY THREE)						12 hours
Determination of:						
<ol style="list-style-type: none"> 1. Soil Moisture 2. Chlorides 3. Sulphates 4. Nitrates 5. Total Phosphates 6. Total organic matter 						
All the above parameters in a) Clayey soil, b) Sandy soil, c) Garden soil / Red soil						
III. BIOLOGICAL ANALYSIS (SPOTTERS)						12 hours
1. Qualitative analysis of organisms (Pollution indicator): (any Ten)						
BIOPHYSICS:						12 hours
<ol style="list-style-type: none"> 1. Preparation of buffers (acetate, phosphate, citrate, borate buffers) 2. Determination of pH titration curve of proteins and calculate the pI values. 3. Determination of Glucose content of a given sample. (Calorimeter method) 						

BIostatistics:	
1. Construction of (a) Frequency polygon (b) Histograms from the Data given (The basic data may be from any material available around)	
2. Calculation of (a) Standard deviation (b) Correlation and (c) Student's test from the given data.	
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 Fieldtrips	
2. Bonafide Record	
	Total Lecture hours
	48hours
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 PreetiGuptha 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

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

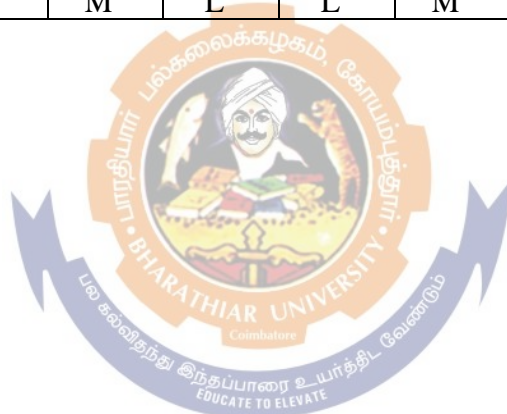
*S-Strong; M-Medium; L-Low

Course code	23R	BIOCHEMISTRY, CELL & MOLECULAR BIOLOGY AND DEVELOPMENTAL BIOLOGY	L	T	P	C
Core/Elective/Supportive		PRACTICAL – III	0	0	2	4
Pre-requisite		Basic understanding on Biochemistry, cell biology and developmental biology	Syllabus Version	2023-2024		
Course Objectives:						
The main objectives of this course are to:						
<ol style="list-style-type: none"> To elucidate its interaction of molecules. To provide an overview of cell structure, basic components of cells and their function. 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	Understand the physical and chemical concepts in biology.					K2
2	Understand metabolism of nucleic acid, amino acid and lipid.					K2
3	Understand and apply the principles and techniques of molecular biology in basic research, or in the health professions.					K3
4	Ensuring accurate macromolecular biosynthesis, unity and diversity at the molecular and cellular levels and the relationship.					K5
5	The learner will able to understand methodological approaches to the study of embryonic development and the characteristics of the principle experimental models.					K4
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create						
BIOCHEMISTRY						12 hours
<ol style="list-style-type: none"> Qualitative and quantitative estimation of Carbohydrates, Proteins and Lipids from the given samples. Preparation of Haemin crystals. Quantitative estimation of Haemoglobin. Separation of plasma, serum and cells from blood. Colorimetric estimation of glucose from blood Estimation of cholesterol in the blood Estimation of alkaline and acid phosphatases 						
CELL AND MOLECULAR BIOLOGY						12 hours
<ol style="list-style-type: none"> Mounting of Polytene chromosome from the salivary gland of a <i>Chironomus</i> larva. Squash preparation of onion root tip to study the stages of Mitosis. Isolation of DNA and RNA from an animal tissue (Demonstration only) Study of different cells from the vertebrate animal (Brain, Liver, Gonad, Kidney and Muscle) 						
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. 						
Total Lecture hours						36 hours

Text Book(s)	
1	Advanced Practical Zoology by Sinha, J., Chatterjee A.K., Chattopadhyay P. 2011. Arunabha Sen Publishers.
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	Fundamentals of Biochemistry by Jain J.L, Sunjay Jain, Nitin Jain. 2007.
3	Cell and Molecular Biology: A Lab Manual by Chaitanya K.V. 2013. Prentice Hall India Learning Private Limited

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 Physiological activities of all the systems in both non-chordates and chordates		Syllabus version		2023-2024	
Course Objectives:						
The main objectives of this course are to:						
<ol style="list-style-type: none"> To study about the adaptive characters in animals To acquire knowledge on the physiological aspects about all organ systems. To acquire knowledge on the osmo and thermo regulatory mechanisms. Understand the concepts of hormonal activities To understand the role of hormones in the biological activities such as pregnancy and lactation 						
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.					K4
2	Learn the significance of osmo and thermo regulations to cope well with the ecological stress.					K3
3	Understand the physiological responses of the meditation practices in human					K2
4	Factors involved in the mechanism of respiratory, excretory physiology, neural and muscular physiology and the influence of hormones in reproduction.					K2
5	Evaluate the various mode of life and adaptive modification of their organ systems in animals					K6
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 – Create						
Unit: I	ADAPTATION AND HOMEOSTASIS				15hours	
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 & YOGIC PRACTICES				15hours	
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 and yogic practices – Meditation & Yoga						
Unit: III	RESPIRATORY PHYSIOLOGY				15hours	
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	15hours
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	15hours
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		
Total Lecture hours		77hours
Text Book(s)		
1	Animal Physiology Vol I &II by Chatterjee	
2	Animal Physiology by Verma & Agarwal	
3	Essential of ANIMAL Physiology by Rastogi	
4	Principles of Animal Physiology by Christopher Moyes and Patricia Schulte	
Reference Books		
1	Comparative Animal physiology by Philip C Withers	
2	Comparative Physiology: Primitive Mammals” by Knut Schmidt-Nielsen and Liana Bolis	
3	“Advances in Comparative and Environmental Physiology: Animal Adaptation to Cold” by J A Boulant and R J Brooks	
4	“Advances in Comparative and Environmental Physiology” by J Machin and S H Wright	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	https://swayam.gov.in/	
2	https://www.mooc.org/	
3	https://nptel.ac.in/	

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	IMMUNOLOGY	L	T	P	C
Core/Elective/Supportive	Core Paper X		6	0	0	4
Pre-requisite	Basic knowledge about the immunology		Syllabus version	2023-2024		
Course Objectives:						
The main objectives of this course are to:						
<ol style="list-style-type: none"> To provide the basic knowledge of different elements of immune system and describe the role of immune system in both maintaining health and contributing to diseases. To identify the cellular and molecular basis of immune responsiveness. To explain immunological response and how it is triggered and regulated. 						
Expected Course Outcomes:						
On the successful completion of the course, student will be able to:						
1	Understanding the multiple interaction between different components of the immune system during the normal immune response.					K2
2	Apply basic techniques for identifying antigen antibody reaction, familiarize with the terminology related with Immunology.					K3
3	Apply basic techniques for identifying antigen antibody interactions					K3
4	Make clear the stages of immune responses, uptake and antigen presentation, cell activation, effector and memory cell and apoptosis mechanisms.					K4
5	Elucidate the reasons for immunization and the effect of immune system including Allergy, hypersensitivity and autoimmunity.					K5
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create						
Unit:1	INNATE AND ACQUIRED IMMUNITY				15hours	
Phylogeny and Ontogeny of immune system - Organization and structure of lymphoid organs Cells of the immune system and their differentiation - Lymphocyte traffic - Nature of immune response.						
Unit:2	NATURE OF ANTIGENS				15hours	
Antigenicity and immunogenicity - Factors influencing immunogenicity - Epitopes and haptens Super antigens - Structure and Functions of Antibodies - Classes and subclasses - Gross and fine structure - Antibody mediated effector functions - Antigen- Ab interactions in vitro and in vivo.						
Unit:3	COMPLEMENT SYSTEM				15hours	
Components, control proteins and activation pathways Major Histocompatibility Complex in mouse and HLA system in human MHC haplotypes - Class I and class II molecules - Cellular distribution – Peptide binding - Expression and diversity - Disease susceptibility and MHC/HLA Organization and expression of Ig genes - Models for Ig gene structure - Multigene organization of Ig genes - DNA rearrangements and mechanisms - Generation of antibody diversity - Differential expression of Ig genes.						
Unit:4	T-CELL GENERATION, ACTIVATION AND DIFFERENTIATION				15hours	
Isolation, molecular components and structure of T-cell receptor complex-T-cell maturation and thymus - T _H - cell activation mechanism - T- cell differentiation - Cell death and T- cell population-B-cell generation, activation and differentiation-B-cell receptors- Selection of immature self-reactive B-cells - B-cell activation and proliferation - T _H - B- Cell interactions						

CYTOKINES

15hours

SCAA DATED: 18.05.2023

Unit:5		
Definition and salient functional features - Cytokine receptors - Cytokines and immune response - Cell-mediated effector functions - Cell adhesion molecules - Effectors cells and molecules - CTL and NK cells- mechanism of action - Immunological tolerance and Anti-immunity - Delayed type hypersensitivity - Hypersensitivity: Types and immunological reactions and immune response to infection agents especially intracellular parasites.		
Unit:6	Contemporary Issues	2 hours
Expert lectures, online seminars – webinars		
Total Lecture hours		77hours
Text Book(s)		
1	Abul Abbas Andrew Lichtman Shiv Pillai. (2015). <i>Basic Immunology-Function and Disorder of the Immune System</i> . Imprint-Elsevier.	
2	Dulsy Fatima and Arumugam N. (2000). <i>Immunology</i> . Saras Publications., Nagercoil.	
Reference Books		
1	Benjamini E, Coico R and Sunskise G. (2000). <i>Immunology-A short course</i> . Wiley – Liss Publication, NY.	
2	Chapel H and Halbey M. (1986). <i>Essentials of Clinical Immunology</i> . ELBS. 1986.	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	https://www.edx.org/learn/immunology	
2	https://www.classcentral.com/course/edx-fundamentals-of-immunology-part-1-1597	

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

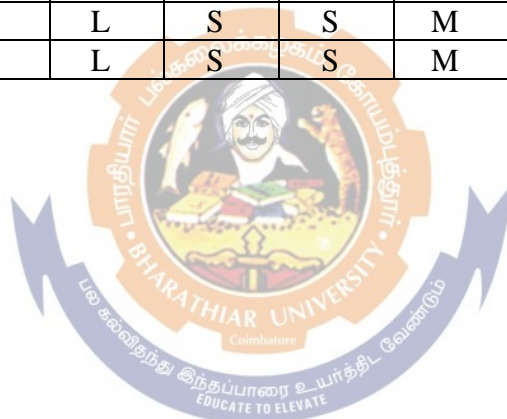
*S-Strong; M-Medium; L-Low

Course code	3EC	ENTOMOLOGY – I	L	T	P	C
Core/Elective/Supportive		Elective I	5	0	0	4
Pre-requisite		Basic knowledge about Insects	Syllabus version		2023-2024	
Course Objectives:						
The main objectives of this course are to:						
1. To make the students understand the insect world.						
2. To study the systems and its organization in insects.						
3. To evaluate the importance of insects.						
Expected Course Outcomes:						
On the successful completion of the course, student will be able:						
1	To identify the insects based on external features.					K1
2	To understand the organization of systems					K2
3	To evaluate the physiological differences.					K5
4	To understand the protective mechanisms					K2
5	To analyze the significance of endocrines					K4
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 – Create						
Unit:1	CLASS INSECTA				15hours	
Classification up to order with example for each order Identification of insects using keys Insect Collection Methods, preservation and significance.						
Unit:2	COMPARATIVE MORPHOLOGY				15hours	
Head, thorax, abdomen and appendages <i>Functional Morphology</i> Mouthparts, genitalia (male, female)						
Unit:3	COMPARATIVE PHYSIOLOGY				15hours	
Digestive system, Respiratory system, Circulatory system, Excretory system, Nervous system Reproductive system.						
Unit:4	INTEGUMENT				15hours	
Integument – Structure, clinical competition and functions, Synthesis of chitin Moulting: Apolysis, ecdysis and sclerotisation Growth - Insect growth, Metamorphosis: types, significance and hormonal regulations						
Unit:5	INSECT ENDOCRINOLOGY				15hours	
Endocrine Glands, Hormones and Neurohormones –functions <i>Insect adaptations</i> Adaptations to environmental stress, Diapauses, pheromones, insect flight, the biomimetics.						
Unit:6	CONTEMPORARY ISSUES				2 hours	
Expert lectures, online seminars – webinars						
Total Lecture hours					77hours	

Text Book(s)	
1	Imms 1986 Textbook of Entomology
2	Snodgrass 1983 Insect Morphology
3	Chapman 1973 Insect Structure and Morphology
Reference Books	
1	Wigglesworth 1969 Insect Physiology
2	Alka Prakash 1996 Applied Entomology
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	Applied Entomology: https://onlinecourses.swayam2.ac.in/cec20_bt02/preview
2	Insect-Human Interactions (Coursera): https://www.mooc-list.com/course/bugs-101-insect-human-interactions-coursera

Mapping with Programme Outcomes										
Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
C01	S	S	S	L	S	S	M	S	S	S
C02	S	S	S	L	S	S	M	S	S	S
C03	S	S	S	L	S	S	M	S	S	S
C04	S	S	S	L	S	S	M	S	S	S
C05	S	S	S	L	S	S	M	S	S	S

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



Course code	3EB	MICROBIOLOGY	L	T	P	C
Core/Elective/Supportive		Elective II	5	0	0	4
Pre-requisite		Knowing the microbial world and its Implications	Syllabus Version		2023-2024	
Course Objectives:						
The main objectives of this course are to:						
1. The course is intended to make aware of the students about the classification, diversity, organization, application and pathogenicity of the microorganisms existing the ecosystem.						
2. The course will help the students to learn about the various microbial culture techniques and its handling.						
3. The course will give an idea that how microbes are used in various industries for generation of various products related to day to daylife.						
Expected Course Outcomes:						
On the successful completion of the course, student will be able to:						
1	The students will be able to explain the taxonomy, diversity and general structure of micro-organisms.					K4
2	They will develop knowledge about the culture, sterilization, handling, identification and assessing growth characters of microorganisms.					K4
3	The students will develop knowledge about the general microbial techniques for isolation of pure cultures of bacteria, fungi and algae and will master the aseptic techniques to perform routine culture handling tasks safely and effectively.					K2
4	The students will get idea about the microbial spoilage and the potentials in the usage of microbes in agriculture.					K5
5	The students will develop an awareness about the various microbial diseases and the causative organisms.					K3
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 – Create						
Unit:1	INTRODUCTION– SCOPE AND HISTORY OF MICROBIOLOGY					15hours
Introduction– Scope and History of microbiology –Classification of bacteria, fungi, yeast and virus. Structure and functions of bacteria and virus. Reproduction in bacteria – Transformation, conjugation, transduction.						
Unit:2	CULTIVATION AND CONTROL OF MICROORGANISM					15hours
Cultivation and control of microorganism – Methods of collection of sample – methods of estimation of microorganism in soil, water and air – Isolation and identification of bacteria. Methods of sterilization and disinfection – Microbial control – Physical and chemical – techniques of pure culture.						
Unit:3	MICROBIAL ECOLOGY					15hours
Microbial Ecology: Distribution of microorganism in soil, water and air – Environmental factors influencing the distribution of microorganism – Role of microorganisms in the cycling of nutrients – Carbon and Nitrogen cycle.						
Unit:4	FOOD MICROBIOLOGY					15 hours
Food Microbiology: Sources, types, incidence of microorganism in vegetables, meats, milk and dairy products – spoilage of food, fruits, vegetables, cereals, meat, canned products – Factors influencing spoilage – Principles of food preservation.						

Unit:5	MICROBIAL TECHNOLOGY		15 hours
Microbial Technology: Genetically modified organisms in food production – Single Cell Protein (SCP) production – Production of organic acids (acetic acid), ethanol – Antibiotics – Microbial toxins			
Unit:6	Contemporary Issues	2 hours	
Expert lectures, online seminars – webinars			
		Total Lecture hours	77hours
Text Book(s)			
1	Burden, K.L. and R.P. Williams (6th Ed.) 1968. Microbiology. The Macmillan Co., London P. 818.		
2	Dawes, E.A. (Ed.) 1986. Energy conservation in bacterial photosynthesis. In: Microbial energetics. Blackie & Son Ltd., Glasgon, 133-144pp		
Reference Books			
1	Doelle, H.W. (Ed.) 1969. Fermentation acetic acid bacteria and lactic acid bacteria. In: Bacterial metabolism. Academic Press. New York, London. 256 – 351 pp.		
2	Hay, J.M. (Ed.) 1986. Modern Food Microbiology. CBS publishers, Delhi. 622 pp.		
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]			
1	Food Microbiology and Food Safety: https://onlinecourses.swayam2.ac.in/cec20_ag13/preview		
2	Food Microbiology: https://onlinecourses.swayam2.ac.in/cec20_ag09/preview		
3	Applied Environmental Microbiology: https://onlinecourses.nptel.ac.in/noc20_ce17/preview		

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	3EB	RESEARCH METHODOLOGY	L	T	P	C
Core/Elective/Supportive	Elective II		5	0	0	4
Pre-requisite	Basic information about research and research articles		Syllabus version	2023-2024		
Course Objectives:						
The main objectives of this course are to:						
<ol style="list-style-type: none"> To familiarize the basics of research To know the literature collection To understand the perfection of research. 						
Expected Course Outcomes:						
On the successful completion of the course, student will be able to:						
1	To understand and improve the art of scientific writing.					K2
2	To familiarize the various literature sources.					K3
3	To analyze the raw data and its interpretation					K4
4	To apply the tools to substantiate scientific findings					K3
5	To create an awareness on publication skills.					K6
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create						
Unit:1	BASICS OF RESEARCH				15hours	
Topic selection - Planning research – defining objectives - Preparation of work plans. Identification of suitable methodology - Preparation of project proposal – Funding agencies – Student project scheme of TNSCST & TANSICHE.						
Unit:2	COLLECTION OF LITERATURE				15hours	
Collection of literature- News articles – Newsletters – Journals. Digital library and search of articles - Key words and search - Internet – Google Scholar – Pub med – Inflibnet – Medline – Agricola – Science direct -Open access Journals - virtual sources - other sources.						
Unit:3	DATA ANALYSIS				15hours	
Collection of samples / data – Data analysis – Microsoft Excel – Construction of tables – headings - footer - hypothesis testing – Test of Significance – Tabulation – Presentation of results.						
Unit:4	THESIS STRUCTURE				15 hours	
Thesis structure –Components - Writing Introduction – review of literature – Materials & Methods – Presentation of results – Discussion of Results based on literature – Arrangement of Bibliography and how to quote reference in thesis - Appendix.						
Unit:5	PUBLISHING OF ARTICLES				15hours	
Publishing of Articles in newspapers /newsletters - Selection of journals – ISSN Number – Peer reviewed Journals – Science citation index – impact factor and importance. Manuscripts preparation for Journals – components – Submission and Publication.						

Unit:6	Contemporary Issues	2 hours
Expert lectures, online seminars – webinars		
Total Lecture hours		77hours
Text Book(s)		
1	Anderson, Durston&Polle 1970: Thesis and assignment, writing Wiley Eastern Limited	
2	Fisher R.A, 1950: Statistical methods of research workers	
3	Freumd J E, 1967: Modern elementary statistics, Prentice Hall, Inc. Englewood cliffs, N J.	
Reference Books		
1	Malter K, 1972: Statistical analysis in Biology, Chapman Hall, London.	
2	Rajendrakumar C 2008 Research Methodology SB Nanja for APHA publishing Corporation New Delhi	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	Research Methodology: https://swayam.gov.in/nd2_ccc20_hs17/preview	
2	Understanding Research Methods: https://www.mooc-list.com/course/understanding-research-methods-coursera	

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

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



Fourth Semester

Course code	43A	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	2023-2024		
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 acquire knowledge on the Gene concepts and their role in inheritance. 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				15hours	
Mendelian principles: Dominance, segregation, independent 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				15hours	
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				15hours	
Methods of genetic transfers – transformation, conjugation, transduction and sexduction, mapping genes by interrupted mating, fine structure analysis of genes Pedigree analysis, karyotypes, genetic disorders - Human Genome Project. Quantitative genetics: Polygenic inheritance, heritability and its measurements,						
Unit:4	MUTATION, POPULATION GENETICS				15hours	
Types, causes and detection, mutant types – lethal, conditional, biochemical, loss of function, gain of function, germinal verses 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	15hours
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		
Total Lecture hours		77hours
Text Book(s)		
1	Brooker: Genetics: Analysis and Principles	
2	Principles of Genetics;Gardener	
3	Basics of Human Genetics-VershaKatira	
4	Russell: 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/	

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

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

Course code	43B	EVOLUTION	L	T	P	C
Core/Elective/Supportive		Core Paper XII	6	0	0	4
Pre-requisite		Basic information about evolutionary principles and process	Syllabus version			2023-2024
Course Objectives:						
The main objectives of this course are to:						
1. To impart knowledge on evolution and its concepts.						
2. To make them understand how life originated.						
3. To realize the current working of evolution and genetic diversity.						
Expected Course Outcomes:						
On the successful completion of the course, student will be able to:						
1	To understand the prehistoric life and its origin.					K2
2	To evaluate the impact of evolution and make them aware of key events in human evolution.					K4
3	To analyze how the higher animals evolved by speciation					K5
4	To understand the evolution of genes by educating phylogeny					K2
5	To imagine how the future evolution will be by comparing the past.					K6
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 – Create						
Unit:1	THEORIES OF EVOLUTION					15hours
Concepts of evolution – Lamarckism – Darwinism – Neo Darwinism – evolutionary synthetic theory – Trends in evolution – Human evolution – Stages of primate evolution including Homo – Species concept.						
Unit:2	NATURAL SELECTION & ADAPTATION					15hours
Concept of stabilizing, directional & disruptive selection – sexual selection – group selection – Kin selection – Altruism – Co evolution – Neutral theory of evolution – Adaptation and evolution – mimicry and colouration.						
Unit:3	MOLECULAR EVOLUTION					15hours
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:4	MOLECULAR PHYLOGENETICS					15hours
Construction of phylogenetic trees - Phylogenetic inference –Distance methods, parsimony methods, maximum likelihood method - Immunological techniques – DNA- DNA hybridization and molecular clocks.						
Unit:5	POPULATION GENETICS					15hours
Metapopulations - Monitoring natural populations - Why small populations become extinct? - Loss of genetic variations –Hardy – Weinberg equilibrium - Conservation of genetic resources in diverse taxa – Artificial evolution (in vitro). Impact of DNA bar coding in modern evolutionary studies						
Unit:6	Contemporary Issues					2 hours
Expert lectures, online seminars – webinars						
Total Lecture hours					77hours	

Text Book(s)	
1	Verma P.S & Agarwal V.K., Concept of Evolution, S.Chand& Co, 2002
2	Dobzhansky, Th. Genetic and Origin of Species. Columbia University Press.
3	Dobzhansky, Th., F.J. Ayala, G.L. Stebbines and J.M Valentine. Evolution. Surjeet Publication, Delhi
4	Jha, A.P. Genes and Evolution. John Publication, New Delhi.
Reference Books	
1	Futuyama, D.J. Evolution Biology, Suinuaer Associates, INC Publishers, Dunderland.
2	Hartl, D.L. A Primer of Population Genetics. Sinauer Associates. Inc, Massachusetts.
3	Strickberger, M.W(2005). Evolution, Jones and Bartett publishes, London.
4	Arthur, W-2011 – Evolution – A developmental approach, wiley – Blackwell, oxford, U.K.
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

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	4EC						
Core/Elective/Supportive	Elective			5	0	0	4
Pre-requisite	Basic information about agricultural pest, insect vectors and its control measures			Syllabus version	2023-2024		
Course Objectives:							
The main objectives of this course are to:							
<ol style="list-style-type: none"> To make the students understand the interaction of insects How to control the insect pests without affecting the environment To understand the modern control measures. 							
Expected Course Outcomes:							
On the successful completion of the course, student will be able to:							
1	To understand how the insect life helps in its control					K2	
2	To analyze the methods of integrated pest management					K4	
3	To elucidate the importance of insects					K5	
4	To know the principles of insect toxicology.					K2	
5	To apply the biological knowledge to control the pests.					K3	
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 – Create							
Unit:1	INTERACTION OF INSECTS					15hours	
Interaction of Insects Social Insects: Caste differentiation and social behaviour of Termite, Honey Bee and Ant, Insect – Plant interaction, Insect vector – Host relationship. Bionomics and control measures a. <i>Locusta migratoria</i> – Polyphagus grasshopper b. <i>Odentotermisobesus</i> – Polyphagus termite c. <i>Heliothisarmigera</i> – Polyphagus moth d. <i>Spodoptera litura</i> – Polyphagus caterpillar e. <i>Oryctusrhynocerus</i> – Coconut beetle							
Unit:2	BIOLOGY AND CONTROL MEASURES OF INSECT PESTS					15hours	
Biology and Control measures of Insect pest Economic crops – Cotton and Sugarcane, Stored grains – Paddy, Wheat and Flour. Insect control methods Cultural, physical, mechanical, biological and chemical control methods, Integrated pest management							
Unit:3	INSECT VECTORS					15hours	
Insect Vectors Systematics, biology and control measures of insect vectors of human diseases. Flies- <i>Anophelessp</i> , <i>Culexsp</i> and <i>Aedes sp.</i> and <i>Muscadomestica</i> Roaches and bugs – <i>Periplanata americana</i> and <i>Cimex indicus</i> Insects of Commercial Importance - Honey Bee – Types and differences in nest building, production of honey. Silk Moth – Types and the differences in life cycles and production of silk. Lac Insect – Indian type only							
Unit:4	INSECT TOXICOLOGY					15hours	
Insect Toxicology Principles and Scope. Chemistry and mode of action of the Insecticides- Inorganic compounds, Arsenic and fluorine compounds Organic compounds: Organochloride, organophosphorus and carbamates, Botanical Insecticides							

Unit:5	INSECTS AND MODERN CHEMICALS	15hours
Insects and Modern chemicals. Growth regulatory compounds Microbial insecticides, Pheromones and pest control Insecticides and Introduction to insect genetics Formulation and appliances, Mechanism of Insecticide resistance – Genetical, Physiological and Biochemical.		
Unit:6	Contemporary Issues	2 hours
Expert lectures, online seminars – webinars		
Total Lecture hours		77hours
Text Book(s)		
1	Imms 1986 Textbook of Entomology	
2	Snodgrass 1983 Insect Morphology	
3	Alka Prakash 1996 Applied Entomology	
Reference Books		
1	Chapman 1973 Insect Structure and Morphology	
2	Wigglesworth 1969 Insect Physiology	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	Applied Entomology: https://onlinecourses.swayam2.ac.in/cec20_bt02/preview	

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

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

Course code	4EA	BIOINSTRUMENTATION, BIOLOGICAL TECHNIQUES, BIOTECHNOLOGY AND GENETIC ENGINEERING	L	T	P	C
Core/Elective/Supportive	ELECTIV – IIB		5	0	0	4
Pre-requisite	Basic knowledge on Bioinstrumentation, Biological techniques, Biotechnology and Genetic Engineering		Syllabus version		2023-2024	
Course Objectives:						
The main objectives of this course are to: 1. The objective of this course is to give a firm foundation in the fundamentals of modern Molecular techniques. 2. The course will give idea various protocols followed in Biotechnology in relation to animal science.						
Expected Course Outcomes:						
On the successful completion of the course, student will be able to:						
1	To develop an idea about the various techniques used in modern biotechnology.					K1
2	To understand the basic principles of all techniques					K2
3	To analyze the latest techniques and its implication					K4
4	To know how to isolate & sequence a gene					K5
5	To apply the knowledge in purifying the environment.					K6
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 – Create						
Unit:1	BIOINSTRUMENTATION				15hours	
Microscopy – Fluorescence Microscope, Phase Contrast Microscope, Electron Microscope (TEM& SEM). Centrifugation – Principle and applications , types . pH meter. Spectrophotometry – Visible and UV spectrophotometry. Spectrophotometer. Chromatographic techniques – Principle and applications of chromatography – Paper and TLC. Electrophoresis Principles and applications.						
Unit:2	BIOLOGICAL TECHNIQUES				15hours	
Southern Blotting, Western Blotting , DNA finger printing techniques. Hybridoma technology production and applications of monoclonal antibodies. Geiger Muller counter – Principles and applications. Liquid Scintillation counter – principle and applications. Applications of radio isotopes in biological sciences. Autoradiography. Applications of Flow cytometry, Cell separation and culture techniques.						
Unit:3	GENE TRANSFER METHODS AND TRANSGENIC ORGANISMS				15hours	
Gene Transfer Methods in Animals – Transgenic animals. Somatic cell hybridization – mechanism and applications. Recombinant DNA Techniques Recombinant DNA – PCR, Restriction enzymes for cloning – Techniques used in recombinant DNA technology – Cloning vectors for rDNA – Construction of Chimeric DNA – Molecular Probes – Construction and screening of genomic libraries.						
Unit:4	ISOLATION, SYNTHESSES AND SEQUENCING OF GENES				15hours	
Isolation, Syntheses and Sequencing Genes Isolation of genes – using DNA and RNA probes; Gene therapy- types of gene therapy. Industrial Biotechnology Fermentation – Designing of bioreactors – stages of fermentation and fermentation products conversion of waste into biogas – conversion of waste into ethanol						

Unit:5	ENVIRONMENTAL BIOTECHNOLOGY	15hours
Biotechnological methods of pollution control – biological treatment of waste water – biotechnology for solid waste management – microbial bioremediation of polluted environment – aerobic and anaerobic treatment – bioleaching and bio mining for recovery of resources – compost making.		
Unit:6	Contemporary Issues	2 hours
Expert lectures, online seminars – webinars		
Total Lecture hours		77hours
Text Book(s)		
1	Dubey, R.C. 2002. A text book of biotechnology. S. Chand and Company Ltd., New Delhi.	
2	Gabriel Melchias, 2001. Biodiversity and conservation, Oxford IBH Publ. Co. Pvt. Ltd, NewDelhi, Calcutta.	
3	Glazer, A.N. and Hiroshi Nikaido, 1995. Microbial biotechnology: Fundamentals of Applied Biotechnology, W.H. Freeman and Company, New York.	
Reference Books		
1	RodenyF.Boyer – Modern Experimental Biochemistry – Pearson publication	
2	Gupta, P.K. 2003. Elements of Biotechnology, Rastogi Publ. Meerut.	
3	Rao, C.V. 2002. An introduction to immunology, Narosa publishing House, New Delhi.	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	Fundamentals of Biotechnology: https://nptel.ac.in/courses/102/103/102103045/	
2	Biomedical Signal Processing: https://onlinecourses.nptel.ac.in/noc20_ee41/preview	

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

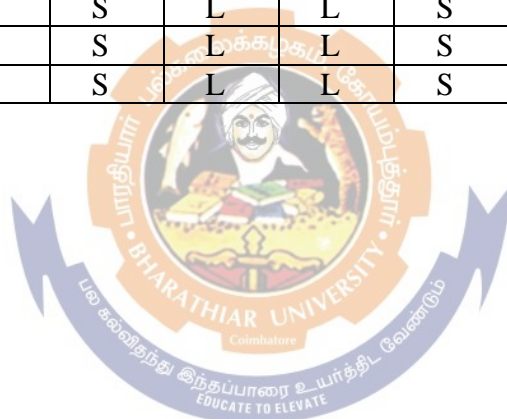
*S-Strong; M-Medium; L-Low

Course code	43P	COMPARATIVE ANIMAL PHYSIOLOGY AND IMMUNOLOGY	L	T	P	C
Core/Elective/Supportive	PRACTICAL - IV		0	0	2	4
Pre-requisite	Basic understanding on Physiology and immunology of animals		Syllabus Version		2023-2024	
Course Objectives:						
The main objectives of this course are to:						
<ol style="list-style-type: none"> To make them understand physiology through practical's To equip them to do the experiments individually To understand the basics of immunology 						
Expected Course Outcomes:						
On the successful completion of the course, student will be able to:						
1	To understand the physiological mechanisms					K2
2	To evaluate the experimental design					K5
3	To interact their results					K6
4	To present their findings and discuss on it					K2
5	To handle the instruments					K3
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 (Humansaliva). <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 & lying posture. Biological responses of animals to various osmotic concentrations and their effects <ol style="list-style-type: none"> Change in weight of Earthworm in heteroosmotic 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 insalinity. 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 heartbeat of cockroach (Result with graphical representation corresponding to different concentration and time interval expected) Determination of the rate of ammonia and urea excretion infish. Determination of the haemoglobin content in fish blood. 						
IMMUNOLOGY:						12 hours
<ol style="list-style-type: none"> Study of Antigen and Antibody reaction through the study of Bloodgrouping. Study of Rh factor through the study of Bloodgrouping. Estimation of protein by Lowry's method Widal Test Western blotting (Demonstration only) ELISA (Demonstration only) Separation of lymphocytes from wholeblood 						
Total Lecture hours						24 hours

Text Book(s)	
1	Advanced Practical Zoology by Sinha, J., Chatterjee A.K., Chattopadhyay P. 2011. Arunabha Sen Publishers.
2	Medical Laboratory Technology, Methods and Interpretations by RamnikSood. 2006. Jaypee publishers.
Reference Books	
1	Modern Experimental Zoology by PreetiGuptha and Mridula Chaturvedi. 2000
2	Richard L. Myers Immunology: A Laboratory Manual. 1994. McGraw-Hill Inc., US; 2nd Revised edition edition.
4	Cell and Molecular Biology: A Lab Manual by Chaitanya K.V. 2013. Prentice Hall India Learning Private Limited

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

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



Course code	43Q	GENETICS AND EVOLUTION	L	T	P	C
Core/Elective/Supportive		PRACTICAL – V	0	0	2	4
Pre-requisite		Basic knowledge about genetics and evolution of Animals	Syllabus Version		2023-2024	
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 current working of evolution. 						
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	Able to learn the Structure and functions of the Nucleotides					K2
4	To analyze how the higher animals evolved.					K5
5	To understand the evolution of genes.					K2
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create						
GENETICS:						20 hours
<ol style="list-style-type: none"> Genetic characteristics of a class room sample. <ol style="list-style-type: none"> Dermatoglyphic patterns (Fingerprint), Earlobe, Rolling of tongue, Mid digital hairs, Widow's peak, Inward bending of little finger. Study of morphology of <i>Drosophila melanogaster</i> Culture of <i>Drosophila melanogaster</i> Identification of sex and mutant characters <i>Drosophila melanogaster</i> Demonstration of dosage compensation in <i>Drosophila</i> males and females. Preparation of genital plate of <i>Drosophila 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 calculation of chiasma frequency 						
EVOLUTION:						10 hours
<ol style="list-style-type: none"> Evolutionary significances: Fossils of each any five from non-chordate and chordate. Analogous and homologous organs of vertebrate animals (Frog, <i>Calotes</i>, Pigeon and Rabbit) Mimicry and colouration of animals. 						
Total Lecture hours						30 hours

Text Book(s)	
1	Advanced Practical Zoology by Sinha, J., Chatterjee A.K., Chattopadhyay P. 2011. Arunabha Sen Publishers.
2	Manual of Practical Zoology: Chordates by Verma.(2000. S. Chand Publishing
Reference Books	
1	Cell and Molecular Biology: A Lab Manual by Chaitanya K.V. 2013. Prentice Hall India Learning Private Limited
2	A Manual of Practical Zoology: Invertebrates by Verma P.S.. 2010. S Chand publication.
3	A Manual of Practical Zoology by Verma P.S. 2000. S Chand publication.

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

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

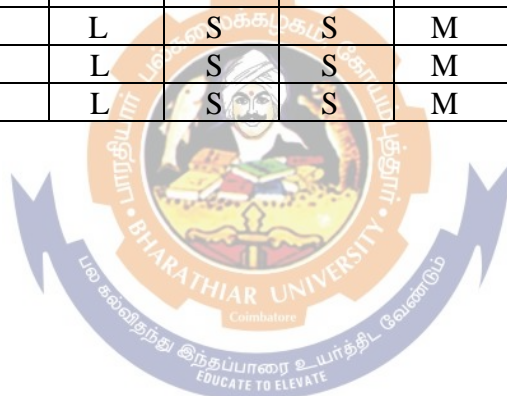


Course code	4EP	ENTOMOLOGY I & II) (Avoid collecting animals from Wild)	L	T	P	C
Core/Elective/Supportive		ELECTIVE I PRACTICAL	0	0	2	4
Pre-requisite		Necessary understanding about Biology of Insects	Syllabus Version		2023-2024	
Course Objectives:						
The main objectives of this course are to:						
<ol style="list-style-type: none"> To make the students understand the insect world. To study the systems and its organization in insects. How to control the insect pests without affecting the environment 						
Expected Course Outcomes:						
On the successful completion of the course, student will be able to:						
1	To identify the insect based on external feature.					K1
2	To understand the organization of systems					K2
3	To analyze the significance of endocrines					K4
4	To know the principles of insect toxicology.					K2
5	To apply the biological knowledge to control the pests.					K3
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create						
1. IDENTIFICATION OF INSECTS						04 hours
A. Key to each order B. One insect for each order (South Indian insects only)						
2. DISSECTION						10 hours
Digestive system, Nervous system and Reproductive system (Any two) Cockroach ,Gryllotalpa, Nepa, Cybister, Silk moth						
3. MOUNTING						06 hours
Mouthparts, Salivary gland and Sting apparatus (Any two) Honey bee, Cockroach, House fly, Mosquito						
<ol style="list-style-type: none"> Morphological studies of different types of antennae and legs of insects. Qualitative study of haemocytes in the haemolymph of cockroach Qualitative study of lipids, carbohydrates and proteins in the haemolymph of cockroach. Identification of Insect pests of the following (3 major pests in each) <ol style="list-style-type: none"> Paddy Cotton Sugarcane Vegetables Storage products Collection and preservation of insects. 						06 hours
9. SPOTTERS						04 hours
<ol style="list-style-type: none"> Systematic Pests Medical importance Veterinary importance Economic importance Insect whole mounts – 10 slides 						

Field study and visit – Visits to agricultural fields and forests for on spot study of pests and damage caused by them.		
Submission at the time of Practical Examination		
1. Report on the Field study and Fieldtrips		
2. Bonafide Record		
3. Insect photographicalalbum/chart		
	Total Lecture hours	30hours
Text Book(s)		
1	Advanced Practical Zoology by Sinha, J., Chatterjee A.K., Chattopadhyay P. 2011. Arunabha Sen Publishers	
2	A Manual of Practical Zoology: Invertebrates by Verma P.S.. 2010. S Chand publication	
Reference Books		
1	Practical Zoology Invertebrate by H.S. Bhamrah. 2003. Dominant Publishers.	

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	4EQ	MICROBIOLOGY, BIOINSTRUMENTATION, BIOLOGICAL TECHNIQUES, BIOTECHNOLOGY & GENETIC ENGINEERING	L	T	P	C
Core/Elective/Supportive		ELECTIVE II PRACTICAL	0	0	2	4
Pre-requisite		Basic information on biological techniques and its applications	Syllabus version		2023-2024	
Course Objectives:						
<p>The main objectives of this course are to:</p> <ol style="list-style-type: none"> 1. The objective of this course is to give a firm foundation in the fundamentals of modern Molecular techniques. 2. The course is intended to make aware of the students about the classification, diversity, organization, application and pathogenicity of the microorganisms existing the ecosystem. 3. The course will give an idea that how microbes are used in various industries for generation of various products related to day to day life. 						
Expected Course Outcomes:						
On the successful completion of the course, student will be able to:						
1	To develop an idea about the various techniques used in modern biotechnology.					K1
2	To analyze the latest techniques and its implication					K4
3	The students will develop an awareness about the various microbial diseases and the causative organisms..					K3
4	The students will be able to explain the taxonomy, diversity and general structure of micro-organisms.					K4
5	The students will get idea about the microbial spoilage and the potentials in the usage of microbes in agriculture.					K5
K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create						
MICROBIOLOGY:			15 hours			
<ol style="list-style-type: none"> 1. Sterilization – Principles and methods 2. Media Preparation – Liquid and Solid media , Agar deep , slant and plate 3. Pure culture techniques – Streak plate, pour plate, spread plate 4. Identification of Gram positive and Gram negative bacterial strains 5. Water quality analysis – MPN 6. Isolation of microorganisms from Spoiled foods – Meat, milk, cereals and bread 7. Milk quality – dye reduction test 8. Antibiotic sensitivity : oxidase test 9. Identification of Symbiotic bacterioids from rood nodules of leguminous plants 						
BIOINSTRUMENTATION & BIOLOGICAL TECHNIQUES:			10 hours			
<ol style="list-style-type: none"> 1. Separation technique of amino acids using paper chromatography. 2. Separation of Proteins on gel electrophoresis 3. Study on the Principles of the Instruments and their uses. <ol style="list-style-type: none"> 1. pHMeter 2. Colorimeter 3. Spectrophotometer 4. Electrophoresis apparatus 5. Microtome 6. Centrifuge 						

BIOTECHNOLOGY & GENETIC ENGINEERING		10 hours
1. Fermenter design and working principle 2. Wine production 3. Antibacterial Sensitivity disc test 4. Isolation and estimation of DNA & RNA 5. Preparation of Tissue culture medium 6. PCR – Working Principle		
Field Study and Visit : Visits to instrumentation lab in university or any research institute		
Total Lecture hours		30 hours
TEXT BOOK		
1	Advanced Practical Zoology by Sinha, J., Chatterjee A.K., Chattopadhyay P. 2011. Arunabha Sen Publishers.	
2	Medical Laboratory Technology, Methods and Interpretations by RamnikSood. 2006. Jaypee publishers.	
Reference Books		
1	Cell and Molecular Biology: A Lab Manual by Chaitanya K.V. 2013. Prentice Hall India Learning Private Limited	
2	Manual of Practical Physiology and Endocrinology by Harsh Vardhan Bhask. 2009. Campus Books International	
3	Richard L. Myers Immunology: A Laboratory Manual. 1994. McGraw-Hill Inc., US; 2nd Revised edition	

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



Annexure

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	

M.Sc. Zoology 2023-24 onwards - Affiliated Colleges - Annexure No.18
BHARATHIAR UNIVERSITY : COIMBATORE
REGULATIONS FOR POSTGRADUATE DEGREE COURSES
In CBCS pattern with effect from 2010-2011
SCAA DATED: 18.05.2023

Definition:

Programme :

“Programme” means a course of study leading to the award of a degree in a discipline.

Course:

“Course” refers to a subject offered under the degree programme.

Core Papers:

“Core Papers” means “the core courses” related to the programme concerned including practicals and project work offered under the programme.

Electives:

“Electives” means the courses offered under the programme related to the major or non major but are to be selected by the students.

A detailed explanation of the above with relevant credits are given under “Scheme of Examinations along with Distribution of Marks and Credits”

1. Eligibility for Admission to the Course

A candidate who has passed the Degree Examination as main subject of study of this University or an examination of some other University accepted by the Syndicate as equivalent thereto shall be eligible for admission to the Master Degree of this University.

2. Duration of the Course

This Course of Study shall be based on Semester System. This Course shall consist of four Semesters covering a total of two Academic Years. For this purpose, each academic year shall be divided into two Semesters; the first and third Semesters; July to November and the second and the fourth Semesters; December to April. The Practical Examinations shall be conducted at the end of even Semester. Each semester have 90 working days consists of 5 teaching hours per working day. Thus, each semester has 450 teaching hours and the whole programme has **1800 teaching hours**.

3. Course of Study

The Course of the Degree of Master of Science/Arts/Commerce shall be under the Semester System according to the Syllabus to be prescribed from time to time. This Course consists of Core Subjects and Elective Subjects.

4. Scheme of Examinations

As given in the respective Board.

5. Requirement to appear for the Examinations

- a) A candidate will be permitted to take the University Examination for any Semester, if he/she secures not less than 75% of attendance out of the 90 instructional days during the Semester.

- b) A candidate who has secured attendance less than 75% but 65% and above shall be permitted to take the Examination on the recommendation of the Head of the Institution to condone the lack of attendance as well as on the payment of the prescribed fee to the University.
- c) A candidate who has secured attendance less than 65% but 55% and above in any Semester, has to compensate the shortage of attendance in the subsequent Semester besides, earning the required percentage of attendance in that Semester and take the Examination of both the Semester papers together at the end of the latter Semester.
- d) A candidate who has secured less than 55% of attendance in any Semester will not be permitted to take the regular Examinations and to continue the study in the subsequent Semester. He/she has to re-do the Course by rejoining the Semester in which the attendance is less than 55%.
- e) A candidate who has secured less than 65% of attendance in the final Semester has to compensate his / her attendance shortage in a manner to be decided by the Head of the Department concerned after rejoining the Course.

6. Restriction to take the Examinations

- a) Any candidate having arrear paper(s) shall have the option to take the Examinations in any arrear paper(s) along with the subsequent regular Semester papers.
- b) Candidates who fail in any of the papers shall pass the paper(s) concerned within 5 years from the date of admission to the said programme. If they fail to do so, they shall take the Examination in the revised Text / Syllabus, if any, prescribed for the immediate next batch of candidates. If there is no change in the Text / Syllabus they shall take the Examination in that paper with the Syllabus in vogue, until there is a change in the Text or Syllabus.

In the event of removal of that paper consequent to the change of Regulations and / or Curriculum after a 5 year period, the candidates shall have to take up on equivalent paper in the revised syllabus as suggested by the Chairman and fulfill the requirements as per Regulations/Curriculum for the award of the Degree.

7. The Medium of Instruction and Examinations

The medium of instruction and Examinations shall be in English, except languages. However, as per directives of the government, if the candidates answer in Tamil, their answer scripts will also be evaluated.

8. Submission of Record Notebooks for Practical Examinations

Candidates taking the Practical Examinations should submit bonafide Record Note Books prescribed for the Practical Examinations. Otherwise the candidates will not be permitted to take the Practical Examinations.

9. The Minimum (Pass)Marks

A candidate shall be declared to have passed in a paper if a student obtains not less than 50% of marks in that paper. A candidate shall be declared to have passed the whole Examination if the student passes in all the papers.

10. Distribution of marks

Table- 1(A): The following are the distribution of marks for external and internal for **theory papers** of PG courses.

DISTRIBUTION OF EXTERNAL AND INTERNAL MARKS FOR THEORY PAPERS

Table – 1(A): Distribution of marks for **External** and **Internal** for University (external) examinations and **Continuous Internal Assessment** and passing minimum marks for **Theory Papers**.

TOTALMARKS	EXTERNAL		INTERNAL	Overall Passing Minimum for total marks (Internal + External)
	Max. marks	Passing Minimum for external alone	Max. marks	
100	75	38	25	50
75	55	28	20	38

Table – 1(B): Distribution of marks for the **Continuous Internal Assessment** in the **Theory Papers** of PG programmes.

FOR THEORY PG-COURSES		Distribution of Marks	
1	Tests (one best test out of 2 tests of 2 hours each)	05	04
2	End semester model test (3hours)	10	08
3	Assignments – 2Nos.	05	4
4	Seminar	05	4
TOTAL MARKS		25	20

DISTRIBUTION OF EXTERNAL AND INTERNAL MARKS FOR PRACTICAL PAPERS

Table – 2(A): Distribution of marks for **External** and **Internal** University (external) examinations and **Continuous Internal Assessments** and passing minimum marks for the **Practical Courses**.

TOTALMARKS	EXTERNAL		INTERNAL	Overall Passing Minimum for total marks (Internal + External)
	Max. marks	Passing Minimum for external alone	Max. marks	
100	60	30	40	50
75	45	23	30	38

Table – 2(B): Distribution of marks for the **Continuous Internal Assessment** in **PG Practical Courses**.

	FOR PRACTICAL PG-COURSES	DISTRIBUTION OF MARKS	
1	Minimum 10 experiments to be conducted practical paper/semester.	20	15
2	Tests: Two tests out of which one shall be during the mid semester and the other to be conducted as model test at the end of the semester.	15	10
3	Record.	05	5
	TOTAL MARKS	40	30

BHARATHIAR UNIVERSITY : : COIMBATORE 641 406

GUIDELINES FOR CONDUCTING VALUE ADDED COURSES

Course Structure

1. The request for approval of syllabus by the concerned authorities is mandatory at least 15 days before the date of commencement of the course. The Syllabus (15/30 hours), Schedule and the Details of Faculty handling the course approved by the Departmental Committee and forwarded by Head of the Department should be enclosed.
 - a. The course offered should not be the same as any course listed in the curriculum of the respective programme or any other programme offered in University / Colleges.
 - b. The value added courses may be also conducted during weekends/ vacation period.
 - c. The course can be offered any semester in the PG Programmes.
 - d. Industry experts/ eminent academicians from other Institutes are also eligible to offer the value added course.
 - e. The course can be offered only if there are at least 10 students opting for it.
 - f. The students may be allowed to take value added courses offered by other departments after obtaining permission from Head of the Department offering the course.

Duration

2. The duration of value added courses is 15(30) periods of theory or a maximum of theory and Laboratory courses and the course can have a maximum of three hours per day.

For the one (two) credit courses either 15(30) periods of theory or a combination of theory and Laboratory may be offered.

Where, **2 periods** of laboratory = **1 period** of theory Evaluation

3. The value added courses shall carry 100 marks and shall be evaluated through internal assessments only.
 - a. Two Assessments shall be conducted preferably one in the middle and the other at the end of the course by the Department concerned.
 - b. The duration of assessment is one hour each.
 - c. The total marks obtained in the tests shall be reduced to 100 marks and rounded to the nearest integer.
 - d. The Head of the Department may identify a faculty member as coordinator for the course. A committee consisting of the Head of the Department, staff handling the course (if available), coordinator and a senior Faculty member nominated by the Head of the Department

shall monitor the evaluation process. The grades shall be assigned to the students by the above committee based on their relative performance.

- e. The coordinator for the course is responsible for maintaining and processing the records with regard to assessment marks and results.

Passing Requirement and Grading

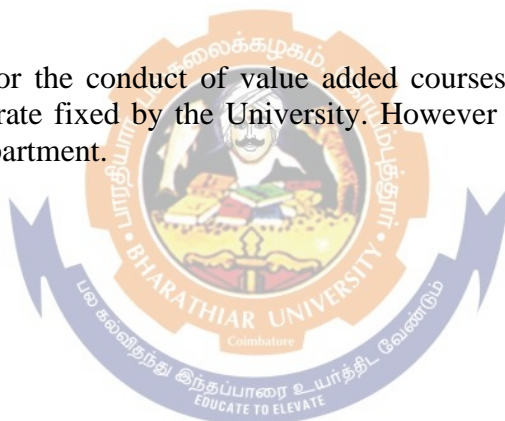
4. The passing requirement for value added courses shall be 50% of the marks prescribed for the course (**Internal assessment only**)
- The grades O, A+, A, B+, B obtained for the one/ two credit shall figure in the Mark sheet under the title '**Value Added Courses**'. The other grades RA, SA **will not figure in the mark sheet**.
 - The credits earned through value added courses shall not be considered for calculating GPA and CGPA.
 - The credits earned through value added courses shall not be considered for classification of degree.
 - If the course is offered during any semester, it will appear in that semester's marksheet. However if the course is offered in summer/ winter vacations, the course will be included in the gradesheet of the subsequent semester.

Maximum Number of Courses

5. A student can earn a maximum of 3 credits during the entire programme of study by attending value added courses which would be over and above the required maximum number of credits for the award of the degrees.

Financial Commitment

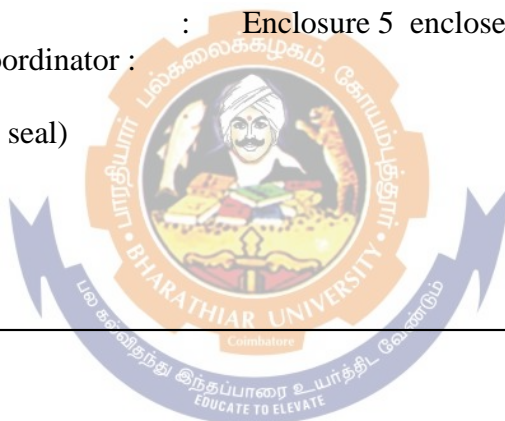
6. The expenditure to be incurred for the conduct of value added courses should be met from nominal fees collected from the students at a rate fixed by the University. However any additional expenditure may be supported by the funds of the Department.



APPLICATION FOR CONDUCTING VALUE ADDED COURSES

1. Name of the Department:
2. PG programme:
3. Details of the Value Added Courses:
 - a. Name of the Value Added Courses
 - b. Type of Value Added Courses (Theory/ Lab/ Lab integrated Theory/others)
 - c. Short Description Enclosure1 enclosed -YES / NO
 - d. Syllabus including Reference Enclosure 2 enclosed - YES / NO
4. Target audience:
Semester (indicate if more than one) Others
5. Details of Faculty handling the course:
 - a. Name of the Faculty handling the Value Added course
 - b. Details including designation and expertise Enclosure3enclosed-YES / NO
 - c. Contact details
Email ID :
Phone No :
6. **Tentative Time Table** including dates of internal assessments : Enclosure 4 enclosed - YES / NO
7. Number of students opting for the course:
8. Department Consultative Committee - Minutes : Enclosure 5 enclosed - YES / NO
9. Name and Designation of the Coordinator :

Head of the Department (with date & seal)



Note:

* Fees if any

DETAILS OF COMPLETION OF VALUE ADDED COURSE

Name of the Department :
 Name of the Value Added course offered :
 Name of the Faculty offered the course :
 : Academic / Industry
 Name of the coordinator :
 E- mail :
 Contact :

Details of students attended the course:

S.No	Name of the student	Reg.No.	Programme	Semester	Marks	Grade

(Faculty handling the course (if available))

(Senior Faculty nominated by HOD)



(Coordinator)

(Head of the Department)
(with date & seal)

Vision

To make the students biologically, socially, environmentally and ethically aware of current scientific issues by imparting zoological knowledge through the curriculum and equip them to care the welfare of the society.

Mission

To create the zoology students as bio-socially responsible citizens through laboratory works, field trips, study tour, visit to biodiversity spots, zoos and museums and research projects works.

To make them talented multi- visionary, and future oriented through various community activities, competitions, and celebrations of National & International days.

Objectives

To inculcate the values of life science, research oriented education has been focussed through seminars, presentations and publications and make them responsible future scientists.

