



BHARATHIDASAN UNIVERSITY, TIRUCHIRAPPALLI - 620 024

M.Sc., Zoology

CHOICE BASED CREDIT SYSTEM -

LEARNING OUTCOMES BASED CURRICULUM FRAMEWORK

(CBCS - LOCF)

(Applicable to the candidates admitted from the academic year 2026 - 2027 onwards)

Sem.	Course	Course Title	Ins. Hrs.	Credi t	Exam Hrs.	Marks		Total
						Int.	Ext.	
I	Core Course – 1 (CC - 1)	Structure and Function of Invertebrata	6	4	3	30	70	100
	Core Course – 2 (CC - 2)	Comparative Anatomy of Chordata	6	4	3	30	70	100
	Core Practical – 1 (CP - 1)	Laboratory in Invertebrata and Chordata	6	4	3	40	60	100
	Discipline Centric Elective Course - 1 (DCEC - 1)	1. Animal Biotechnology (or) 2. Endocrinology	5	4	3	30	70	100
	Generic Elective Course - 1 (GEC - 1)	1. Vectors, Disease and Management (or) 2. Economic Entomology (or) 3. Animal Behaviour	5	3	3	30	70	100
	Skill Enhancement Course - 1 (SEC - 1)	Bee Keeping	2	2	3	30	70	100
	Value Added Course – 1 (VAC - 1)*	Freshwater Ornamental Fish Culture	-	2*		30	70	100*
Total			30	21	-	-	-	600
II	Core Course - 3 (CC - 3)	Developmental Biology	6	4	3	30	70	100
	Core Course - 4 (CC - 4)	Cell Biology	6	4	3	30	70	100
	Core Practical - 2 (CP - 2)	Laboratory in Developmental Biology and Cell Biology	6	4	3	40	60	100
	Discipline Centric Elective Course - 2 (DCEC - 2)	1. Applied Microbiology (or) 2. Evolutionary Biology	4	4	3	30	70	100
	Generic Elective Course - 2 (GEC - 2)	1. Reproductive Biology (or) 2. Bioinformatics (or) 3. Estuarine Biology	4	3	3	30	70	100
	Skill Enhancement Course - 2 (SEC - 2)	Vermitechnology	2	2		30	70	100
	Non-Major Elective Course - 1 (NMEC - 1)	One Course from Outside Department	2	2	3	30	70	100
Total			30	23	-	-	-	700
Summer Internship / Industrial Activity during the Summer Vacation after 1st Year								

III	Core Course - 5 (CC - 5)	Animal Physiology	6	4	3	30	70	100
	Core Course - 6 (CC - 6)	Environmental Biology	6	4	3	30	70	100
	Core Practical - 3 (CP - 3)	Laboratory in Environmental Biology and Animal Physiology	6	4	2	40	60	100
	Discipline Centric Elective Course - 3 (DCEC - 3)	1. Nanobiotechnology (or) 2. Aquaculture	5	4	2	30	70	100
	Generic Elective Course - 3 (GEC - 3)	1. Toxicology (or) 2. Research Methodology (or) 3. Computational Biology	5	3	3	30	70	100
	Non-Major Elective Course – 2 (NMEC - 2)	One Course from Outside Department	2	2	3	30	70	100
	Internship / Industrial Activity @			2		20	80	100
	Total			30	23	-	-	-
IV	Core Course - 7 (CC - 7)	Genetics	6	4	3	30	70	100
	Core Course - 8 (CC - 8)	Immunology	6	4	3	30	70	100
	Core Course- 9 (CC - 9)	Biochemistry	6	4	3	30	70	100
	Discipline Centric Elective Course - 4 (DCEC - 4)	1. Biophysics and Biostatistics (or) 2. Wildlife Biology and Conservation	4	4	2	30	70	100
	Entrepreneurship / Industry Based Course @	Sericulture	3	3	3	30	70	100
	Project Work @		5	5	-	20	80	100
	Value Added Course - 2 2)*	Poultry Farming	-	2*		30	70	100*
	Total			30	24	-	-	-
Grand Total				91				2600

LIST OF DISCIPLINE CENTRIC ELECTIVE COURSE

Discipline Centric Elective Course - 1 (DCEC - 1)	
1.	Animal Biotechnology
2.	Endocrinology
Discipline Centric Elective Course - 2 (DCEC - 2)	
1.	Applied Microbiology
2.	Evolutionary Biology
Discipline Centric Elective Course - 3 (DCEC - 3)	
1.	Nanobiotechnology
2.	Aquaculture
Discipline Centric Elective Course - 4 (DCEC - 4)	
1.	Biophysics and Biostatistics
2.	Wildlife Biology and Conservation

LIST OF NON-MAJOR ELECTIVE COURSE
(for other Department Students only)

NON-MAJOR ELECTIVE COURSE – 1 (NME-1)	
1	Fisheries Biology
NON-MAJOR ELECTIVE COURSE – 2 (NME-2)	
2	Agricultural Entomology

LIST OF GENERIC ELECTIVE COURSE (GEC)

GENERIC ELECTIVE COURSE - 1 (GEC - 1)	
1. A	Vectors, Disease and Management
2. B	Economic Entomology
3. C	Animal Behaviour
GENERIC ELECTIVE COURSE - 2 (GEC - 2)	
1. A	Reproductive Biology
2. B	Bioinformatics
3. C	Estuarine Biology
GENERIC ELECTIVE COURSE - 3 (GEC - 3)	
1. A	Toxicology
2. B	Research Methodology
3. C	Computational Biology

SUMMARY OF CURRICULUM STRUCTURE OF PG PROGRAMMES: SCIENCE

Sl. No.	Types of the Course	No. of Courses	Credits for each Course	Total Credits	Marks
1.	Core Course	9	4	36	900
2.	Core Practical	3	4	12	300
3.	Discipline Centric Elective Course	4	4	16	400
4.	Generic Elective Course	3	3	9	300
5.	Skill Enhancement Course	2	2	4	200
6.	Non-Major Elective Courses	2	2	4	200
7.	Internship / Industrial Activity @	1	2	2	100
8.	Entrepreneurship / Industry Based Course @	1	3	3	100
9.	Project @	1	5	5	100
Total		26	-	91	2600
Value Added Courses *		2*	2	4*	200*

*	The value added courses credit will not be included in the total CGPA . These courses are extra-credit courses. Instruction hours for these courses is 30 hours								
@	Summer Internship will be carried out during the summer vacation after the First year. Viva Voce will be conducted by the college and Marks shall be sent to the University and the same will be included in the 3rd semester Mark Statement. Summer Internship / Industrial Activity & Project Scheme of Evaluation: <table border="1"> <tr> <th>Description</th><th>Marks</th></tr> <tr> <td>Report</td><td>80</td></tr> <tr> <td>Viva</td><td>20</td></tr> <tr> <td>Total</td><td>100</td></tr> </table>	Description	Marks	Report	80	Viva	20	Total	100
Description	Marks								
Report	80								
Viva	20								
Total	100								

Programme outcomes (PO):

PO 1	Disciplinary Knowledge: Broad and in-depth knowledge of advanced scientific concepts, principles, and methodologies within the chosen domain. Ability to critically explain, integrate, and apply scientific knowledge to theoretical and practical problems. Opportunities to earn additional credits through specialized and interdisciplinary courses further enhance expertise and broaden disciplinary understanding.
PO 2	Critical Thinking: Field visits, academic interactions, and experiential learning activities will help students develop critical observation, interpretation, and analytical skills. Ability to evaluate and interpret scientific data, formulate hypotheses, and draw logical conclusions. Encourages independent thinking and the ability to assess scientific problems from multiple perspectives.
PO3	Analytical Reasoning: Through classroom discussions, scientific literature reviews, and interactive learning environments, students will strengthen their analytical reasoning abilities. Ability to critically evaluate scientific texts, identify gaps in existing knowledge, formulate research questions, and synthesize new ideas and concepts. Promotes evidence-based reasoning and logical interpretation of scientific information.
PO 4	Scientific Reasoning: Strong foundation in scientific methods,

	experimental design, and data interpretation through laboratory-based courses. Enhances practical knowledge of scientific instrumentation, calibration procedures, laboratory safety, and appropriate research techniques. Ability to conduct scientifically sound experiments and interpret results accurately.
PO 5	Self-Directed Learning: Encourages independent and self-directed learning through assignments, field reports, project work, and literature-based studies. Ability to organize, analyze, and present scientific findings in professional formats relevant to academic and industrial settings. Fosters responsibility, time management, and continuous self-improvement in learning.
PO 6	Reflective Thinking: Laboratory-intensive core courses will expose students to a broad range of research methodologies and experimental techniques. Ability to reflect on learning experiences, evaluate the effectiveness of scientific approaches, and understand the broader applications of scientific techniques within the discipline.
PO 7	Problem-Solving Skills: Ability to develop and apply scientific principles, quantitative reasoning, and mathematical concepts to solve discipline-specific problems. Ability to analyze experimental data, interpret scientific observations, and derive meaningful conclusions. Prepares students to address real-world scientific and societal challenges effectively.
PO 8	Research-Related Skills: Internships, dissertation work, and research-oriented projects provide opportunities to design, develop, and execute independent research studies. Students gain hands-on experience in research methodology, experimental techniques, data analysis, scientific writing, and ethical research practices. These experiences strengthen laboratory competence and prepare students for advanced research and professional careers.
PO 9	Lifelong Learning: Cultivates a mindset of continuous learning and

	professional adaptability. Ability to identify gaps in knowledge and skills, adapt to emerging technologies and scientific advancements, and pursue self-directed learning throughout their careers. Encourages lifelong learning that supports academic growth, employability, and professional excellence.
PO 10	Leadership Readiness: Ability to take initiative, work collaboratively, and manage academic and research responsibilities effectively. Through seminars, group projects, internships, and research activities, students develop decision-making, problem-solving, organizational, and interpersonal skills. Ability to lead scientific teams, communicate effectively in professional environments, and contribute responsibly to academic, industrial, and societal development.

CORE COURSE 1: STRUCTURE AND FUNCTION OF INVERTEBRATA

Course Code		Course Type	Core	L	T	P	C	Academic Year	2026-2027
				6	-	-	4		
Pre-requisite	Knowledge in taxonomic classification of Invertebrata								

Course Objectives:

- To familiarize with the basis of the taxonomic classification of species.
- To make them relate to the diverse physiology of invertebrates.
- To provide the importance to understand the larval form of invertebrates.
- To signify the role of minor phyla and its significance.
- To impart the significance of organization and evolution of coelom with examples.

Detailed Course Content:

Unit I TAXONOMY (8 Lectures)	Principles of taxonomy -general characteristics and classification of animal Kingdom (up to order). Species concept – taxonomy. International Code of Zoological Nomenclature (ICZN) – taxonomic principles and procedures. New trends in taxonomy -animal collection-Molecular taxonomy and application of bioinformatics tools - handling and preservation. - Organization of coelom - symmetry - embryogeny.
Unit II LOCOMOTION, NUTRITION AND DIGESTION (7 Lectures)	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 Polychaetes, Mollusca and Echinodermata.
Unit III RESPIRATION, EXCRETION AND OSMOREGULATION (7 Lectures)	Organs of respiration - gills - lungs and trachea. Respiratory pigments - mechanism of respiration. Excretion - organs of excretion - coelom – coelomoducts - nephridia and Malpighian tubules - mechanisms of excretion - excretion and osmoregulation – body fluids.
Unit IV NERVOUS SYSTEM	Primitive nervous system - Coelenterata and Echinodermata -advanced nervous system - Annelida - Arthropoda (Class - Crustacea and Insecta) and Mollusca

AND ITS EVOLUTION (8 Lectures)	(Class - Cephalopoda). Trends in neuro-evolution -evolution of nervous system in Invertebrates.
Unit V INVERTEBRATE LARVAE AND MINOR PHYLA (10 Lectures)	Larval forms of free-living Invertebrates -larval forms of parasites -strategies and evolutionary significance of larval forms. Minor phyla -organization – general characters and structural features -Rotifera -Chaetognatha -Ectoprocta - Endoprocta and Phoronida – affinities and significance.

Defining the Course Outcomes (NOT Unit-wise)

At the end of the course, the students will have the ability to		
CO1	Classify the animal species based on the characteristic features.	Disciplinary Knowledge/ Communication Skills/Research-related Skills/ Scientific Reasoning
CO2	Identify the behavior pattern of various invertebrates.	Disciplinary Knowledge/ Communication Skills/ Critical Thinking/ Research-related Skills/ Scientific Reasoning/ Self-directed learning
CO3	Explain the similarities and differences in the morphology of organs in a functional view.	Disciplinary Knowledge/ Critical Thinking/ Problem Solving/ Analytical Reasoning/ Research-related Skills/ Scientific Reasoning
CO4	Describe and signify the role of larval forms of invertebrates in the ecosystem.	Disciplinary Knowledge/ Research-related Skills/ Scientific Reasoning/ Reflective Thinking/ Self-directed learning
CO5	Understand the concept of regulation among species.	Problem Solving/ Analytical Reasoning/ Research-related Skills/ Scientific Reasoning/ Reflective Thinking/ Self-directed learning/
K1 - Knowledge; K2 - Understanding; K3 - Practice; K4 – Analysis; K5 - Synthesis; K6 – Creation; K7- Evaluation		

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	S	S	M	M	S	M	S	L	S
CO2	S	M	M	S	S	S	S	M	M	M
CO3	M	S	M	M	S	S	M	S	L	S
CO4	M	S	S	L	M	M	M	S	S	S
CO5	S	M	M	L	M	S	M	S	M	S
S-Strong; M-Medium; L-Low										

References:

1. Ayyar. E.M. (1966). A Manual of Zoology Part I, Invertebrata, S. Viswanathan Pvt. Ltd., Chennai.
2. Harzsch, S., Purschke, G. and Schmidt-Rhaesa, A. (2015). Structure and Evolution of Invertebrate Nervous Systems. United Kingdom: OUP Oxford.
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5. Pechenik, J. A. (2005). Biology of the Invertebrates. United Kingdom: McGraw-Hill, Higher Education.
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17. Hyman, L.H (1959). The Invertebrate Smaller Coelomate Groups. (Vol.V). McGraw Hill Co., New York.
18. Kotpal. (1990). Minor Phyla. Rastogi Publication, Meerut.
19. Russel-Hunter, W.D. (1969). A biology of Higher Invertebrates. Macmillan Co. Ltd., London.
20. Read, C.P (1972). Animal Parasitism. Prentice Hall Inc., New Jersey.

Related Online Sources:

1. <https://www.uou.ac.in/sites/default/files/slm/MSczo-501.pdf>
2. <https://www.pdfdrive.com/biosystematics-structure-and-functionsofinvertebrates-e34328227.html>
3. <http://assets.vmu.ac.in/MZO01.pdf>
4. https://adventisteducationbydesign.com/wpcontent/themes/bydesign/assets/downloads/sample_lessons/student_editions/KH_BD1_SEG7_U1C2_Lesson_1_sample.pdf
5. <https://pdfdrive.com/download/4660813-biology-form-and-function-ininvertebrates-answers>
6. <https://infinitylearn.com/surge/biology/difference-between-protostomesand-deuterostomes/>
7. https://www.researchgate.net/publication/11355321_Robots_in_invertebrate_neuroscience

CORE COURSE 2: COMPARATIVE ANATOMY OF CHORDATA

Course Code		Course Type	Core	L	T	P	C	Academic Year	2026-2027
				6	-	-	4		
Pre-requisite	Basic Knowledge in Anatomy of Chordata								

Course Objectives:

- To incorporate the comparative morphology and functional anatomy of vertebrates.
- To make them understand the role of organs and their regulation in secretion during feeding and stimulation in sensory response.
- To compare studies about circulation and respiration in vertebrate animals.
- To study the sense organs and nervous systems of vertebrates.
- To know about the skeletal system and urinogenital system of vertebrates.

Detailed Course Content:

Unit I PROTOCHORDATES AND CHORDATES (7 Lectures)	General characters - significance and evolution - classification of Protochordata. Origin of chordates and classification - vertebrate morphology –definition - scope and relation to other disciplines.
Unit II INTEGUMENTARY SYSTEM AND DIGESTIVE SYSTEM (8 Lectures)	Origin and classification of vertebrates - integumentary system and their derivatives - structure and function -skin - glands -scales - horns - claws -hoofs - feathers - hairs. Digestive system – comparative account of digestive system in relation to feeding habits - herbivores - carnivores - omnivores.
Unit III CIRCULATORY SYSTEM AND RESPIRATORY SYSTEM (8 Lectures)	Circulatory system of vertebrates - general plan of circulation- blood - evolution of heart - evolution of aortic arches. Respiratory system - comparative account on respiratory organs –fishes, - amphibians, reptiles, birds and mammals.

Unit IV NERVOUS SYSTEM AND SENSORY ORGANS (9 Lectures)	Nervous system - comparative anatomy of brain –Fish – Frog – Calotes - Pigeon - Rabbit. Anatomy of spinal cord – nerves – cranial nerves. Sensory organs - organs of vision - auditory- olfaction and gustatory- lateral line system.
Unit V SKELETAL SYSTEM AND URINOGENITAL SYSTEM (8 Lectures)	Skeletal system – form - function - comparative account of jaw suspension - vertebral column - girdles and limbs. Urinogenital system - evolution of urinogenital system in vertebrate groups.

Defining the Course Outcomes (NOT Unit-wise)

At the end of the course, the students will have the ability to		
CO1	Understand the morphology and functional anatomy of chordates.	Disciplinary Knowledge/ Communication Skills/Research-related Skills/ Scientific Reasoning
CO2	Relate the comparative anatomy of vertebrate integument and digestive system according to their habit and habitat.	Disciplinary Knowledge/ Communication Skills/ Critical Thinking/ Research-related Skills/ Scientific Reasoning/ Self-directed learning
CO3	Analyze the integration of physiology of circulation and respiration in Vertebrates.	Disciplinary Knowledge/ Critical Thinking/ Problem Solving/ Analytical Reasoning/ Research-related Skills/ Scientific Reasoning
CO4	Compare the distinct organ structure of vision, hearing, olfaction, taste, etc.,	Disciplinary Knowledge/ Research-related Skills/ Scientific Reasoning/ Reflective Thinking/ Self-directed learning
CO5	Gain detailed knowledge about the complexity of the skeletal and urinogenital systems in vertebrates.	Problem Solving/ Analytical Reasoning/ Research-related Skills/ Scientific Reasoning/ Reflective Thinking/ Self-directed learning/

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	S	S	M	M	S	M	S	L	S
CO2	S	M	M	S	S	S	S	M	M	M
CO3	M	S	M	M	S	S	M	S	L	S
CO4	M	S	S	L	M	M	M	S	S	S
CO5	S	M	M	L	M	S	M	S	M	S
S-Strong; M-Medium; L-Low										

References:

1. Ayyar, E.M. and Anantha Krishnan T.N. (1995). Manual of Zoology Vol.II, Part I & II. (Chordata), S. Viswanathan Pvt. Ltd.,
2. Kriska, G., Zboray, G., Kovács, Z., Palfia, Z. and Molnr, K. (2011). Atlas of Comparative Sectional Anatomy of 6 Invertebrates and 5 Vertebrates. Austria: Springer Vienna.
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Related Online Sources:

1. [https://www.syllabusfinder.com/university-of-toronto/eeb266-introductionto-animal-biodiversity---invertebrates-fall-2014\(Toronto University,Canada\)](https://www.syllabusfinder.com/university-of-toronto/eeb266-introductionto-animal-biodiversity---invertebrates-fall-2014(Toronto University,Canada))
2. <https://fas.calendar.utoronto.ca/course/eeb266h1> (Toronto University, Canada).
3. <https://www.syllabusfinder.com/university-of-toronto/eeb263-comparativevertebrate-anatomy-fall-2014> (Toronto University, Canada)
4. <https://www.syllabusfinder.com/static/syllabus/EEB263-Comparative-Vertebrate-Anatomy-Fall-2014.pdf>(Toronto University, Canada)
5. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3594521/>

CORE PRACTICAL 1: LABORATORY IN INVERTEBRATA AND CHORDATA

Course Code		Course Type	Core	L	T	P	C	Academic Year	2026-2027
				-	2	4	4		
Pre-requisite	Basic knowledge in organ system of Invertebrata and Chordata								

Course Objectives:

- To impart practical knowledge on the functional aspects of a different system of invertebrates.
- To comprehend the internal organ system of invertebrates.
- To enrich the knowledge of the invertebrate evolution and types of the coelom.
- To highlight various species and their affinities with other phyla and provides an idea on methods of preservation of specimens.
- To relate the comparative study of digestive, nervous, and reproductive systems of vertebrates.

Detailed Course Content:**INVERTEBRATES****Dissections**

Earthworm	-	Digestive system, Nervous system
Pila	-	Digestive system, Nervous system
Cockroach	-	Digestive system, Nervous system
Prawn	-	Digestive system, Nervous system

Mountings

Earthworm	-	Body setae, Penial setae
Cockroach	-	Mouth parts
Honey bee	-	Mouth parts, Sting apparatus
Pila	-	Radula
Housefly	-	Mouth parts

Identification of Invertebrate animals:

Spotters: Trypanosoma, Leishmania, Plasmodium, Nereis, Nereis - Parapodium, Peripatus, Sacculina on Crab, Limulus, Sepia, Octopus, Holothuria (Sea cucumber), Echinus (Sea urchin), Asterias (Starfish), Trochophore larva, Veliger larva, Ophiopluteus larva, Echinopluteus larva, Bipinnaria larva.

Minor phyla: Rotifera, Chaetognatha, Endoprocta, Ectoprocta.

COMPARATIVE ANATOMY OF VERTEBRATES

Dissections:

Fish - Digestive System and Nervous system

Virtual mode:

Comparative study of digestive system, nervous system and reproductive system of Frog.

Mounting:

Placoid scale, Cycloid scale and Ctenoid scale.

Brain of Scoliodon/Rattus.

Spotters:

1. **Prochordates:** Amphioxus, Balanoglossus and Ascidia.
2. **Pisces:** Scoliodon, Ray, Echineis, Hippocampus (Sea horse), Exocoetus, Catla, Labeo (Rohu), Cirrhinus (Mrigal) and Oreochromis (Tilapia).
3. **Amphibia:** Rana, Tadpole larva, Axolotl larva, Hyla, Salamander, Ichthyophis.
4. **Reptilia:** *Naja naja*, Viper, Draco, Chamaeleon, Phrynosoma, Sphenodon.
5. **Aves:** Columbia (Pigeon), Psittacula (Parrot), Alcedo (King fisher), Bubo (Owl), Quill feather.
6. **Mammalia:** Megaderma (Bat), Loris, Oryctolagus (Rabbit), Rattus (Rat), Echidna, Ornithorhynchus (Duck-billed Platypus).
7. **Dentition in Mammals:** Rabbit, Dog, Rat, Horse and Man.
8. **Osteology:** Pigeon – Synsacrum, Rabbit – Pectoral and pelvic girdles, Forelimb and hindlimb bones.

Field Study / Visit: Visit to Freshwater / Marine / terrestrial ecosystem for on spot study of faunal diversity.

Submission at the time of practical Examination

1. Report on the field study and field trips
2. Bonafide Record
3. Faunal photographic album / chart.

Defining the Course Outcomes (NOT Unit-wise)

At the end of the course, the students will have the ability to		
CO1	Comprehend the adaptation and interactions of various species of invertebrates.	Disciplinary Knowledge/ Communication Skills/Research-related Skills/ Scientific Reasoning
CO2	Understand the importance of protozoan	Disciplinary Knowledge/ Communication Skills/ Critical Thinking/ Research-related

	and helminth parasites.	Skills/ Scientific Reasoning/ Self-directed learning
CO3	Identify the behavior and significance of various invertebrates and their larval forms.	Disciplinary Knowledge/ Critical Thinking/ Problem Solving/ Analytical Reasoning/ Research-related Skills/ Scientific Reasoning
CO4	Compare the functional morphology and regulation of vertebrates.	Disciplinary Knowledge/ Research-related Skills/ Scientific Reasoning/ Reflective Thinking/ Self-directed learning
CO5	Acquire knowledge about morphological features and ecological significance of minor phyla	Problem Solving/ Analytical Reasoning/ Research-related Skills/ Scientific Reasoning/ Reflective Thinking/ Self-directed learning/
K1 - Knowledge; K2 - Understanding; K3 - Practice; K4 – Analysis; K5 - Synthesis; K6 – Creation; K7- Evaluation		

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	S	S	M	M	S	M	S	L	S
CO2	S	M	M	S	S	S	S	M	M	M
CO3	M	S	M	M	S	S	M	S	L	S
CO4	M	S	S	L	M	M	M	S	S	S
CO5	S	M	M	L	M	S	M	S	M	S
S-Strong; M-Medium; L-Low										

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DISCIPLINE CENTRIC ELECTIVE COURSE 1:

1. ANIMAL BIOTECHNOLOGY

Course Code		Course Type	Core	L	T	P	C	Academic Year	2026-2027
				5	-	-	4		
Pre-requisite	Basic Knowledge in Molecular Biology								

Course Objectives:

- To implement high-quality teaching on fundamentals of Animal Biotechnology and its related experimental techniques.
- To render knowledge on scientific research in applied biotechnology with recent highlights.
- To provide ideas and applications of recombinant DNA technology for the betterment of mankind.
- To impart knowledge to students about the Ethical implications of biotechnology and
- To enrich the students about the available scope, techniques in the fields of medicine and industry to improve their skills.

Detailed Course Content:

Unit I FUNDAMENTALS OF ANIMAL BIOTECHNOLOGY (8 Lectures)	Animal cell culture - Basic requirements and techniques of cell culture, natural and synthetic culture media, Separations cells from animal tissues - primary culture and cell lines; r-DNA technology: Vectors - pBR322, Phage lambda, Cosmid; Host cells; Gene cloning: steps in cloning, selection of clones.
Unit II TECHNIQUES IN ANIMAL BIOTECHNOLOGY (8 Lectures)	Isolation and purification of genomic DNA and mRNA; Blotting techniques: Methods of different types of blotting; DNA sequencing: Sanger method, PCR: principle, types and application; Gene library - Gene transfer in animal cells: transfection, liposomal, viral mediated, electroporation.
Unit III TRANSGENESIS, GENE THERAPY	Transgenesis concept - transgenes - Transgenic animals transgenic animal model development – transgenic mouse, knockout mice – embryonic stem cell and pronucleus method – transgenic fish-sheep-pig. Production and applications of monoclonal and polyclonal antibodies – gene therapy – cell

AND MOLECULAR PHARMING (8 Lectures)	bank – animal bioreactor (silk worm) and molecular pharming.
Unit IV ANIMAL BIOTECHNOLOGY IN HEALTH CARE AND MEDICINE (8 Lectures)	Applications of rDNA technology in human health - recombinant DNA proteins and their uses - interferons - interleukin - tissue plasminogen activator. Recombinant DNA vaccines - hepatitis-B and FMD Vaccine – DNA finger printing - RAPD and RFLP profiling and its use in forensic science.
Unit V HUMAN GENOME PROJECT, BIOETHICS AND INDUSTRIAL APPLICATIONS (8 Lectures)	Human genome project – Mapping of human genome and Applications of Human genome Project - Ethics: Socio ethical problem, ethical implications. Bioreactors: Basic concepts of fermentation, bioreactor design, production of ethanol and streptomycin.

Defining the Course Outcomes (NOT Unit-wise)

At the end of the course, the students will have the ability to		
CO1	Understand the animals cell culture techniques	Disciplinary Knowledge/ Communication Skills/Research-related Skills/ Scientific Reasoning
CO2	Understand the diverse role/applications of rDNA technology in human welfare.	Disciplinary Knowledge/ Communication Skills/ Critical Thinking/ Research-related Skills/ Scientific Reasoning/ Self-directed learning
CO3	Analyse the methods of expression of transgenics and their usage.	Disciplinary Knowledge/ Critical Thinking/ Problem Solving/ Analytical Reasoning/ Research-related Skills/ Scientific Reasoning
CO4	Evaluate the role of genetically modified organisms. Understand the Human genome project and ethics in	Disciplinary Knowledge/ Research-related Skills/ Scientific Reasoning/ Reflective Thinking/ Self-directed learning

	biotechnology	
CO5	Comprehend the designing of fermenters and the selection of potential microbes used widely in fermentation technology.	Problem Solving/ Analytical Reasoning/ Research-related Skills/ Scientific Reasoning/ Reflective Thinking/ Self-directed learning/
K1 - Knowledge; K2 - Understanding; K3 - Practice; K4 – Analysis; K5 - Synthesis; K6 – Creation; K7- Evaluation		

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	S	S	M	M	S	M	S	L	S
CO2	S	M	M	S	S	S	S	M	M	M
CO3	M	S	M	M	S	S	M	S	L	S
CO4	M	S	S	L	M	M	M	S	S	S
CO5	S	M	M	L	M	S	M	S	M	S
S-Strong; M-Medium; L-Low										

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2. ENDOCRINOLOGY

Course Code		Course Type	Core	L	T	P	C	Academic Year	2026-2027
				5	-	-	4		
Pre-requisite	Basic knowledge about Endocrine System								

Course Objectives:

- To highlight the role of hormones and their classification.
- To provide a thorough knowledge of endocrine glands and their neurosecretion.
- To provide the chemical structure of peptide and steroid hormones.
- To understand hormonal action and its regulation.
- To enrich knowledge and applications of hormones in therapy.

Detailed Course Content:

Unit I INTRODUCTION TO ENDOCRINOLOGY (8 Lectures)	Scope of endocrinology - objectives -hormones as chemical messengers –classification – mechanism of hormone actions – feedback mechanism – hypothalamus – neuroendocrine system in Insects and Crustaceans. Hormonal control of reproduction – metamorphosis and moulting – pheromones.
Unit II ENDOCRINE ORGANS (8 Lectures)	Structural organization – biosynthesis of hormones -targeted organs – functions –abnormalities of thyroid -parathyroid - pancreas -adrenal -testis -ovary -placenta. Role of hormones in sexual cycle – menopause – pregnancy - parturition – lactation – role of prostaglandins.
Unit III STRUCTURE OF PROTEIN AND STEROID HORMONES (8 Lectures)	Purification and characterization of hormones – structure – functional relationship. Phylogenic analysis of hormonal structure and function. Biosynthesis of hormones - storage - secretion of hormones – molecular mechanisms of regulation - transcriptional and post transcriptional mechanisms of hormone biosynthesis and secretion. Regulation of biosynthesis and secretion – inhibitors.
Unit IV HORMONAL	Discovery of receptors in target tissues - mechanisms of hormone action and signal attenuation – signal discrimination – signal transduction and amplification.

EFFECTS AND ACTIONS (8 Lectures)	Hormone – receptor interactions - receptor antagonists and their applications. Metabolism of hormones by target and non-target tissues – hormones and behaviour.
Unit V HORMONES AS THERAPEUTIC AGENTS (8 Lectures)	Current developments in design and production of hormonal contraceptives –recombinant protein hormones – production -applications in regulation of fertility in farm animals and humans – Hormones Replacement Therapy (HRT) –genetic engineering for commercial production of insulin. Hormone Assays- Follicle Stimulating Hormone (FSH)- Thyroid stimulating Hormone (TSH).

Defining the Course Outcomes (NOT Unit-wise)

At the end of the course, the students will have the ability to		
CO1	Understand the basics and scope of endocrinology.	Disciplinary Knowledge/ Communication Skills/Research-related Skills/ Scientific Reasoning
CO2	Know the structure and functions of endocrine glands and their regulation.	Disciplinary Knowledge/ Communication Skills/ Critical Thinking/ Research-related Skills/ Scientific Reasoning/ Self-directed learning
CO3	Comprehend the structural and functional roles of hormones in signal transduction.	Disciplinary Knowledge/ Critical Thinking/ Problem Solving/ Analytical Reasoning/ Research-related Skills/ Scientific Reasoning
CO4	Learn the importance of receptor sites and hormonal actions.	Disciplinary Knowledge/ Research-related Skills/ Scientific Reasoning/ Reflective Thinking/ Self-directed learning
CO5	Get deep knowledge of hormones in reproduction and its assisted techniques.	Problem Solving/ Analytical Reasoning/ Research-related Skills/ Scientific Reasoning/ Reflective Thinking/ Self-directed learning/
K1 - Knowledge; K2 - Understanding; K3 - Practice; K4 – Analysis; K5 - Synthesis; K6 – Creation; K7- Evaluation		

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	S	S	M	M	S	M	S	L	S
CO2	S	M	M	S	S	S	S	M	M	M
CO3	M	S	M	M	S	S	M	S	L	S
CO4	M	S	S	L	M	M	M	S	S	S
CO5	S	M	M	L	M	S	M	S	M	S
S-Strong; M-Medium; L-Low										

References:

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6. [https://academic.oup.com/endo/article-](https://academic.oup.com/endo/article-abstract/162/12/bqab211/6382454?redirectedFrom=fulltext)
7. [abstract/162/12/bqab211/6382454?redirectedFrom=fulltext](https://academic.oup.com/endo/article-abstract/162/12/bqab211/6382454?redirectedFrom=fulltext)
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GENERIC ELECTIVE COURSE 1:

1. VECTORS, DISEASE AND MANAGEMENT

Course Code		Course Type	Core	L	T	P	C	Academic Year	2026-2027
				5	-	-	3		
Pre-requisite	Basic Knowledge about disease transmission								

Course Objectives:

- To familiarize the students with a variety of diseases caused by insects.
- To learn the complex interactions between the transmission by insect-borne pathogens affecting human health.
- To impart basics on the characteristics of vector role in host selection.
- To familiarize the prophylaxis for disease prevention.
- To motivate students to pursue a career in health management.

Detailed Course Content:

Unit I BASIC INTRODUCTION (8 Lectures)	Introduction to vector borne diseases and vectors - World scenario; Indian scenario. Historical perspective- Epidemics, discoveries; Scientists and major events involved in the discovery of vectors and pathogens of communicable diseases.
Unit II EPIDEMIOLOGY - I (8 Lectures)	Epidemiology, biology of vectors and pathogens, transmission cycles and symptoms- of malaria, filariasis, yellow fever, leishmaniasis and anthrax.
Unit III EPIDEMIOLOGY - II (8 Lectures)	Epidemiology, biology of vectors and pathogens, transmission cycles and symptoms of dengue, chikungunya, Japanese encephalitis, schistosomiasis and plague.
Unit IV EPIDEMIOLOGY - III (8 Lectures)	Distribution, epidemiology and control of Yellow fever, African sleeping sickness, oncocerciasis and chagas disease.

Unit V MECHANICAL VECTORS (8 Lectures)	Mechanical vectors - House flies, cockroaches and bedbugs- Transmission of dysentery, diarrhea, typhoid, cholera, epidemic conjunctivitis and skin infections.
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Defining the Course Outcomes (NOT Unit-wise)

At the end of the course, the students will have the ability to		
CO1	By studying this course, students will be able to	Disciplinary Knowledge/ Communication Skills/Research-related Skills/ Scientific Reasoning
CO2	Describe the host-pathogen relationships and the role of host reservoir on transmission of parasite.	Disciplinary Knowledge/ Communication Skills/ Critical Thinking/ Research-related Skills/ Scientific Reasoning/ Self-directed learning
CO3	Explain various modes of transmission of parasite by insect vectors.	Disciplinary Knowledge/ Critical Thinking/ Problem Solving/ Analytical Reasoning/ Research-related Skills/ Scientific Reasoning
CO4	Recognize various possible modern tools and methodologies for laboratory diagnosis, surveillance and treatment of diseases.	Disciplinary Knowledge/ Research-related Skills/ Scientific Reasoning/ Reflective Thinking/ Self-directed learning
CO5	Spread awareness on Public health Programs about vector borne diseases and their control.	Problem Solving/ Analytical Reasoning/ Research-related Skills/ Scientific Reasoning/ Reflective Thinking/ Self-directed learning/
K1 - Knowledge; K2 - Understanding; K3 - Practice; K4 – Analysis; K5 - Synthesis; K6 – Creation; K7- Evaluation		

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	S	S	M	M	S	M	S	L	S
CO2	S	M	M	S	S	S	S	M	M	M
CO3	M	S	M	M	S	S	M	S	L	S
CO4	M	S	S	L	M	M	M	S	S	S
CO5	S	M	M	L	M	S	M	S	M	S
S-Strong; M-Medium; L-Low										

References:

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GENERIC ELECTIVE COURSE 1:

2. ECONOMIC ENTOMOLOGY

Course Code		Course Type	Core	L	T	P	C	Academic Year	2026-2027
				5	-	-	3		
Pre-requisite	Basic Knowledge about Common Insects								

Course Objectives:

- To enrich with basic knowledge of common insect pests.
- To provide an idea on the classification of pests of crops.
- To impart ideas on the ideology behind pest management.
- To provide the importance of biological agents adopted to control pests.
- To enhance the idea on the behavior of insects towards the selective measures.

Detailed Course Content:

Unit I CLASSIFICATION OF INSECTS (8 Lectures)	Introduction - definition - classification of insect-classification of pests based on magnitude of damage - occurrence on crops – types of crop plants – biological success of insects – pest outbreak – pest resurgence – insects as phyto-pathogenic vectors.
Unit II BIONOMICS AND MANAGEMENT (8 Lectures)	Introduction - bionomics and management of selected insect pests of crops – pests of paddy -cotton -pulses (black gram)- vegetables (brinjal and tomato) – fruits (Mango). Pests of stored products - polyphagous insects.
Unit III TOOLS OF INSECT PEST MANAGEMENT (8 Lectures)	Introduction - tools of pest management and their integration – legislative - cultural - physical and mechanical methods - pest survey and surveillance - forecasting - types of surveys - remote sensing methods - factors affecting survey. IPM -pest risk analysis -pesticide risk analysis - case studies of successful IPM programs.
Unit IV MANAGEMENT OF BIOLOGICAL AGENTS	Management with natural enemies - other biological agents - parasites and parasitoids -predators - microbial agents. Conservation of natural enemies – botanical pesticides. Non-conventional methods for managing insect pests– uses of Insect Growth Regulators (IGRs) -repellents -anti-feedants -

(8 Lectures)	pheromones - chemo-sterilizers -irradiation - quarantine.
Unit V BEHAVIOUR OF INSECTS (8 Lectures)	Biological rhythm and behaviour of insects – foraging - reproduction and infestation – periodicity in migration of Locusts – impacts of catastrophic earthquakes on insect communities.

Defining the Course Outcomes (NOT Unit-wise)

At the end of the course, the students will have the ability to		
CO1	Acquire basic and applied knowledge on the classification of common pests.	Disciplinary Knowledge/ Communication Skills/Research-related Skills/ Scientific Reasoning
CO2	Understand the role and impact of insect pests on crops.	Disciplinary Knowledge/ Communication Skills/ Critical Thinking/ Research-related Skills/ Scientific Reasoning/ Self-directed learning
CO3	Get an idea of management tools and strategies for pest management.	Disciplinary Knowledge/ Critical Thinking/ Problem Solving/ Analytical Reasoning/ Research-related Skills/ Scientific Reasoning
CO4	Understand natural enemies and biological agents.	Disciplinary Knowledge/ Research-related Skills/ Scientific Reasoning/ Reflective Thinking/ Self-directed learning
CO5	Know an idea on the chronobiology and its mechanism of insects.	Problem Solving/ Analytical Reasoning/ Research-related Skills/ Scientific Reasoning/ Reflective Thinking/ Self-directed learning/
K1 - Knowledge; K2 - Understanding; K3 - Practice; K4 – Analysis; K5 - Synthesis; K6 – Creation; K7- Evaluation		

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	S	S	M	M	S	M	S	L	S
CO2	S	M	M	S	S	S	S	M	M	M
CO3	M	S	M	M	S	S	M	S	L	S
CO4	M	S	S	L	M	M	M	S	S	S
CO5	S	M	M	L	M	S	M	S	M	S
S-Strong; M-Medium; L-Low										

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5. <https://www.aces.edu/blog/topics/farming/understanding-nop-standardsfor-pest-management-in-specialty-crops/>
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GENERIC ELECTIVE COURSE 1:

3. ANIMAL BEHAVIOUR

Course Code		Course Type	Core	L	T	P	C	Academic Year	2026-2027
				5	-	-	3		
Pre-requisite	Interest to learn different behaviour								

Course Objectives:

- Classify the different types of behaviour.
- Discuss the different parameters used to evaluate the behaviour.
- Illustrate the different sampling methods for different behaviour in population.
- Integrate the communication signals and response in different category.
- Compare the types of signals and mode of transmission for finding the food, shelter, foraging, and mating.

Detailed Course Content:

Unit I HISTORY AND CLASSICAL ETHOLOGY (8 Lectures)	Introduction to ethology; history of ethology; concepts, goals and terminology. Learning and memory: conditioning; habituation; insight learning; association learning; reasoning; cognitive skills.
Unit II COMMUNICATION (7 Lectures)	Chemical; visual; light; audio; species specific songs; evolution of language (primates). Biological rhythms; circadian and circannual rhythms; orientation and navigation; migration of fish, turtles and birds.
Unit III NEURONAL, HORMONAL AND ECOLOGICAL ASPECTS OF BEHAVIOUR (7 Lectures)	Habitat selection, food selection, optimal foraging theory, homing, dispersal, territoriality.
Unit IV	Predator versus cryptic prey, warning colouration, predator-prey arms races, brood parasites and their hosts.

PREY-PREDATOR RELATIONSHIP (8 Lectures)	Sociobiology: social and sexual behaviour, selfishness, cooperation, altruism, kinship, inclusive fitness, reciprocal altruism, concepts of selfish genes.
Unit V REPRODUCTIVE BEHAVIOUR (10 Lectures)	Evolution of sex and reproductive strategies, mating systems, courtship, sperm competition, sexual selection, parental care. Genetic and environmental components in the development of behaviour.

Defining the Course Outcomes (NOT Unit-wise)

At the end of the course, the students will have the ability to		
CO1	Interpret the animal behavior with social context.	Disciplinary Knowledge/ Communication Skills/Research-related Skills/ Scientific Reasoning
CO2	Describe the factors which influence their Dispersal and migration.	Disciplinary Knowledge/ Communication Skills/ Critical Thinking/ Research-related Skills/ Scientific Reasoning/ Self-directed learning
CO3	Summarize the characteristics of the mate selection for maintaining their community's genetic diversity.	Disciplinary Knowledge/ Critical Thinking/ Problem Solving/ Analytical Reasoning/ Research-related Skills/ Scientific Reasoning
CO4	Discuss about the different types of parental care.	Disciplinary Knowledge/ Research-related Skills/ Scientific Reasoning/ Reflective Thinking/ Self-directed learning
CO5	Integrate the neuronal regulation of behavior, learning, memory and cognition.	Problem Solving/ Analytical Reasoning/ Research-related Skills/ Scientific Reasoning/ Reflective Thinking/ Self-directed learning/
K1 - Knowledge; K2 - Understanding; K3 - Practice; K4 – Analysis; K5 - Synthesis; K6 – Creation; K7- Evaluation		

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	S	S	M	M	S	M	S	L	S
CO2	S	M	M	S	S	S	S	M	M	M
CO3	M	S	M	M	S	S	M	S	L	S
CO4	M	S	S	L	M	M	M	S	S	S
CO5	S	M	M	L	M	S	M	S	M	S
S-Strong; M-Medium; L-Low										

References:

1. Audeskirk, T., Audeskirk, G. and Byers, B. E. 2002. Biology, Life on Earth. Upper Saddle River, New Jersey: Prentice Hall.
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Course Code		Course Type	Core	L	T	P	C	Academic Year	2026-2027
				2	-	-	2		
Pre-requisite									

Course Objectives:

- To enrich knowledge on the history and distribution of honey bees.
- To understand the methods of breeding strategies in honey production.
- To comprehend the application of honey bee products, their economics, and marketing.
- To attain the practical knowledge of becoming an entrepreneur after his/her post-graduation.
- To participate in different research organizations and funding agencies to promote apiary.

Detailed Course Content:

Unit I INTRODUCTION (8 Lectures)	History and scope of Bee keeping. Present status of Apiculture in India. Honey – Systematic position – Species of Honey bees – Morphology and Life history. Stinging apparatus and bee poisoning.
Unit II BEE COLONY AND FORAGING (7 Lectures)	Bee colony – Castes – natural colonies and their yield. Bee foraging: Pollen and nectar yielding plants. Honey bee – behaviour – swarming – Pheromones.
Unit III MANAGEMENT PRACTICES (7 Lectures)	Apiary Management – Artificial bee hives – types – construction of space frames – Selection of sites – Handling – Maintenance – Instruments employed in Apiary.
Unit IV MARKETING AND DISEASE MANAGEMENT (8 Lectures)	Honey – Composition – Honey extraction, seasonal maintenance – uses. Bee was and its uses – National and International markets for Honey and Wax. Natural enemies and diseases of honey bees and their control measures.

Unit V ECONOMICS OF APIARY (10 Lectures)	Apiculture as Self – employment venture – financial assistance and funding agencies – Economics of Apiculture and Management.
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Defining the Course Outcomes (NOT Unit-wise)

At the end of the course, the students will have the ability to		
CO1	Analyze and understand the history and the status of apiary in India and worldwide.	Disciplinary Knowledge/ Communication Skills/Research-related Skills/ Scientific Reasoning
CO2	Understand the colony polymorphism dynamics and the qualities of a good queen, methods of raising queens.	Disciplinary Knowledge/ Communication Skills/ Critical Thinking/ Research-related Skills/ Scientific Reasoning/ Self-directed learning
CO3	Comprehend and evaluate the role of general management practices in the apiary.	Disciplinary Knowledge/ Critical Thinking/ Problem Solving/ Analytical Reasoning/ Research-related Skills/ Scientific Reasoning
CO4	Apply the knowledge about the usage, nutrients and composition of honey and honeybee products.	Disciplinary Knowledge/ Research-related Skills/ Scientific Reasoning/ Reflective Thinking/ Self-directed learning
CO5	Perceive about the pests and disease management system and global impact on pollination.	Problem Solving/ Analytical Reasoning/ Research-related Skills/ Scientific Reasoning/ Reflective Thinking/ Self-directed learning/
K1 - Knowledge; K2 - Understanding; K3 - Practice; K4 – Analysis; K5 - Synthesis; K6 – Creation; K7- Evaluation		

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	S	S	M	M	S	M	S	L	S
CO2	S	M	M	S	S	S	S	M	M	M
CO3	M	S	M	M	S	S	M	S	L	S
CO4	M	S	S	L	M	M	M	S	S	S
CO5	S	M	M	L	M	S	M	S	M	S
S-Strong; M-Medium; L-Low										

References:

1. Blackiston, H. (2020). Beekeeping for Dummies., (V Edition), Wiley.
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Related Online Contents:

1. <https://www.kvic.gov.in/newhm/cbrtintro.html>
2. <https://www.thespruce.com/beekeeping-for-beginners-step-by-step-3016540>
3. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8396518/>

FRESHWATER ORNAMENTAL FISH CULTURE

Course Code		Course Type	Core	L	T	P	C	Academic Year	2026-2027
				-	-	-	2*		
Pre-requisite	Basic Knowledge in Fish Culture								

Course Objectives:

- To imply the current status of ornamental fish farming in India.
- To impart knowledge about the ornamental fish trade in the national and international scenario.
- To provide practical knowledge on culturing live feed for ornamental fishes.
- To familiarize concepts and scopes on aquascaping.
- To effectively familiarize on the ornamental fish diseases and its management.

Detailed Course Content:

Unit I INTRODUCTION TO ORNAMENTAL FISHES (8 Lectures)	Basics of fish keeping - definition and current scope-state - national – International scenario of ornamental fishery. Different types of aquarium-types of ornamental fishes.
Unit II IMPORT AND EXPORT OF ORNAMENTAL FISHES (7 Lectures)	World trade of ornamental fishes and export potential -role of MPEDA in ornamental fishes. Import and export of ornamental fishes in India. Varieties of indigenous species - exotic species. Current status of ornamental fish exporters in Tamil Nadu.
Unit III VARIETIES OF ORNAMENTAL FISHES AND	Ornamental fishes of fresh water - brackish water - marine water. Live bearers – egg laying fishes – breeding and rearing. Ornamental shrimp - clown fish. Live feed culture - Artemia – Daphnia

LIVE FEED CULTURE (7 Lectures)	
Unit IV AQUASCAPING AND WATER QUALITY PARAMETERS (8 Lectures)	Basics of Aquascaping - aquascaping soil - aquarium plants - propagation methods – aquascaping tools - lighting and aeration, accessories and decorative. Water quality management - water filtration system- types of filters – advantages and uses.
Unit V DISEASE MANAGEMENT (10 Lectures)	Identification of ornamental fish diseases and prophylactic measures - parasites of fish - viral diseases - bacterial diseases – fungal diseases - specific syndrome and disease - fish treatment.

Defining the Course Outcomes (NOT Unit-wise)

At the end of the course, the students will have the ability to		
CO1	Discuss proficiently about the strategies involving in ornamental fish culture.	Disciplinary Knowledge/ Communication Skills/Research-related Skills/ Scientific Reasoning
CO2	Understand the current status of ornamental fish marketing.	Disciplinary Knowledge/ Communication Skills/ Critical Thinking/ Research-related Skills/ Scientific Reasoning/ Self-directed learning
CO3	Gain practical knowledge of culturing of live feed.	Disciplinary Knowledge/ Critical Thinking/ Problem Solving/ Analytical Reasoning/ Research-related Skills/ Scientific Reasoning
CO4	Create their own idea on aquascaping technique for the ornamental fish culture maintenance.	Disciplinary Knowledge/ Research-related Skills/ Scientific Reasoning/ Reflective Thinking/ Self-directed learning
CO5	Identify and know the preventive strategies on ornamental fish diseases	Problem Solving/ Analytical Reasoning/ Research-related Skills/ Scientific Reasoning/ Reflective Thinking/ Self-

	and management.	directed learning/
K1 - Knowledge; K2 - Understanding; K3 - Practice; K4 – Analysis; K5 - Synthesis; K6 – Creation; K7- Evaluation		

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	S	S	M	M	S	M	S	L	S
CO2	S	M	M	S	S	S	S	M	M	M
CO3	M	S	M	M	S	S	M	S	L	S
CO4	M	S	S	L	M	M	M	S	S	S
CO5	S	M	M	L	M	S	M	S	M	S
S-Strong; M-Medium; L-Low										

Recommended References:

1. Dholakia A. D. Daya. (2009). Ornamental Fish Culture and Aquarium Management Publishing House.
2. Archana and Sinha (2021). Breeding and Culture of Freshwater Ornamental Fish New India Publishing Agency.
3. Mercy, S., Anna, T. V. and Swain S. Felix. (2013). Ornamental Aquaculture: Technology and Trade in India. Daya Publishing House.
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Related Online Contents:

1. <https://link.springer.com/article/10.1007/s00338-004-0393-y>
2. <https://link.springer.com/article/10.1007/s10499-021-00689-3>
3. <https://pubmed.ncbi.nlm.nih.gov/11841167/>
4. <https://link.springer.com/article/10.1007/s40071-017-0164-3>
5. <https://thefishsite.com/articles/an-introduction-to-ornamental-aquaculturestarting-a-business-part-i>

Course Code		Course Type	Core	L	T	P	C	Academic Year	2026-2027
				6	-	-	4		
Pre-requisite	Basic knowledge in embryonic development								

Course Objectives:

- To provide the basic process of early embryonic development.
- To emphasize embryonic organizers, the nature of genetic information during cell differentiation
- To highlight gametogenesis and its regulation.
- To compare the types of eggs, cleavage patterns, and developmental fate.
- To discuss the molecular regulation of organogenesis and regeneration in amphibians and reptiles.

Detailed Course Content:

Unit I BASIC CONCEPTS OF DEVELOPMENT (8 Lectures)	Introduction - potency - commitment - specification - induction - competence - determination - differentiation. Morphogenetic gradients - cell fate and cell lineages. Stem cells. Genomic equivalence and cytoplasmic determinants. Imprinting. Mutants and transgenics in analysis of development - organizers - classical experiments on organizers.
Unit II GAMETOGENESIS AND FERTILIZATION (7 Lectures)	Gametogenesis - spermatogenesis - spermiogenesis - structure and types of sperm. Oogenesis - origin and growth of oocyte - maturation of egg - vitellogenesis - types of eggs. Polarity and symmetry of an egg - organization of egg cytoplasm. Fertilization - events of fertilization - acrosome reaction in sperm - egg activation during fertilization - theories of fertilization.
Unit III CLEAVAGE, GASTRULATION AND CYTODIFFERENTIATION	Cleavage - patterns of cleavage - blastula formation - embryonic fields - gastrulation - morphogenetic movements - formation of germ layers - metabolism during gastrulation - activity of gene during gastrulation - gastrulation in frog and chick. Cellular differentiation - cytodifferentiation and

ATION (7 Lectures)	chemo-differentiation. Stem cells - totipotency and pluripotency. Embryonic stem cells and their applications.
Unit IV ORGANOGENESIS, REGENERATION AND METAMORPHOSIS (8 Lectures)	Organogenesis- ectodermal derivatives - formation of central nervous system development of eye in frog. Mesodermal derivatives - kidney in frog - endodermal derivative - intestine in frog. Regeneration - types of regeneration. Regenerative capacity in the animals - factors influencing regeneration - stimulation and suppression - polarity and gradients. Metamorphosis - types- amphibian metamorphosis- events and hormonal control. Insect metamorphosis -moulting -growth and hormonal control.
Unit V HORMONES AND REPRODUCTIVE DISORDERS (8 Lectures)	Hormones - hormones role in sexual cycles in mammals-placenta in mammals. Asexual reproduction - Assisted Reproductive Technology (ART) - male infertility - sperm abnormalities. Superovulation - In vitro fertilization (IVF) - Intracytoplasmic sperm injection (ICSI) - Gameto intrafallopian transfer (GIFT) - screening for genetic disorders. Surrogacy and ethical issues

Defining the Course Outcomes (NOT Unit-wise)

At the end of the course, the students will have the ability to		
CO1	Understand the basic concepts of development.	Disciplinary Knowledge/ Communication Skills/ Research-related Skills/ Scientific Reasoning
CO2	Compare the formation of gametes and their molecular regulation.	Disciplinary Knowledge/ Critical Thinking/ Problem Solving/ Analytical Reasoning/ Research-related Skills/ Scientific Reasoning
CO3	Understanding the knowledge of fertilization initiates the cleavage and gastrulation process.	Disciplinary Knowledge/ Critical Thinking/ Problem Solving/ Analytical Reasoning/ Research-related Skills/ Scientific Reasoning
CO4	Integrate organogenesis in frogs and metamorphosis in amphibians and insects.	Disciplinary Knowledge/ Critical Thinking/ Problem Solving/ Analytical Reasoning/ Research-related Skills/ Scientific Reasoning/ Reflective Thinking/ Self-directed learning/
CO5	Stimulate the functional importance of hormones in	Disciplinary Knowledge/ Problem Solving/ Analytical Reasoning/ Research-related

	aging, infertility, birth control, and superovulation.	Skills/ Scientific Reasoning/ Reflective Thinking/ Self-directed learning
K1 - Knowledge; K2 - Understanding; K3 - Practice; K4 – Analysis; K5 - Synthesis; K6 – Creation; K7- Evaluation		

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	S	S	M	M	S	M	S	L	S
CO2	S	M	M	S	S	S	S	M	M	M
CO3	M	S	M	M	S	S	M	S	L	S
CO4	M	S	S	L	M	M	M	S	S	S
CO5	S	M	M	L	M	S	M	S	M	S
S-Strong; M-Medium; L-Low										

Recommended References:

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12. Browder, L.N. (1980). Developmental Biology. Saunders College, Philadelphia.
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Related Online Sources:

1. <https://as.nyu.edu/content/dam/nyuas/biology/documents/Biol.UA26DevelopmentalBiology.pdf> (developmental biology – New York University).
2. <https://as.nyu.edu/content/dam/nyuas/biology/documents/Biol.UA26DevelopmentalBiology.pdf> (New York University)
3. <https://ched.gov.ph/wp-content/uploads/2017/10/Sample-Curricula-Bachelor-of-Science-in-Biology.pdf> (Republic of the Philippines – Page No: 54 – syllabus of developmental biology)
4. [https://www.google.co.in/books/edition/Current_Topics_in_Developmental_Biology/rsW28RL41u_kC?hl=en&gbpv=1&dq=current+contour+developmental+biology&pg=PA123&printsec=front cover](https://www.google.co.in/books/edition/Current_Topics_in_Developmental_Biology/rsW28RL41u_kC?hl=en&gbpv=1&dq=current+contour+developmental+biology&pg=PA123&printsec=front+cover)
5. <https://www.ncbi.nlm.nih.gov/books/NBK225682/>
6. <https://nap.nationalacademies.org/read/9871/chapter/8#125>
7. <https://www.pnas.org/doi/10.1073/pnas.0806007105>
8. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3664914/>
9. <https://embryo.asu.edu/pages/hedgehog-signaling-pathway>
10. <https://www.frontiersin.org/articles/10.3389/fimmu.2018.01230/full>

Course Code		Course Type	Core	L	T	P	C	Academic Year	2026-2027
				6	-	-	4		
Pre-requisite	Basic knowledge about cellular organelles and their function								

Course Objectives:

- To relate the cell structure at the molecular level and impart the functions of prokaryotic and eukaryotic cells.
- To enlighten about the cellular organelles and their functional integrity.
- To impart mechanisms involved in cell communication and signaling using examples.
- To provide students with relevant knowledge, skills, and values in contemporary molecular cell biology.
- To enrich knowledge about cancer/oncogenes, virus-induced cancer, therapies, cellular morphology, and markers.

Detailed Course Content:

Unit I MEMBRANE ORGANIZATION, CYTOSKELETON AND MICROMETRY (8 Lectures)	Molecular organization of cell membrane – models for membrane structure – cell permeability – cell surface differentiation. Role of microtubules – microfilaments and intermediate filaments in cell organization - division and motility. Methods of cell study - micrometry – cell culture methods – cell fractionation technique – cytochemical staining methods – cytophotometry – immunocytochemistry - autoradiography.
Unit II MOLECULAR ORGANIZATION OF CELL ORGANELLES (7 Lectures)	Mitochondria - molecular organization - energy transduction – oxidative phosphorylation. Structure and functions of Golgi bodies - lysosomes - endoplasmic reticulum. Nucleus and chromosomes - nuclear envelope – nuclear pore – nuclear proteins and nucleosome. Structure and function of chromatin - euchromatin and heterochromatin. Structure and function of giant chromosomes - polytene and lamp brush chromosome - significance.
Unit III NUCLEIC ACIDS AND THEIR	DNA and RNA – chemical composition - types and functions. Exons – introns - cistrons - recons – mutons – extra chromosomal DNA - overlapping genes - transposable

FUNCTIONS (7 Lectures)	elements. Gene amplifications. Replication of DNA - DNA repair mechanisms. Mechanism of RNA splicing in eukaryotes. Cell cycle - phases of cell cycle - molecular events in cell cycle. Cell division - mitosis and meiosis - significance.
Unit IV TRANSCRIPTION AND TRANSLATIONAL EVENTS (8 Lectures)	Ribosomes - morphology - ultra-structure - biochemistry and functions. Protein synthesis - mechanism of transcription – role of transcription factors – transcription regulators – processing of mRNA. Translation – post translational modifications and control mechanism. Protein sorting and targeting – protein transport - intracellular compartments. Vesicular trafficking in secretory and endocytic pathways.
Unit V CELL COMMUNICATION (8 Lectures)	General principles of cell communication - signaling pathways- G-protein linked cell surface receptors - signaling through enzyme-linked cell surface receptors. Biology of cancer cells–characteristics- types of tumors. Apoptosis and its relevance in cancer biology. Oncogenes – biotic and environmental factors inducing cancer.

Defining the Course Outcomes (NOT Unit-wise)

At the end of the course, the students will have the ability to		
CO1	Obtain knowledge of membrane structure and functional organization.	Disciplinary Knowledge/ Communication Skills/ Research-related Skills/ Scientific Reasoning
CO2	Understand the ultra-structure and functions of vital cellular organelles and specialized giant chromosomes.	Disciplinary Knowledge/ Critical Thinking/ Problem Solving/ Analytical Reasoning/ Research-related Skills/ Scientific Reasoning
CO3	Compare the intracellular and extracellular responses in the cell cycle, DNA replication, and DNA repair mechanisms.	Disciplinary Knowledge/ Critical Thinking/ Problem Solving/ Analytical Reasoning/ Research-related Skills/ Scientific Reasoning
CO4	Understand the process of gene expression and relay knowledge on molecular mechanisms of protein synthesis.	Disciplinary Knowledge/ Critical Thinking/ Problem Solving/ Analytical Reasoning/ Research-related Skills/ Scientific Reasoning/ Reflective Thinking/ Self-directed learning/

C05	Perceive the complexities in membrane transport and cell communications.	Disciplinary Knowledge/ Problem Solving/ Analytical Reasoning/ Research-related Skills/ Scientific Reasoning/ Reflective Thinking/ Self-directed learning
K1 - Knowledge; K2 - Understanding; K3 - Practice; K4 – Analysis; K5 - Synthesis; K6 – Creation; K7- Evaluation		

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
C01	M	S	S	M	M	S	M	S	L	S
C02	S	M	M	S	S	S	S	M	M	M
C03	M	S	M	M	S	S	M	S	L	S
C04	M	S	S	L	M	M	M	S	S	S
C05	S	M	M	L	M	S	M	S	M	S
S-Strong; M-Medium; L-Low										

Recommended References:

1. Lohar. P.S. (2021). Cell and Molecular Biology. India: MJP Publisher.
2. Gromley, Z. and Gromley, A. (2021). Biochemistry, Cell and Molecular Biology, and Genetics: An Integrated Textbook. Germany: Thieme.
3. Iwasa, J., Marshall, W. and Karp, G. (2020). Karp's Cell and Molecular Biology. United States: Wiley.
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CORE PRACTICAL 2:**LABORATORY IN DEVELOPMENTAL BIOLOGY AND CELL BIOLOGY**

Course Code		Course Type	Core	L	T	P	C	Academic Year	2026-2027
				-	2	4	4		
Pre-requisite	Basic knowledge about laboratory instruments								

Course Objectives:

- To provide practical skills in handling microscopes.
- To train them to handle analytical instruments.
- To enrich the basic skill and ability to prepare chemicals and solvents.
- To make them know the practical skill in observing slides and specimens with required theoretical knowledge.
- To understand the methods to prepare and preserve slides and specimens.

Detailed Course Content:**DEVELOPMENTAL BIOLOGY****Experiments:**

1. Preparation of sperm suspension of bull and microscopic observation of spermatozoa.
2. Observation of live spermatozoa and study of rate of motility of sperm in bull' semen.
3. Developmental stages in chick embryo – 24hrs, 48 hrs, 72 hrs and 96 hrs.

Spotters:

1. Fertilized egg stage.
2. Two, four and eight cell stage.
3. Blastula and C.S. of blastula stage.
4. Gastrula and C.S. gastrula stage.
5. Neural tube and C.S. of neural tube stage.
6. Tail bud and tadpole stage.

CELL AND MOLECULAR BIOLOGY**Experiments:**

1. Isolation of DNA from animal tissue.
2. Quantitative estimation of Protein.
3. Human buccal smear – Barr body.
4. Blood Smear of Cockroach.
5. Blood Smear of Human.
6. Squash preparation of Onion root tip and study the different stages of mitosis.

7. Squash preparation of Grasshopper testes and study of meiosis.
8. Micrometry - Measurement of the size and volume of cells using ocular and Stage micrometer.
9. Differential cell count – Human blood sample.
10. Enumeration of RBC and WBC count by using haemocytometer.

Spotters:

Instruments: Compound microscope, Centrifuge – cooling and ultra- centrifuge, Autoradiography, Ocular micrometer, Stage micrometer and Haemocytometer.

Models: Structure of DNA, Types of RNA, DNA replication, Protein synthesis.

Defining the Course Outcomes (NOT Unit-wise)

At the end of the course, the students will have the ability to		
CO1	Understand the principles involved in the isolation of DNA / plasmid DNA.	Disciplinary Knowledge/ Communication Skills/ Research-related Skills/ Scientific Reasoning
CO2	Focus and differentiate the cell morphology and count of blood cells.	Disciplinary Knowledge/ Critical Thinking/ Problem Solving/ Analytical Reasoning/ Research-related Skills/ Scientific Reasoning
CO3	Get practice on methods of cell study.	Disciplinary Knowledge/ Critical Thinking/ Problem Solving/ Analytical Reasoning/ Research-related Skills/ Scientific Reasoning
CO4	Understand the process and gains the skill to prepare slides for different stages of mitosis.	Disciplinary Knowledge/ Critical Thinking/ Problem Solving/ Analytical Reasoning/ Research-related Skills/ Scientific Reasoning/ Reflective Thinking/ Self-directed learning/
CO5	Gain knowledge and skill to measure the size and volume of cells using ocular and stage micrometers.	Disciplinary Knowledge/ Problem Solving/ Analytical Reasoning/ Research-related Skills/ Scientific Reasoning/ Reflective Thinking/ Self-directed learning
K1 - Knowledge; K2 - Understanding; K3 - Practice; K4 – Analysis; K5 - Synthesis; K6 – Creation; K7- Evaluation		

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	S	S	M	M	S	M	S	L	S
CO2	S	M	M	S	S	S	S	M	M	M
CO3	M	S	M	M	S	S	M	S	L	S
CO4	M	S	S	L	M	M	M	S	S	S
CO5	S	M	M	L	M	S	M	S	M	S
S-Strong; M-Medium; L-Low										

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1. APPLIED MICROBIOLOGY

Course Code		Course Type	Core	L	T	P	C	Academic Year	2026-2027
				4	-	-	4		
Pre-requisite	Basic knowledge about microorganism and their significance								

Course Objectives:

- To enrich knowledge on the scope and characteristics of microorganisms.
- To make them understand the technology-based microbial incorporation for the benefit of the human.
- To compare environmental-related microbes and their significance.
- To enrich the knowledge about the action mechanism of the microbes in food.
- To provide information about microbial disease management strategies.

Detailed Course Content:

Unit I INTRODUCTION TO MICROBIOLOGY (8 Lectures)	History and scope of microbiology - classification of microbes. Structure of a bacterium. Bacterial respiration and reproduction. Bacterial nutrition and growth - nutritional types. Types of culture - culture media - isolation of pure culture - colony morphology and growth - growth curve and growth kinetics.
Unit II MICROBIAL TECHNOLOGY (7 Lectures)	Microbial genetics - recombinant technology in bacteria - transformation - conjugation - sex duction. Recombination in bacteriophage - transduction - lytic and lysogenic cycle. - Applications of bacteria and viruses - gene therapy and vaccine development.
Unit III ENVIRONMENTAL MICROBIOLOGY (7 Lectures)	Microorganism of different soils, Biofertilizers - Nitrogen fixing (Clostridium sp.) - Phosphate solubilizing (Penicillium sp.) - phosphate mobilizing (Rhizoctonia sp.). Bioremediation and its types. Microorganisms in aquatic habitats - microbiological analysis in fresh water and marine water. Microorganism in extreme environments - thermophiles - mesophiles - psychrophiles - methanogens and halophiles.

Unit IV INDUSTRIAL MICROBIOLOGY (8 Lectures)	Fermentor - types - extraction of fermentation products. Productions of industrial products – vinegar – Single Cell Protein (SCP) - beer and yeast production. Production of microbial insecticides. Production of organic acids (citric acid and lactic acid) and alcohol (ethanol) - antibiotics (Penicillin and Cephalosporin). Microbes of milk and milk products.
Unit V MICROBIAL DISEASE MANAGEMENT (8 Lectures)	Microorganisms and microbial diseases - general account of pathogenic bacteria –prognosis - diagnosis and treatment for diseases - Virus (COVID-19 and Monkey pox) – Bacteria (Tuberculosis and typhoid) – Fungi histoplasmosis and candidiasis) and Protozoa (amoebic dysentery, leptospirosis).

Defining the Course Outcomes (NOT Unit-wise)

At the end of the course, the students will have the ability to		
CO1	Understand the fundamental concepts and characteristic nature of the microbes.	Disciplinary Knowledge/ Communication Skills/ Research-related Skills/ Scientific Reasoning
CO2	Perceive knowledge about microbial genetics, culture, and its applications.	Disciplinary Knowledge/ Critical Thinking/ Problem Solving/ Analytical Reasoning/ Research-related Skills/ Scientific Reasoning
CO3	Aware about the beneficial microbes for the safeguarding of the environment.	Disciplinary Knowledge/ Critical Thinking/ Problem Solving/ Analytical Reasoning/ Research-related Skills/ Scientific Reasoning
CO4	Analyze the importance of microbes in product commercialization.	Disciplinary Knowledge/ Critical Thinking/ Problem Solving/ Analytical Reasoning/ Research-related Skills/ Scientific Reasoning/ Reflective Thinking/ Self-directed learning/
CO5	Comprehend microbial disease management, symptoms, diagnosis, and treatments.	Disciplinary Knowledge/ Problem Solving/ Analytical Reasoning/ Research-related Skills/ Scientific Reasoning/ Reflective Thinking/ Self-directed learning

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	S	S	M	M	S	M	S	L	S
CO2	S	M	M	S	S	S	S	M	M	M
CO3	M	S	M	M	S	S	M	S	L	S
CO4	M	S	S	L	M	M	M	S	S	S
CO5	S	M	M	L	M	S	M	S	M	S
S-Strong; M-Medium; L-Low										

References:

1. Prescott, L.M., Harvey, J.P. and Klein, D.A. (2008). Microbiology. VII edition, McGraw Hill Publications.
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7. <https://core.ac.uk/download/pdf/328024045.pdf>
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2. EVOLUTIONARY BIOLOGY

Course Code		Course Type	Core		L	T	P	C	Academic Year	2026 - 2027
					4	-	-	4		
Pre-requisite	Knowledge in theories of evolution									

Course Objectives:

- To provide an idea of the origin and evolution of life through shreds of evidence.
- To make them relate and understand theories of evolution.
- To provide a thorough knowledge of molecular processes of evolution.
- To highlight population growth and speciation.
- To justify the importance of molecular evolution using techniques.

Detailed Course Content:

Unit I EVIDENCES OF EVOLUTION (8 Lectures)	Origin of life – biochemical origin of life – Urey–Miller experiment. Evidences of evolution – morphology and anatomy – embryology – physiology – genetic – biochemical and paleontology.
Unit II THEORIES OF ORGANIC EVOLUTION (7 Lectures)	Lamarckism – neo-Lamarckism – Darwinism – neo- Darwinism. Mutation theory – modern synthetic theory. Natural selection – convergent – divergent and parallel evolution.
Unit III EVOLUTIONARY PROCESS (7 Lectures)	Genetic basis for variation – mutation – isolating mechanism – speciation – adaptation – colouration and mimicry – neoteny – genetic drift – Hardy Weinberg Equilibrium.
Unit IV	Species selection – population genetics – metapopulations. Monitoring natural populations – extinction of small

SPECIES SELECTION AND POPULATION GROWTH (8 Lectures)	populations – loss of genetic variations. Conservation of genetic resources in diverse taxa – artificial evolution. Evolution of <i>Homo sapiens</i> .
Unit V MOLECULAR PHYLOGENY AND EVOLUTION (8 Lectures)	History of molecular phylogenetics - evolution of amino acid sequences. DNA sequences – nucleic acid phylogeny, DNA – DNA hybridization – nucleotide sequences – nucleic acid and amino acid phylogenies. Molecular clock – regulatory genes and evolution.

Defining the Course Outcomes (NOT Unit-wise)

At the end of the course, the students will have the ability to		
CO1	Understand the process and evidence of evolution.	Disciplinary Knowledge/ Communication Skills/ Research-related Skills/ Scientific Reasoning
CO2	Gain knowledge of the theories regarding evolution.	Disciplinary Knowledge/ Critical Thinking/ Problem Solving/ Analytical Reasoning/ Research-related Skills/ Scientific Reasoning
CO3	Get deep knowledge of types of the evolutionary process.	Disciplinary Knowledge/ Critical Thinking/ Problem Solving/ Analytical Reasoning/ Research-related Skills/ Scientific Reasoning
CO4	Comprehend the population genetics and conservation.	Disciplinary Knowledge/ Critical Thinking/ Problem Solving/ Analytical Reasoning/ Research-related Skills/ Scientific Reasoning/ Reflective Thinking/ Self-directed learning/
CO5	Get an in-depth understanding of molecular evolution.	Disciplinary Knowledge/ Problem Solving/ Analytical Reasoning/ Research-related Skills/ Scientific Reasoning/ Reflective Thinking/ Self-directed learning
K1 - Knowledge; K2 - Understanding; K3 - Practice; K4 – Analysis; K5 - Synthesis; K6 – Creation; K7- Evaluation		

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	S	S	M	M	S	M	S	L	S
CO2	S	M	M	S	S	S	S	M	M	M
CO3	M	S	M	M	S	S	M	S	L	S
CO4	M	S	S	L	M	M	M	S	S	S
CO5	S	M	M	L	M	S	M	S	M	S
S-Strong; M-Medium; L-Low										

References:

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1. REPRODUCTIVE BIOLOGY

Course Code		Course Type	Core		L	T	P	C	Academic Year	2026 - 2027
					4	-	-	3		
Pre-requisite	Basic knowledge in mechanisms regulating reproduction									

Course Objectives:

- To acquire basic knowledge of reproductive physiology.
- To enrich the basic biological concepts of reproductive anatomy, physiology, and endocrinology.
- To attain knowledge about sexually transmitted diseases.
- To highlight cellular and molecular mechanisms controlling reproduction.
- To signify the principles, ethics, and regulatory guidelines involved in Assisted Reproductive Technology.

Detailed Course Content:

Unit I INTRODUCTION TO REPRODUCTIVE BIOLOGY (8 Lectures)	Gametogenesis - conversion of germ cells – male and female gametes – ovulation fertilization - implantation - bilaminar germ disc - trilaminar germ disc. Development of male reproductive system - development of female reproductive system – reproductive toxicology and reproductive pathology.
Unit II REPRODUCTIVE ANATOMY AND PHYSIOLOGY (7 Lectures)	Reproductive system - gross anatomy, neuro-endovascular supply. Hormones -gonadotropins - prolactin - melatonin – estrogen – progesterone – testosterone -Triiodothyronine (T3) – Thyroxine (T4) - thyroid stimulating hormone (TSH) - Cortisol - dehydroepiandrosterone (DHEA). Physiology of pregnancy - parturition and lactation.
Unit III REPRODUCTIVE	Basics of immune system - immuno-physiology of male and female reproduction -Immunology of pregnancy - pubertal changes - reproductive ageing – menopause-andropause.

IMMUNOLOGY (7 Lectures)	Epigenetics of reproduction- prevention of sexually transmitted diseases and reproductive health. Autoimmune disorders.
Unit IV REPRODUCTIVE DISORDERS (8 Lectures)	Developmental abnormalities - menstrual disorders - precocious - delayed or absent puberty - amenorrhea - fertility disorders - sexual dysfunction - infertility –spontaneous pregnancy loss. Pregnancy disorders -pre-eclampsia - Intrauterine growth restriction (IUGR), labor abnormalities. Endocrine disorders - hyperprolactinemia.
Unit V ASSISTED REPRODUCTIVE TECHNIQUES (ART), ETHICS, REGULATORY LAWS AND GUIDELINES (8 Lectures)	Introduction - semen analysis - ovulation induction - oocyte retrieval. In vitro maturation -in vitro fertilization (IVF) - Intracytoplasmic sperm injection (ICSI) – Gamete intrafallopian transfer (GIFT). Cryopreservation of gametes and embryos. Embryo biopsy - embryo hatching - pre-implantation genetic diagnosis (PGD). - Ethical practices - national and international guidelines for ART .

Defining the Course Outcomes (NOT Unit-wise)

At the end of the course, the students will have the ability to		
CO1	Describe the anatomy of gametes and relate them to its function.	Disciplinary Knowledge/ Communication Skills/ Research-related Skills/ Scientific Reasoning
CO2	Demonstrate the key principles of reproductive endocrinology including hormones and their mechanisms of action.	Disciplinary Knowledge/ Critical Thinking/ Problem Solving/ Analytical Reasoning/ Research-related Skills/ Scientific Reasoning
CO3	Evaluate the principles, merits, and limitations of various types of reproductive technology in use.	Disciplinary Knowledge/ Critical Thinking/ Problem Solving/ Analytical Reasoning/ Research-related Skills/ Scientific Reasoning
CO4	Understand the knowledge of the key steps in sexual determination and	Disciplinary Knowledge/ Critical Thinking/ Problem Solving/ Analytical Reasoning/ Research-related Skills/ Scientific

	differentiation of hormonal levels.	Reasoning/ Reflective Thinking/ Self-directed learning/
CO5	Explore more on the current scenario in ART for the welfare of mankind.	Disciplinary Knowledge/ Problem Solving/ Analytical Reasoning/ Research-related Skills/ Scientific Reasoning/ Reflective Thinking/ Self-directed learning
K1 - Knowledge; K2 - Understanding; K3 - Practice; K4 – Analysis; K5 - Synthesis; K6 – Creation; K7- Evaluation		

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	S	S	M	M	S	M	S	L	S
CO2	S	M	M	S	S	S	S	M	M	M
CO3	M	S	M	M	S	S	M	S	L	S
CO4	M	S	S	L	M	M	M	S	S	S
CO5	S	M	M	L	M	S	M	S	M	S
S-Strong; M-Medium; L-Low										

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2. <https://prsindia.org/billtrack/the-assisted-reproductive-technology-regulation-bill-2020>
3. <https://link.springer.com/article/10.1007/s10815-021-02272-4>
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2. BIOINFORMATICS

Course Code		Course Type	Core		L	T	P	C	Academic Year	2026 - 2027
					3	1	-	3		
Pre-requisite										

Course Objectives:

- To understand the basics of bioinformatics
- To familiarize the tools and imparting it into science and environment.
- To know the library designing and its screening.
- To relate the pathways and functions related to new targets.
- To provide current discoveries and its role in genomics.

Detailed Course Content:

Unit I BASICS OF BIOINFORMATICS (8 Lectures)	Bioinformatics and its relation with Molecular Biology – Historical overview and Definition of Bioinformatics – Data generation through Genome sequencing.
Unit II BIOLOGICAL DATABASES (7 Lectures)	Biological Databases; Nucleic acid databases (NCBI, DDBJ, and EMBL) - Protein databases (Primary, Composite, and Secondary) - Specialized Genome databases: (SGD, TIGR, and ACeDB) - Structural databases (PDB, MMDB, CATH, SCOP)
Unit III PROTEIN STRUCTURE AND MOLECULAR DOCKING (7 Lectures)	Protein Structures: Primary, Secondary, Super Secondary, Domains, Tertiary, Quaternary, Ramachandran plot - Protein secondary structure prediction methods: GOR, Chou-Fasman - Protein Tertiary structure prediction methods: Homology Modeling and Protein folding, Molecular Dynamics of Protein, Molecular Docking of Protein.

Unit IV DATA ANALYSIS (8 Lectures)	Pairwise Sequence alignment (BLAST and FASTA Algorithm) and multiple sequence alignment (Clustal W algorithm) - 3D structure viewers (Rasmol, SPDBv, Chime, Cn3D, PyMol), Anatomical visualization. Quantitative Structure Activity Relationship (2D & 3D).
Unit V METAGENOMICS (8 Lectures)	Metabolic pathway database (KEGG pathway database) - Concept of metabolome and metabolomics – Computer Aided Drug Design (CADD) – Drug Design Approaches – Target based, Structure based and De novo Approaches.

Defining the Course Outcomes (NOT Unit-wise)

At the end of the course, the students will have the ability to		
CO1	Retrieve molecular information from a variety of databases.	Disciplinary Knowledge/ Communication Skills/ Research-related Skills/ Scientific Reasoning
CO2	Understand the theory behind the sequential analysis and apply the bioinformatics tools used in the sequence alignment.	Disciplinary Knowledge/ Critical Thinking/ Problem Solving/ Analytical Reasoning/ Research-related Skills/ Scientific Reasoning
CO3	Apply, interpret and evaluate the evolutionary relationship among species.	Disciplinary Knowledge/ Critical Thinking/ Problem Solving/ Analytical Reasoning/ Research-related Skills/ Scientific Reasoning
CO4	Molecular taxonomical studies using bioinformatics software.	Disciplinary Knowledge/ Critical Thinking/ Problem Solving/ Analytical Reasoning/ Research-related Skills/ Scientific Reasoning/ Reflective Thinking/ Self-directed learning/
CO5	Perceive the significance of different gene prediction programs.	Disciplinary Knowledge/ Problem Solving/ Analytical Reasoning/ Research-related Skills/ Scientific Reasoning/ Reflective Thinking/ Self-directed learning
K1 - Knowledge; K2 - Understanding; K3 - Practice; K4 – Analysis; K5 - Synthesis; K6 – Creation; K7- Evaluation		

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	S	S	M	M	S	M	S	L	S
CO2	S	M	M	S	S	S	S	M	M	M
CO3	M	S	M	M	S	S	M	S	L	S
CO4	M	S	S	L	M	M	M	S	S	S
CO5	S	M	M	L	M	S	M	S	M	S
S-Strong; M-Medium; L-Low										

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3. ESTUARINE BIOLOGY

Course Code		Course Type	Core		L	T	P	C	Academic Year	2026 - 2027
					4	-	-	3		
Pre-requisite	Basic knowledge about different aquatic ecosystem									

Course Objectives:

- Impart knowledge on the physical and chemical characteristics of estuaries, including salinity gradients, nutrient loading, tidal action and sediment transport.
- Explore the biodiversity of estuarine organisms (plankton, benthos, nekton) and their adaptations to fluctuating salinity and temperature.
- Understand the trophic structure, food webs, and high biological productivity of estuarine habitats.
- Identify anthropogenic threats, such as pollution, habitat loss, and climate change, and explore management strategies for sustainable use.
- Equip students with skills for sampling and analyzing estuarine water and sediment.

Detailed Course Content:

Unit I ESTUARINE ENVIRONMENT (8 Lectures)	Classification, characteristics – physical, chemical and biological. South Indian Estuaries: any three with their biota. Mangrove swamps: Classification and ecology – their role in fishery potential.
Unit II ECOLOGY AND ADAPTATIONS (7 Lectures)	Plankton – types – their collection and identification. Fauna – types: Meiofauna, Macrofauna and Microfauna – Composition and characteristics. Estuarine benthos – their ecology and adaptations.
Unit III ESTUARINE BIOTA (7 Lectures)	Nekton – fishes – food and feeding habits – growth, reproduction and larval cycle of fin fish, prawns, crabs and edible mollusks. Estuarine animals and their adaptations.

Unit IV ESTUARINE FISHERY RESOURCES (8 Lectures)	Estuarine fishery resources of South India – fin fish and shell fish – fishing methods – crafts and gears.
Unit V ESTUARINE FARMING (8 Lectures)	Construction and maintenance of fish and prawn farms. Fish culture, Prawn culture, Oyster culture, Crab culture, Clam culture, Artemia culture.

Defining the Course Outcomes (NOT Unit-wise)

At the end of the course, the students will have the ability to		
CO1	Identify and describe the major components of estuaries, including salt marshes, mangroves and tidal flats.	Disciplinary Knowledge/ Communication Skills/ Research-related Skills/ Scientific Reasoning
CO2	Explain the adaptations (physiological and behavioral) of organisms to the stressful, variable conditions of the estuary.	Disciplinary Knowledge/ Critical Thinking/ Problem Solving/ Analytical Reasoning/ Research-related Skills/ Scientific Reasoning
CO3	Analyze the impact of natural and anthropogenic factors on estuarine biodiversity.	Disciplinary Knowledge/ Critical Thinking/ Problem Solving/ Analytical Reasoning/ Research-related Skills/ Scientific Reasoning
CO4	Apply scientific techniques to assess the water quality and biological productivity of an estuary.	Disciplinary Knowledge/ Critical Thinking/ Problem Solving/ Analytical Reasoning/ Research-related Skills/ Scientific Reasoning/ Reflective Thinking/ Self-directed learning/
CO5	Formulate management strategies for the sustainable exploitation of estuarine fishery	Disciplinary Knowledge/ Problem Solving/ Analytical Reasoning/ Research-related Skills/ Scientific Reasoning/ Reflective Thinking/ Self-directed learning

	resources.	
K1 - Knowledge; K2 - Understanding; K3 - Practice; K4 – Analysis; K5 - Synthesis; K6 – Creation; K7- Evaluation		

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	S	S	M	M	S	M	S	L	S
CO2	S	M	M	S	S	S	S	M	M	M
CO3	M	S	M	M	S	S	M	S	L	S
CO4	M	S	S	L	M	M	M	S	S	S
CO5	S	M	M	L	M	S	M	S	M	S
S-Strong; M-Medium; L-Low										

References:

1. Bardach, J.E., Ryther, W.O. and Mclarrey (1972) Aquaculture: The farming and Husbandry of Freshwater and Marine Organisms. Wiley Interscience, New York.
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VERMITECHNOLOGY

Course Code		Course Type	Core		L	T	P	C	Academic Year	2026 - 2027
					2	-	-	2		
Pre-requisite	Basic knowledge about biology of earthworm									

Course Objectives:

• To create awareness about vermiculture and technology.
• To emphasize the designing of the vermitech unit and its resources.
• To know and highlight the mechanism of waste degradation using earthworms and managing solid wastes.
• To relate the theoretical concepts of earthworms and their microbial interactions in soil fertility.
• To provide imbibe knowledge on application-oriented skills of vermitechnology.

Detailed Course Content:

Unit I INTRODUCTION TO VERMICULTURE (8 Lectures)	Vermiculture – importance - general species for culture. Collection and preservation of earthworms - role of ecological importance -significance. Recent developments in vermiculture around the world and in India.
Unit II VERMITECHNOLOGY (7 Lectures)	Vermitechnology - definition - scope - construction of compost beds. Vermicompost methods (small and large scale) - field pits - ground heaps - tank method - roof shed method - static pile windrows - top fed windrows - wedges and bin method. Role of earthworms in soil fertility.
Unit III WASTE RECYCLING MANAGEMENT (7 Lectures)	Vermicompost applications in a nursery – vermifilter - earthworms as bioreactor. Organic farming - advantages in earthworm activity over chemical fertilizers. Vermiculture for waste reduction - economic importance of earthworms.
Unit IV EARTHWORMS AND	Earthworm classification - indigenous and exotic species of earthworm - Anecic earthworms. Endogeic earthworms. Epigeic earthworms. Interactions of earthworms with

MICROORGANISMS (8 Lectures)	microorganisms - microorganisms associated in earthworm guts - different types of soil microbes, - Actinomycetes – Fungi.
Unit V ADVANTAGES AND APPLICATIONS OF VERMITECHNOLOGY (8 Lectures)	Economics of vermicomposting products - innovative waste management technologies for sustainable development. Formulation of feed and fertilizer - financial support from government and NGOs for vermiculture.

Defining the Course Outcomes (NOT Unit-wise)

At the end of the course, the students will have the ability to		
CO1	Acquire knowledge about the scope of vermitechnology.	Disciplinary Knowledge/ Communication Skills/ Research-related Skills/ Scientific Reasoning
CO2	Differentiate the environmental factors affecting the vermicompost unit.	Disciplinary Knowledge/ Critical Thinking/ Problem Solving/ Analytical Reasoning/ Research-related Skills/ Scientific Reasoning
CO3	Generate income from selling organic manures made from household – solid wastes.	Disciplinary Knowledge/ Critical Thinking/ Problem Solving/ Analytical Reasoning/ Research-related Skills/ Scientific Reasoning
CO4	Be aware of the impact of vermicompost over other fertilizers for a sustainable environment.	Disciplinary Knowledge/ Critical Thinking/ Problem Solving/ Analytical Reasoning/ Research-related Skills/ Scientific Reasoning/ Reflective Thinking/ Self-directed learning/
CO5	Understand the advantages of vermitechnology and can implement environment-friendly techniques in the future.	Disciplinary Knowledge/ Problem Solving/ Analytical Reasoning/ Research-related Skills/ Scientific Reasoning/ Reflective Thinking/ Self-directed learning
K1 - Knowledge; K2 - Understanding; K3 - Practice; K4 – Analysis; K5 - Synthesis; K6 – Creation; K7- Evaluation		

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	S	S	M	M	S	M	S	L	S
CO2	S	M	M	S	S	S	S	M	M	M
CO3	M	S	M	M	S	S	M	S	L	S
CO4	M	S	S	L	M	M	M	S	S	S
CO5	S	M	M	L	M	S	M	S	M	S
S-Strong; M-Medium; L-Low										

References:

1. Ismail, S.A. (1997). Vermitechnology: The biology of Earthworm. Orient Longman.
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1. https://www.kngac.ac.in/elearningportal/ec/admin/contents/4_18K4ZEL02_2021012803204629.pdf
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Course Code		Course Type	Core		L	T	P	C	Academic Year	2026 - 2027
					2	-	-	2		
Pre-requisite	Basic knowledge in Aquaculture									

Course Objectives:

- To give information about the basic culture practice of fishes.
- To compare the global and local needs under fisheries sector.
- Understanding the role of different research organizations and funding agencies to promote aquaculture.
- Practicing disease management for a sustainable future.
- Promoting self-employment opportunities to the students.

Detailed Course Content:

Unit I BASIC INTRODUCTION (8 Lectures)	History of Ichthyology – World and Indian fisheries. Fishes and their evolutionary history. Ponds and its management. Crustacean fisheries, molluscan fisheries and its economic importance.
Unit II FISHERIES AND ITS ECONOMICS (7 Lectures)	Marine fisheries – Sardines, Mackerels and Silver bellies. Inland fisheries – Freshwater, riverine, reservoir, pond and cold-water fisheries. Estuarine and brackish water fisheries and their economics.
Unit III FISHERY POPULATION STUDY (7 Lectures)	Fish population studies – Assessment of fish stocks: marking and recapture method, area sampling method. Age and growth studies - length-frequency methods, scale method, otolith methods - Length –weight relationship.

Unit IV CULTURE FISHERIES (8 Lectures)	Culture fisheries – Integrated fish farming technology – rice cum common carp culture, fish cum duck culture- sewage fed fisheries- monosex culture, polyculture, ornamental fishes.
Unit V MARKETING AND DISEASE MANAGEMENT (8 Lectures)	Fish processing and preservation- fish products and by products. Induced breeding techniques with examples. Fish transport and marketing. Fish pathology: Parasites – Protozoan, Fungal, Bacterial, Worms and Arthropods.

Defining the Course Outcomes (NOT Unit-wise)

At the end of the course, the students will have the ability to		
CO1	Understands the basic morphology and types of marine fishes.	Disciplinary Knowledge/ Communication Skills/ Research-related Skills/ Scientific Reasoning
CO2	Relate the age, growth and juvenile stages and fisheries conservation.	Disciplinary Knowledge/ Critical Thinking/ Problem Solving/ Analytical Reasoning/ Research-related Skills/ Scientific Reasoning
CO3	Compare the best practice methods against diseases and infections.	Disciplinary Knowledge/ Critical Thinking/ Problem Solving/ Analytical Reasoning/ Research-related Skills/ Scientific Reasoning
CO4	Integrate trade and marketing strategies for a sustainable future.	Disciplinary Knowledge/ Critical Thinking/ Problem Solving/ Analytical Reasoning/ Research-related Skills/ Scientific Reasoning/ Reflective Thinking/ Self-directed learning/
CO5	Basic knowledge on fisheries sector and possibilities for an entrepreneur.	Disciplinary Knowledge/ Problem Solving/ Analytical Reasoning/ Research-related Skills/ Scientific Reasoning/ Reflective Thinking/ Self-directed learning
K1 - Knowledge; K2 - Understanding; K3 - Practice; K4 – Analysis; K5 - Synthesis; K6 – Creation; K7- Evaluation		

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	S	S	M	M	S	M	S	L	S
CO2	S	M	M	S	S	S	S	M	M	M
CO3	M	S	M	M	S	S	M	S	L	S
CO4	M	S	S	L	M	M	M	S	S	S
CO5	S	M	M	L	M	S	M	S	M	S
S-Strong; M-Medium; L-Low										

References:

1. Bose, A.N., Yang, C.T., And Misra, A. (1991) Coastal Aquaculture Engineering. Oxford And Ibh Publishing Co., Pvt. Ltd., New Delhi.
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Course Code		Course Type	Core		L	T	P	C	Academic Year	2026 - 2027
					6	-	-	4		
Pre-requisite	Basic knowledge in physiological function									

Course Objectives:

- To enrich knowledge on body functions and adaptations concerning its external and internal environment.
- To differentiate the internal physical and chemical functions related to nervous integration, sensation, metabolism and reproduction.
- To impart knowledge about digestion and excretion, blood and circulatory systems.
- To perceive the mechanism of respiration and the nervous system.
- To relate the regulation of the sensory organs according to the stimuli.

Detailed Course Content:

Unit I NUTRITIONAL, THERMAL PHYSIOLOGY AND HOMEOSTASIS (8 Lectures)	Introduction - definition and nutrition - food requirements - physiology of ingestion - types of digestion – extra and intracellular. Digestive enzymes and their role - absorption and assimilation of digested food materials - Balanced diet. Homeostatic mechanisms - osmo-ionic regulation in Crustaceans and fishes. Light – photo biological processes – pressure – acclimatization to high altitudes – hydrostatic pressure – buoyancy.
Unit II RESPIRATORY AND CIRCULATORY PHYSIOLOGY (7 Lectures)	Respiration - structure of lungs and gaseous exchange - transport of O ₂ and CO ₂ – respiratory pigments - Formation of oxyhemoglobin and affinity of hemoglobin for O ₂ and CO ₂ dissociation curves - chloride shift - Bohr Effect. Circulation - open and closed circulatory system - structure of heart and its working mechanism – heartbeat and cardiac cycle - ECG. Myogenic and neurogenic hearts. Properties and functions of blood – heart diseases in human.
Unit III EXCRETORY AND MUSCULAR	Excretion - excretory organs of vertebrates structure and function of nephron and kidney in Mammals – counter current mechanism of urine formation and excretion – excretory product types. Muscles – structure and types of muscles - muscle contraction-theories - sliding filament mechanism. Chemical

PHYSIOLOGY (7 Lectures)	changes during muscle contraction.
Unit IV NEURONAL AND SENSORY PHYSIOLOGY (8 Lectures)	Structure of nerve cell - nature of nerve impulse – resting potential and action potential. Conduction of nerve impulse - structure of synapse – mechanism of synaptic transmission – electrical and chemical transmissions – neurotransmitters. Receptors - types - photoreceptor – structure of human eye and physiology of vision. Phonoreceptor – structure of human ear - organ of Corti- physiology of hearing.
Unit V Endocrine System/Physiology (8 Lectures)	Endocrine glands – relationship between hypothalamus and pituitary gland. Hormones of hypothalamus-adenohypophysis - neurohypophysis. Hormones of pineal gland - thyroid gland - parathyroid - thymus - adrenal - pancreas. Endocrine control of mammalian reproduction – male and female hormones – hormonal control of menstrual and oestrous cycle. Hormones of insects involved in moulting and metamorphosis.

Defining the Course Outcomes (NOT Unit-wise)

At the end of the course, the students will have the ability to		
CO1	Understand and relation of adaptations and mechanism of homeostasis in Vertebrates.	Disciplinary Knowledge/ Communication Skills/ Research-related Skills/ Scientific Reasoning
CO2	Know the importance of nutrients and the controlling process in the regulation of digestion.	Disciplinary Knowledge/ Critical Thinking/ Problem Solving/ Analytical Reasoning/ Research-related Skills/ Scientific Reasoning
CO3	Comprehend the mode of action of circulation, respiration, and excretion.	Disciplinary Knowledge/ Critical Thinking/ Problem Solving/ Analytical Reasoning/ Research-related Skills/ Scientific Reasoning
CO4	Analyze the physiology of effectors, receptors, and neuronal conduction in somatic regulation.	Disciplinary Knowledge/ Critical Thinking/ Problem Solving/ Analytical Reasoning/ Research-related Skills/ Scientific Reasoning/ Reflective Thinking/ Self-directed learning/
CO5	Perceive the physiology of reproductive organs and	Disciplinary Knowledge/ Problem Solving/ Analytical Reasoning/ Research-related

	apply the techniques for infertility management.	Skills/ Scientific Reasoning/ Reflective Thinking/ Self-directed learning
K1 - Knowledge; K2 - Understanding; K3 - Practice; K4 – Analysis; K5 - Synthesis; K6 – Creation; K7- Evaluation		

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	S	S	M	M	S	M	S	L	S
CO2	S	M	M	S	S	S	S	M	M	M
CO3	M	S	M	M	S	S	M	S	L	S
CO4	M	S	S	L	M	M	M	S	S	S
CO5	S	M	M	L	M	S	M	S	M	S
S-Strong; M-Medium; L-Low										

References:

1. Moyes, C.D. and Schulte, P.M. (2016). Principles of Animal Physiology. Pearson Education India.
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CORE COURSE 6: ENVIRONMENTAL BIOLOGY

Course Code		Course Type	Core		L	T	P	C	Academic Year	2026 - 2027
					6	-	-	4		
Pre-requisite	Basic knowledge about ecosystem									

Course Objectives:

- To provide an idea of biotic and abiotic factors of the environment and its interactions.
- To understand and relate the mechanism of nutrient cycles using examples.
- To make them understand and learn about population ecology and urbanization.
- To relate concepts and evaluate the pollutant levels and their impact on the environment.
- To make them know the importance of wastewater treatment and solid waste management.

Detailed Course Content:

Unit I Ecosystem (8 Lectures)	Ecosystem - scope - abiotic factors -water - soil - light. Biotic factors -intra and inter specific associations. Ecosystem - structure and function - autotrophic and heterotrophic producers - consumers – ecological pyramids. Primary and secondary productivity -different trophic level - energy flow in an ecosystem - food chain - food web.
Unit II COMMUNITY ECOLOGY (7 Lectures)	Nutrient cycles – nitrogen - phosphorus -carbon and sulphur in nature – (role of microbes in environment: Nitrogen fixing bacteria. Biotic community – nature and structure of community -community concepts stratification – ecological niches – ecotone and ecological succession. Population ecology and biological control. Population growth – population growth curve – biotic potential in regulation of population size – population interaction – human population and urbanization.
Unit III HABITAT ECOLOGY AND CONSERVATION	Biodiversity-basic concepts – types - hot spots of bio diversity. Wildlife conservations and management – international / national policies and conservation strategies of biodiversity management. Remote sensing -satellite images – aerial photography – thermal and infrared images - radar in ecological applications. Instrumentation –Global Position

(7 Lectures)	System (GPS) – radio telemetry and satellite telemetry techniques used in ecological research. Geographic information system (GIS) techniques in ecological research.
Unit IV ENVIRONMENTAL POLLUTION (8 Lectures)	Effects and control measures of air -water -soil -marine pollution -types of pollutants. Acid rain and ozone layer depletion. Bio accumulation – bio magnification - Biological Oxygen Demand (BOD) – Oxygen Demand (OD), Chemical Oxygen Demand (COD) - Total Dissolved Solids (TDS) - Total Suspended Solids (TSS) -Total Solids (TS). EIA (Environmental Impact Assessment) – steps – methods of EIA.
Unit V TOXICOLOGY (8 Lectures)	Toxicity -types of toxicity - acute toxicity – chronic toxicity – assessment of safety/risk. Toxins - types of toxins - pesticide toxicity - pesticides and their types – insecticides – herbicides – fungicides – rodenticides –nematicides – fumigants. Toxicological methods - acute - sub-acute chronic and special tests. Statistical concept of toxicity -concentrations. Response relationship – margin of safety -toxicity curve - cumulative toxicity and toxicity of chemical mixture - LC ₅₀ and LD ₅₀ .

Defining the Course Outcomes (NOT Unit-wise)

At the end of the course, the students will have the ability to		
CO1	Gain knowledge of different components of ecosystems.	Disciplinary Knowledge/ Communication Skills/ Research-related Skills/ Scientific Reasoning
CO2	Obtain practical ideology/knowledge on environmental monitoring software like GIS and GPS.	Disciplinary Knowledge/ Critical Thinking/ Problem Solving/ Analytical Reasoning/ Research-related Skills/ Scientific Reasoning
CO3	Understand the basic ecoinformatics and its role.	Disciplinary Knowledge/ Critical Thinking/ Problem Solving/ Analytical Reasoning/ Research-related Skills/ Scientific Reasoning
CO4	Know the cause and impact of environmental pollution and the steps to control it.	Disciplinary Knowledge/ Critical Thinking/ Problem Solving/ Analytical Reasoning/ Research-related Skills/ Scientific Reasoning/ Reflective Thinking/ Self-directed learning/

C05	Be aware on environmental toxins and toxicological screening methods.	Disciplinary Knowledge/ Problem Solving/ Analytical Reasoning/ Research-related Skills/ Scientific Reasoning/ Reflective Thinking/ Self-directed learning
K1 - Knowledge; K2 - Understanding; K3 - Practice; K4 – Analysis; K5 - Synthesis; K6 – Creation; K7- Evaluation		

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
C01	M	S	S	M	M	S	M	S	L	S
C02	S	M	M	S	S	S	S	M	M	M
C03	M	S	M	M	S	S	M	S	L	S
C04	M	S	S	L	M	M	M	S	S	S
C05	S	M	M	L	M	S	M	S	M	S
S-Strong; M-Medium; L-Low										

References:

1. Benny Joseph. (2005). Environmental Studies. Tata McGraw Hill.
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CORE PRACTICAL 3:**LABORATORY IN ENVIRONMENTAL BIOLOGY AND ANIMAL PHYSIOLOGY**

Course Code		Course Type	Core		L	T	P	C	Academic Year	2026 - 2027
					6	-	-	4		
Pre-requisite	Basic knowledge about laboratory instruments									

Course Objectives:

- To give an idea about natural resources and conservation.
- To provide knowledge on physiology using animal models.
- To make them identify the endocrine glands and highlight their secretions.
- To impart knowledge on osmoregulation in aquatic animals using experiments.
- To imply theoretical ideas to understand the structure of endocrine glands and reproductive organs using histological sections.

Detailed Course Content:**ENVIRONMENTAL BIOLOGY****Major Experiments:**

1. Estimation of dissolved oxygen in different water samples.
2. Estimation of salinity in different water samples.
3. Estimation of Silicate in different water samples.
4. Estimation of Phosphate in different water samples.
5. Estimation of BOD in different water samples.
6. Estimation of primary production in aquatic environment.
7. Mounting and identification of plankton (fresh water / marine)

Spotters:

Animal association - (Mutualism, Commensalism, Parasitism – any two examples)
Sandy shore, Muddy shore, Rocky shore fauna (any two examples).

Educational Tour / Field Visit:

Marine / Freshwater / Sanctuaries and National Parks / Botanical gardens, threats to local biodiversity.

*Educational Tour / Field visit is compulsory.

ANIMAL PHYSIOLOGY**Major Experiments:**

1. Estimation of salivary amylase activity with reference to temperature
3. Blood grouping by coagulation and Rh factor determination.
4. Estimation of Haemoglobin in human blood.
5. Quantitative estimation of ammonia, uric acid and urea from samples.
6. Quantitative analysis of carbohydrates.

7. Quantitative analysis of protein

Spotters:

Slides: T.S. of pineal gland, Thyroid, Parathyroid, Thymus, Adrenal and Pancreas, T.S. of Ovary, T.S. of Testes, Muscles - (striated, nonstriated and cardiac), Nerve cell.

Models: Structure of mammalian eye, organ of Corti.

Instruments: Haemocytometer, Spectrophotometer, compound microscope.

Defining the Course Outcomes (NOT Unit-wise)

At the end of the course, the students will have the ability to		
CO1	Understand and identify the toxic, chemical composition of major and minor nutrients and analyse Physio-chemical parameters that regulate metabolism.	Disciplinary Knowledge/ Communication Skills/ Research-related Skills/ Scientific Reasoning
CO2	Assess the inter-relationship between organism and between biotic and abiotic factors in an ecosystem.	Disciplinary Knowledge/ Critical Thinking/ Problem Solving/ Analytical Reasoning/ Research-related Skills/ Scientific Reasoning
CO3	Understand the normal physiology of organs under laboratory conditions.	Disciplinary Knowledge/ Critical Thinking/ Problem Solving/ Analytical Reasoning/ Research-related Skills/ Scientific Reasoning
CO4	Evaluate and examine the various hematological parameters.	Disciplinary Knowledge/ Critical Thinking/ Problem Solving/ Analytical Reasoning/ Research-related Skills/ Scientific Reasoning/ Reflective Thinking/ Self-directed learning/
CO5	Determine the amount of biomolecules in any biological samples.	Disciplinary Knowledge/ Problem Solving/ Analytical Reasoning/ Research-related Skills/ Scientific Reasoning/ Reflective Thinking/ Self-directed learning
K1 - Knowledge; K2 - Understanding; K3 - Practice; K4 – Analysis; K5 - Synthesis; K6 – Creation; K7- Evaluation		

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	S	S	M	M	S	M	S	L	S
CO2	S	M	M	S	S	S	S	M	M	M
CO3	M	S	M	M	S	S	M	S	L	S
CO4	M	S	S	L	M	M	M	S	S	S
CO5	S	M	M	L	M	S	M	S	M	S
S-Strong; M-Medium; L-Low										

References:

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1. NANOBIO TECHNOLOGY

Course Code		Course Type	Core		L	T	P	C	Academic Year	2026 - 2027
					5	-	-	4		
Pre-requisite	Basic knowledge about nanoparticles									

Course Objectives:

- To make them understand the fundamental concepts of nanotechnology and its unique properties.
- To provide knowledge on the synthesis of various characterization techniques.
- To highlight the importance of fabrication techniques and their biological applications.
- To demonstrate the applications of nanomaterials in various streams.
- To make them learn toxicity mechanisms and regulatory functions of nanomaterials.

Detailed Course Content:

Unit I GENERIC METHODOLOGIES FOR NANOBIO TECHNOLOGY (8 Lectures)	Introduction to nanotechnology - challenges and opportunities associated with biology on the nanoscale. Top-down approaches – sputtering - chemical etching - thermal/laser ablation - mechanical/ball missing. Bottom-up approaches - vapour deposition - sol-gel process - spray pyrolysis - aerosol process - bio-reduction. Advantages and disadvantages of nanotechnology.
Unit II Nanomaterials Synthesis and Characterization Techniques (7 Lectures)	Synthesis of nanoparticles - characterization techniques - UV-Visible spectrophotometer - Field Emission Scanning-Electron Microscopy (FE-SEM) - Energy Dispersive X-ray (EDX) - High Resolution-Scanning Electron Microscopy (HRTEM) - Dynamic Light Scattering (DLS) - zeta potential - Fourier Transform - Infra red (FT-IR) - X-ray Diffraction (XRD) and Raman spectroscopy.
Unit III INTRODUCTION	Principles of biosensors -types - important component of biosensor - materials for biosensor applications. Fabrication of biosensor devices - electrochemical methods - techniques

TO SENSORS (7 Lectures)	used for microfabrication - biological applications.
Unit IV BIO-NANOMATERIALS (8 Lectures)	Biomolecules for designing nano-structures - nanoprinting of DNA - RNA - proteins - biological and medical applications. Classification of nanomaterials - properties and applications of bionanomaterials
Unit V TOXICOLOGY AND ENVIRONMENTAL SAFETY (8 Lectures)	Mechanism of nanomaterials toxicity - oxidative stress - ecotoxicity - mutagenicity and immunotoxicity. Ethics and regulations issues in nanotechnology - exploration pattern matters associated with nanotechnology - social impacts and human resources for nanotechnology.

Defining the Course Outcomes (NOT Unit-wise)

At the end of the course, the students will have the ability to		
CO1	Acquire mastery of synthesis procedures and their chemical interactions.	Disciplinary Knowledge/ Communication Skills/ Research-related Skills/ Scientific Reasoning
CO2	Understand the fundamental applications of various analytical instruments.	Disciplinary Knowledge/ Critical Thinking/ Problem Solving/ Analytical Reasoning/ Research-related Skills/ Scientific Reasoning
CO3	Understand the usage of biosensor devices for the early detection of infectious diseases.	Disciplinary Knowledge/ Critical Thinking/ Problem Solving/ Analytical Reasoning/ Research-related Skills/ Scientific Reasoning
CO4	Apply bionanomaterials in biomedical research and therapeutic applications.	Disciplinary Knowledge/ Critical Thinking/ Problem Solving/ Analytical Reasoning/ Research-related Skills/ Scientific Reasoning/ Reflective Thinking/ Self-directed learning/
CO5	Profile the individual nanomaterial toxicity profile and mechanistic	Disciplinary Knowledge/ Problem Solving/ Analytical Reasoning/ Research-related Skills/ Scientific Reasoning/ Reflective

	pathways.	Thinking/ Self-directed learning
K1 - Knowledge; K2 - Understanding; K3 - Practice; K4 – Analysis; K5 - Synthesis; K6 – Creation; K7- Evaluation		

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	S	S	M	M	S	M	S	L	S
CO2	S	M	M	S	S	S	S	M	M	M
CO3	M	S	M	M	S	S	M	S	L	S
CO4	M	S	S	L	M	M	M	S	S	S
CO5	S	M	M	L	M	S	M	S	M	S
S-Strong; M-Medium; L-Low										

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2. AQUACULTURE

Course Code		Course Type	Core		L	T	P	C	Academic Year	2026 - 2027
					3	1	-	4		
Pre-requisite	Basic knowledge about aquaculture									

Course Objectives:

- To impart knowledge on the current status, scope and importance of aquaculture in India.
- To provide information about types of freshwater aquaculture.
- To comprehend sea farming and mariculture practices in India.
- To relate the impact of diseases in production and their management.
- To elucidate the import and export status in India.

Detailed Course Content:

Unit I INTRODUCTION TO AQUACULTURE (8 Lectures)	Aquaculture - introduction – definition -historical patterns and practices Aquaculture activities -current status - future aquaculture techniques in India. Major cultivable species for aquaculture in India. A knowledge of inland water bodies suitable for culture in India.
Unit II FRESHWATER AQUACULTURE (7 Lectures)	Different types of freshwater aquaculture - preparation and management of nursery and rearing ponds - use of fertilizers and manures -control of aquatic weeds and algal blooms. Culture of Indian major carps -culture of cold-water fishes - culture of freshwater prawns. Recirculatory aquaculture systems – cages and pens.
Unit III COASTAL AND MARINE AQUACULTURE (7 Lectures)	Biology of cultivable finfish and shellfish –coastal and marine aquaculture. Types of culture - traditional (Pokkali, Bheries) - semi-intensive and intensive culture. Shrimp and fish hatchery and farm management. Cage and pen culture practices in India. Commercially important seaweed species - culture of sea weeds – crab culture.

Unit IV BEST MANAGEMENT PRACTICES (8 Lectures)	Biosecurity of nursery and rearing ponds - role of abiotic and biotic factors - water quality management. Intrinsic factors - generic - species and strain. Extrinsic factors - environment - nutritional status - role of stress in disease process. Microbial disease - viral - bacterial - fungal diseases and their control. Parasitic diseases and their control.
Unit V AQUACULTURE ECONOMICS (8 Lectures)	The basis of production -interrelationships of aquaculture systems – fish marketing methods in India. Basic concepts in demand and price analysis - demand - supply and fish prices - elasticity of demand. Export of fishery products from India and major countries - important products - export documents and procedures.

Defining the Course Outcomes (NOT Unit-wise)

At the end of the course, the students will have the ability to		
CO1	Proficiently discuss the basics of aquaculture practices.	Disciplinary Knowledge/ Communication Skills/ Research-related Skills/ Scientific Reasoning
CO2	Understand the types of aquaculture systems and its significance.	Disciplinary Knowledge/ Critical Thinking/ Problem Solving/ Analytical Reasoning/ Research-related Skills/ Scientific Reasoning
CO3	Differentiate the types of mariculture and its management for various culture systems.	Disciplinary Knowledge/ Critical Thinking/ Problem Solving/ Analytical Reasoning/ Research-related Skills/ Scientific Reasoning
CO4	Gain knowledge on major bacterial, viral, protozoan, and fungal diseases in aquaculture.	Disciplinary Knowledge/ Critical Thinking/ Problem Solving/ Analytical Reasoning/ Research-related Skills/ Scientific Reasoning/ Reflective Thinking/ Self-directed learning/
CO5	Signify the current status of the fish trade and marketing methodologies in India.	Disciplinary Knowledge/ Problem Solving/ Analytical Reasoning/ Research-related Skills/ Scientific Reasoning/ Reflective Thinking/ Self-directed learning
K1 - Knowledge; K2 - Understanding; K3 - Practice; K4 – Analysis; K5 - Synthesis; K6 – Creation; K7- Evaluation		

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	S	S	M	M	S	M	S	L	S
CO2	S	M	M	S	S	S	S	M	M	M
CO3	M	S	M	M	S	S	M	S	L	S
CO4	M	S	S	L	M	M	M	S	S	S
CO5	S	M	M	L	M	S	M	S	M	S
S-Strong; M-Medium; L-Low										

References:

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1. TOXICOLOGY

Course Code		Course Type	Core		L	T	P	C	Academic Year	2026 - 2027
					5	-	-	3		
Pre-requisite	Basic knowledge about toxicants and its impact on environment									

Course Objectives:

- To impart the knowledge of principals and scope of toxicology.
- To gain the knowledge about the factors influence toxicity.
- To integrate the relationship between response and effect of toxicity.
- To provide basics on the assessment of a toxicant.
- To relate with examples of toxicants and its impact on biotic systems.

Detailed Course Content:

Unit I BASIC CONCEPTS OF TOXICOLOGY (8 Lectures)	Principles of Toxicology – Scope of Toxicology – Dose response relationship, concept of LC ₅₀ , LD ₅₀ and ED ₅₀ – Types of toxic substances: Degradable and non-degradable – Acute and chronic toxicity – Synergism and Antagonism – Sigmoid relationships – Chemical and biological factors influencing toxicity.
Unit II ENVIRONMENTAL TOXICANTS (7 Lectures)	Toxic substances in the environment, their sources and entry routes – exposure of toxicants by air, water, soil and diet. Bioaccumulation, bio magnifications and biotransformation of toxic materials in food chain.
Unit III DOSE-RESPONSE RELATIONSHIPS (7 Lectures)	Graded response – Quantal response, Time action curves – Threshold limit value (TLV) – Margin of safety – Toxicity curves. Physiological and metabolic effects on flora and fauna.
Unit IV	Methods used to assess toxicity, Bioassay – types, characteristics, significance and Limitations. Bioassay

TOXICITY TESTING (8 Lectures)	methods using plant, animal and microbial models – Teratogenicity, carcinogenicity and mutagenicity.
Unit V Organ toxicity- Hepatotoxicity (8 Lectures)	Common examples of hepatotoxicants, Nephrotoxicity: Common examples of nephrotoxicity, Pulmonary toxicity: Common examples of pulmonary toxicants, Neurotoxicity: Common examples of neurotoxicants.

Defining the Course Outcomes (NOT Unit-wise)

At the end of the course, the students will have the ability to		
CO1	Provide an outline toxicology, major classes of pollutants.	Disciplinary Knowledge/ Communication Skills/ Research-related Skills/ Scientific Reasoning
CO2	Introduces the basis of toxicology and gives an over view about natural and anthropogenic toxicants.	Disciplinary Knowledge/ Critical Thinking/ Problem Solving/ Analytical Reasoning/ Research-related Skills/ Scientific Reasoning
CO3	Entry, distribution and mode of action of the toxicants in the environment.	Disciplinary Knowledge/ Critical Thinking/ Problem Solving/ Analytical Reasoning/ Research-related Skills/ Scientific Reasoning
CO4	Effects of toxicants in various systems like respiratory, excretory, reproductive and cardiovascular.	Disciplinary Knowledge/ Critical Thinking/ Problem Solving/ Analytical Reasoning/ Research-related Skills/ Scientific Reasoning/ Reflective Thinking/ Self-directed learning/
CO5	Toxicity testing methods and assessments of risks. Ecotoxicogenomics for environmental monitoring and toxicant identification.	Disciplinary Knowledge/ Problem Solving/ Analytical Reasoning/ Research-related Skills/ Scientific Reasoning/ Reflective Thinking/ Self-directed learning
K1 - Knowledge; K2 - Understanding; K3 - Practice; K4 – Analysis; K5 - Synthesis; K6 – Creation; K7- Evaluation		

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	S	S	M	M	S	M	S	L	S
CO2	S	M	M	S	S	S	S	M	M	M
CO3	M	S	M	M	S	S	M	S	L	S
CO4	M	S	S	L	M	M	M	S	S	S
CO5	S	M	M	L	M	S	M	S	M	S
S-Strong; M-Medium; L-Low										

References:

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2. RESEARCH METHODOLOGY

Course Code		Course Type	Core		L	T	P	C	Academic Year	2026 - 2027
					5	-	-	3		
Pre-requisite	Basic understanding about research									

Course Objectives:

- Provide detailed information about the research design and data collection.
- Deal with strategies for the preparation of scientific presentations and data analysis.
- Make familiar with the sample preparation for the micrograph techniques.
- Highlight the methods of immunological techniques for medicinal diagnosis.
- Practice them on the handling cell culture techniques, cryopreservation and storage of cell lines.

Detailed Course Content:

Unit I INTRODUCTION TO RESEARCH (8 Lectures)	Concept of scientific research – selection of a research problem – research design – sampling methods – hypothesis testing- null hypothesis- alternate hypothesis data collection – making observation and records. Preparation of index cards – reference collection and alignment – refereed journals -impact factor –citation index - science direct – H-index. Intellectual Property Rights (IPR) – trademarks and copyright.
Unit II PREPARATION OF SCIENTIFIC PRESENTATIONS (7 Lectures)	Introduction - preparation of scientific papers for publication in a journal. Preparation and presentation of research paper for symposia -seminar and conferences. Technical papers and monographs. Internet and e-journals. Preparation of thesis – components of thesis. Selection of animal models – maintenance – Committee for the Purpose of Control and Supervision of Experiments on Animals (CPCSEA) guidelines. Using computers in research – computer aided techniques for data analysis - data interpretation and presentation. Levels of significance - regression and correlation – plagiarism detecting software

	and multivariate statistics.
Unit III BIOPHYSICAL AND MICROTECHNIQUES (7 Lectures)	Thin layer chromatography (TLC) –Paper chromatography (PC) -Gas chromatography and Mass spectrometry (GC-MS) - High performance liquid chromatography (HPLC). Permanent mounting narcotization and killing – fixing – washing – processing – staining – mounting – labelling. Histological preparation of tissues for SEM and TEM.
Unit IV TECHNIQUES (8 Lectures)	Electrophoresis techniques – gel electrophoresis – SDS-PAGE – two-dimensional gel electrophoresis -Enzyme-linked immunosorbent assay (ELISA) -blotting techniques - immuno-fluorescence -flow cytometry - RT-PCR -Matrix Assisted Laser Desorption/Ionization (MALDI) and N-terminal sequencing.
Unit V ANIMAL CELL CULTURE TECHNIQUES (8 Lectures)	Design and functioning of tissue culture laboratory – cell proliferation measurements – cell viability testing – culture media preparation. Experimental procedures - types of culture – flask - test tube - organ and embryo culture. Protoplast culture. Stem cell culture. Cryopreservation for cells - tissues - organisms. Application of cell culture.

Defining the Course Outcomes (NOT Unit-wise)

At the end of the course, the students will have the ability to		
CO1	Understand the basic concepts of scientific research and the steps to be followed during research.	Disciplinary Knowledge/ Communication Skills/ Research-related Skills/ Scientific Reasoning
CO2	Attain knowledge about the preparation and presentation of research outcomes in any scientific forum.	Disciplinary Knowledge/ Critical Thinking/ Problem Solving/ Analytical Reasoning/ Research-related Skills/ Scientific Reasoning
CO3	Perceive the micro techniques for the detection of molecules in living cells.	Disciplinary Knowledge/ Critical Thinking/ Problem Solving/ Analytical Reasoning/ Research-related Skills/ Scientific Reasoning

CO4	Acquire knowledge of antigen-antibody complexes to treat various killer diseases.	Disciplinary Knowledge/ Critical Thinking/ Problem Solving/ Analytical Reasoning/ Research-related Skills/ Scientific Reasoning/ Reflective Thinking/ Self-directed learning/
CO5	Understand the mechanism of cell proliferation and storage of germplasms.	Disciplinary Knowledge/ Problem Solving/ Analytical Reasoning/ Research-related Skills/ Scientific Reasoning/ Reflective Thinking/ Self-directed learning
K1 - Knowledge; K2 - Understanding; K3 - Practice; K4 – Analysis; K5 - Synthesis; K6 – Creation; K7- Evaluation		

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	S	S	M	M	S	M	S	L	S
CO2	S	M	M	S	S	S	S	M	M	M
CO3	M	S	M	M	S	S	M	S	L	S
CO4	M	S	S	L	M	M	M	S	S	S
CO5	S	M	M	L	M	S	M	S	M	S
S-Strong; M-Medium; L-Low										

References:

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3. COMPUTATIONAL BIOLOGY

Course Code		Course Type	Core		L	T	P	C	Academic Year	2026 - 2027
					5	-	-	3		

Course Objectives:

- Introduce biological data resources and bioinformatics tools for analysis and
- Familiarize database management system for biological data storage and query.
- Impart knowledge on the techniques for phylogenetic studies and protein modeling.
- Analysis of proteomic, genomic and transcriptomic data.
- Emphasize the applications and advantages.

Detailed Course Content:

Unit I INTRODUCTION TO BIOLOGICAL SEQUENCES AND DATABASES (8 Lectures)	Biological databases: Protein, Nucleotide, Genomic, Transcriptomic and other specialized databases, Sequence Alignment, Local and Global Alignment, Basic Local Alignment tool and its applications, Multiple sequence alignment.
Unit II INTRODUCTION TO BIG DATA AND GENOME SEQUENCING (7 Lectures)	Pipeline and data, Next generation sequencing data and analysis, Whole genome sequencing, RNA-Sequencing, Exome sequencing, Single cell sequencing.
Unit III PHYLOGENETICS (7 Lectures)	Introduction to Phylogenetics, Distance and Character based methods for phylogenetic tree construction: UPGMA, Neighbour joining, Maximum Likelihood Trees, Ultrametric and Min ultrametric trees, Parsimonous trees, Additive trees, Bootstrapping.

Unit IV INFORMATICS TECHNIQUES FOR ANALYSIS OF OMICS DATA (8 Lectures)	Microarrays and Clustering techniques for microarray data analysis, Informatics in Genomics and Proteomics: Genome alignment tools, Peptide Mass Fingerprinting, Mass spectrometry data and protein identification resources.
Unit V DBMS AND SQL: APPLICATIONS FOR BIOLOGICAL DATA (8 Lectures)	Creating database tables with biological data, Joining Tables, Building simple and nested queries for analyzing biological data. Demos for Biological Databases, Sequence alignment: BLAST family of programs, Clustal Omega for multiple sequence alignment, Phylogenetics software, SQL Language commands, SQL functions and queries.

Defining the Course Outcomes (NOT Unit-wise)

At the end of the course, the students will have the ability to		
CO1	Acquire knowledge of basic concepts in computational biology and its tools.	Disciplinary Knowledge/ Communication Skills/ Research-related Skills/ Scientific Reasoning
CO2	Explain various omics technologies and data.	Disciplinary Knowledge/ Critical Thinking/ Problem Solving/ Analytical Reasoning/ Research-related Skills/ Scientific Reasoning
CO3	Extend the evolutionary relationship using phylogenetic analysis.	Disciplinary Knowledge/ Critical Thinking/ Problem Solving/ Analytical Reasoning/ Research-related Skills/ Scientific Reasoning
CO4	Analyze and interpret data corresponding to experimental techniques.	Disciplinary Knowledge/ Critical Thinking/ Problem Solving/ Analytical Reasoning/ Research-related Skills/ Scientific Reasoning/ Reflective Thinking/ Self-directed learning/
CO5	Infer, relate and build database management system for biological data storage and query.	Disciplinary Knowledge/ Problem Solving/ Analytical Reasoning/ Research-related Skills/ Scientific Reasoning/ Reflective Thinking/ Self-directed learning

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	S	S	M	M	S	M	S	L	S
CO2	S	M	M	S	S	S	S	M	M	M
CO3	M	S	M	M	S	S	M	S	L	S
CO4	M	S	S	L	M	M	M	S	S	S
CO5	S	M	M	L	M	S	M	S	M	S
S-Strong; M-Medium; L-Low										

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AGRICULTURAL ENTOMOLOGY

Course Code		Course Type	Core		L	T	P	C	Academic Year	2026 - 2027
					2	-	-	2		
Pre-requisite	Basic knowledge about biology of insects									

Course Objectives:

- To enrich with basic knowledge of common insect pests.
- To provide an idea on the classification of pests of crops.
- To impart ideas on the ideology behind pest management.
- To provide the importance of biological agents adopted to control pests.
- To enhance the idea on the behavior of insects towards the selective measures.

Detailed Course Content:

Unit I CLASSIFICATION OF INSECTS (8 Lectures)	Introduction - definition - classification of insect-classification of pests based on magnitude of damage - occurrence on crops – types of crop plants –biological success of insects – reasons for the success of insects – pest outbreak – pest resurgence – insects as phyto-pathogenic vectors.
Unit II BIONOMICS AND MANAGEMENT (7 Lectures)	Introduction - bionomics and management of selected insect pests of crops – pests of paddy - cotton - pulses (green gram and black gram)-vegetables (brinjal and tomato) – fruits (Mango and Citrus). Economic threshold levels - pests of stored products – external and internal feeders. Basic requirements for storage of food grains in godowns - polyphagous insects.
Unit III TOOLS OF INSECT PEST MANAGEMENT (IPM) (7 Lectures)	Introduction - tools of pest management and their integration – legislative - cultural - physical and mechanical methods - pest survey and surveillance - forecasting - types of surveys - remote sensing methods - factors affecting survey. Political - social and legal implications of IPM -pest risk analysis - pesticide risk analysis - cost benefit ratios and partial budgeting – case studies of successful IPM programs.

Unit IV MANAGEMENT OF BIOLOGICAL AGENTS (8 Lectures)	Management with natural enemies -other biological agents - parasites and parasitoids -predators -microbial agents. Conservation of natural enemies – botanical pesticides. Non-conventional methods for managing insect pests– uses of Insect Growth Regulators (IGRs) -repellents - anti-feedants - pheromones - chemo-sterilizers -irradiation - quarantine.
Unit V BEHAVIOUR OF INSECTS (8 Lectures)	Chronobiology and unusual behaviour - biological rhythm in insects – foraging - reproduction and infestation – periodicity in migration of Locusts – impacts of catastrophic earthquakes on insect communities.

Defining the Course Outcomes (NOT Unit-wise)

At the end of the course, the students will have the ability to		
CO1	Acquire basic and applied knowledge on the classification of common pests.	Disciplinary Knowledge/ Communication Skills/ Research-related Skills/ Scientific Reasoning
CO2	Understand the role and impact of insect pests on crops.	Disciplinary Knowledge/ Critical Thinking/ Problem Solving/ Analytical Reasoning/ Research-related Skills/ Scientific Reasoning
CO3	Get an idea of management tools and strategies for pest management.	Disciplinary Knowledge/ Critical Thinking/ Problem Solving/ Analytical Reasoning/ Research-related Skills/ Scientific Reasoning
CO4	Understand natural enemies and biological agents.	Disciplinary Knowledge/ Critical Thinking/ Problem Solving/ Analytical Reasoning/ Research-related Skills/ Scientific Reasoning/ Reflective Thinking/ Self-directed learning/
CO5	Know the idea on chronobiology and its mechanism of insects.	Disciplinary Knowledge/ Problem Solving/ Analytical Reasoning/ Research-related Skills/ Scientific Reasoning/ Reflective Thinking/ Self-directed learning
K1 - Knowledge; K2 - Understanding; K3 - Practice; K4 – Analysis; K5 - Synthesis; K6 – Creation; K7- Evaluation		

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	S	S	M	M	S	M	S	L	S
CO2	S	M	M	S	S	S	S	M	M	M
CO3	M	S	M	M	S	S	M	S	L	S
CO4	M	S	S	L	M	M	M	S	S	S
CO5	S	M	M	L	M	S	M	S	M	S
S-Strong; M-Medium; L-Low										

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Course Code		Course Type	Core		L	T	P	C	Academic Year	2026 - 2027
					6	-	-	4		
Pre-requisite	Basic knowledge about biology of inheritance									

Course Objectives:

- To enlighten the structure of genes in Prokaryotes and Eukaryotes.
- To make them understand the molecular structure of gene expression and its regulation.
- To develop a comprehensive understanding of DNA techniques.
- To provide extensive knowledge on DNA sequencing and genomic library.
- To impart in-depth knowledge on gene transfer techniques and gene therapy.

Detailed Course Content:

Unit I IDENTIFICATION OF GENETIC MATERIAL (8 Lectures)	Introduction - fine structure of gene – cistron - muton - recon - exon - intron. Multigene families – types – simple and complex multigene. Regulation of gene expression in prokaryotes – Lac operon - Tryptophan operon of bacteria. Regulation of gene expression in eukaryotes – gene clustering - mechanism of positive and negative control of gene expression. Genetic code – decoding of gene control – alphabets of the code (triplet codon) - coding dictionary – Wobble base pairing - translational and transcriptional control of gene expression. Environmental effects of gene regulation and epigenetics.
Unit II STRUCTURE AND FUNCTION OF GENETIC MATERIAL (7 Lectures)	Genome organization -nucleus and mitochondria - structure of DNA and RNA stereochemistry of bases and secondary structures. Genetic structure analyses of eukaryotic genomes - chromatin structure and nucleosome concept. Organization and function of genetic materials -gene paradox - repetitive DNA-satellite DNA – overlapping genes -split genes-pseudogenes.
Unit III TECHNIQUES OF MOLECULAR	Recombinant DNA techniques –introduction -restriction modification systems – enzymes in recombinant DNA technology -restriction maps and mapping techniques – nucleic acid probes – blotting techniques – DNA finger

GENETICS (7 Lectures)	printing – foot printing – methyl interference assay – polymerase chain reaction – methods and applications.
Unit IV PRINCIPLES OF DNA TECHNOLOGY (8 Lectures)	Principles of DNA sequencing -manipulation of genes in animals - automated sequencing methods - synthesis of oligonucleotides – primer design - micro arrays – construction of genomic and cDNA libraries. Strategies of expressing cloned genes - phage display.
Unit V GENE MANIPULATION AND PHARMACOGENOMICS (8 Lectures)	Gene transfer to animals – transgenic technology – genetically modified organisms – gene knock outs – gene silencing. Gene therapy -somatic - germ line - stem cell and micro-RNA therapy. Concept of Pharmacogenomics – use of pharmacogenetics for disease diagnosis and treatment.

Defining the Course Outcomes (NOT Unit-wise)

At the end of the course, the students will have the ability to		
CO1	Comprehend the ultra-structure of a gene.	Disciplinary Knowledge/ Communication Skills/ Research-related Skills/ Scientific Reasoning
CO2	Acquire wide knowledge of the organization of genome.	Disciplinary Knowledge/ Critical Thinking/ Problem Solving/ Analytical Reasoning/ Research-related Skills/ Scientific Reasoning
CO3	Learn the techniques and tools in molecular genetics.	Disciplinary Knowledge/ Critical Thinking/ Problem Solving/ Analytical Reasoning/ Research-related Skills/ Scientific Reasoning
CO4	Gain knowledge on DNA sequencing and construction of genomic library.	Disciplinary Knowledge/ Critical Thinking/ Problem Solving/ Analytical Reasoning/ Research-related Skills/ Scientific Reasoning/ Reflective Thinking/ Self-directed learning/
CO5	Understand the techniques in construction	Disciplinary Knowledge/ Problem Solving/ Analytical Reasoning/ Research-related

	of transgenic organisms and pharmacogenomics.	Skills/ Scientific Reasoning/ Reflective Thinking/ Self-directed learning
K1 - Knowledge; K2 - Understanding; K3 - Practice; K4 – Analysis; K5 - Synthesis; K6 – Creation; K7- Evaluation		

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	S	S	M	M	S	M	S	L	S
CO2	S	M	M	S	S	S	S	M	M	M
CO3	M	S	M	M	S	S	M	S	L	S
CO4	M	S	S	L	M	M	M	S	S	S
CO5	S	M	M	L	M	S	M	S	M	S
S-Strong; M-Medium; L-Low										

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Course Code		Course Type	Core		L	T	P	C	Academic Year	2026 - 2027
					6	-	-	4		
Pre-requisite	Basic knowledge about immune system									

Course Objectives:

- To impart knowledge about organs and their role as immune systems.
- To study and compare the cells of immunity and their role in the protection of the human body.
- To familiarize the terms antigen, antibody concepts, hypersensitivity, MHC, and complement pathways.
- To perceive immunological techniques used in clinical testing.
- To enrich knowledge about autoimmune diseases using examples.

Detailed Course Content:

Unit I ORGANS OF IMMUNE SYSTEM (8 Lectures)	History and scope of immunology - innate and acquired immunity. Lymphoid system - primary and secondary lymphoid organs - tissues. Cells of immune system - lymphoid lineage - myeloid lineage. Molecules - complement - acute phase proteins - interferons - lymphokines and cytokines and phagocytosis.
Unit II ANTIGENS AND ANTIBODY (7 Lectures)	Antigens - types of antigens - factors affecting antigenicity. T cell and B cell epitopes - haptens - adjuvants and carriers. Antibodies - Molecular structure of immunoglobulin - types. Immune response - humoral - cell mediated immune response. Superantigens - antigen-antibody interactions in vitro and in vivo studies.
Unit III HYPERSENSITIVITY AND TRANSPLANTATION (7 Lectures)	Hypersensitivity - definition and classification - Types (I, II, III, IV and V). Major Histocompatibility Complex (MHC) in mouse - HLA system in human - cellular distribution - peptide binding. Complements - Complement activation - classical - alternate pathway. Mannose-binding Lectin and Lytic Pathway - Transplantation immunology - types of grafts - allograft rejection - prevention of allograft rejection - Tissue Typing.

Unit IV VACCINATION AND AUTOIMMUNITY (8 Lectures)	Introduction – vaccine - principle and types - antigen as vaccines – subunit vaccines - recombinant vaccines - anti-idiotypic antibodies. Vaccination schedule for humans. Tumour immunology - tumour antigens- immune response to tumours - immunotherapy - tumour vaccines. Autoimmune diseases. Immunodeficiency - inherited and acquired.
Unit V IMMUNO-TECHNIQUES (8 Lectures)	Clinical methods for detection of antigens and antibodies – immunodiffusion - immuno-electrophoresis. Binder-ligand assays – Radio Immuno Assay (RIA), Enzyme-Linked Immuno-Sorbent Assay (ELISA) - Enzyme Multiplied Immunoassay Technique (EMIT).

Defining the Course Outcomes (NOT Unit-wise)

At the end of the course, the students will have the ability to		
CO1	Understand the difference between natural and acquired immunity.	Disciplinary Knowledge/ Communication Skills/ Research-related Skills/ Scientific Reasoning
CO2	Classify the role of immunoglobulins and understand vaccine production.	Disciplinary Knowledge/ Critical Thinking/ Problem Solving/ Analytical Reasoning/ Research-related Skills/ Scientific Reasoning
CO3	Realize the various mechanisms that regulate immune responses.	Disciplinary Knowledge/ Critical Thinking/ Problem Solving/ Analytical Reasoning/ Research-related Skills/ Scientific Reasoning
CO4	Understand the structure and function of antibodies and immunological techniques.	Disciplinary Knowledge/ Critical Thinking/ Problem Solving/ Analytical Reasoning/ Research-related Skills/ Scientific Reasoning/ Reflective Thinking/ Self-directed learning/
CO5	Comprehend the adverse effect of the immune system causing autoimmune disorder.	Disciplinary Knowledge/ Problem Solving/ Analytical Reasoning/ Research-related Skills/ Scientific Reasoning/ Reflective Thinking/ Self-directed learning
K1 - Knowledge; K2 - Understanding; K3 - Practice; K4 – Analysis; K5 - Synthesis; K6 – Creation; K7- Evaluation		

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	S	S	M	M	S	M	S	L	S
CO2	S	M	M	S	S	S	S	M	M	M
CO3	M	S	M	M	S	S	M	S	L	S
CO4	M	S	S	L	M	M	M	S	S	S
CO5	S	M	M	L	M	S	M	S	M	S
S-Strong; M-Medium; L-Low										

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Course Code		Course Type	Core		L	T	P	C	Academic Year	2026 - 2027
					6	-	-	4		
Pre-requisite	Basic knowledge about biomolecules									

Course Objectives:

- To visualize and discuss the basic structure and function of biomolecules.
- To provide deep knowledge on the metabolism of biomolecules with suitable examples.
- To illustrate the mechanism and importance of enzyme kinetics.
- To highlight thermodynamics and energy transduction of biological systems.
- To perceive using examples about the principle mechanism of catalysis.

Detailed Course Content:

Unit I PRINCIPLES OF BIOCHEMISTRY (8 Lectures)	Introduction to Biochemistry - structure of atoms - molecules and chemical bonds. Water and its functions - structure and physicochemical properties of water. Dissolved gases and their properties – pH and buffer. Stabilizing interactions (Van der Waals, electrostatic, hydrogen bonding and hydrophobic interaction).
Unit II BIOMOLECULES (7 Lectures)	Introduction - structure - classification and function of carbohydrates - proteins -lipids. Amino acids - structure and classification – ketogenic and glucogenic amino acids – prostaglandins – classes -functions -pharmacological uses. Vitamins -structure of water soluble and fat-soluble vitamins -deficiency symptoms.
Unit III METABOLISM (7 Lectures)	Introduction - metabolism of carbohydrate - glycolysis - TCA cycle - HMP shunt pathway - glycogenesis and glycogenolysis. Protein -general pathway of amino acid metabolism – deamination - transamination and decarboxylation – urea cycle. Lipid metabolism - beta-oxidation Nucleic acids -metabolism of purine and pyrimidine nucleotides.
Unit IV ENZYME KINETICS	Enzymes -classification – properties – mechanism of action of enzymes - active site - lock and key model-induced fit hypothesis. Enzyme-substrate complex formation –allosteric enzymes - co-enzymes and its

(8 Lectures)	properties - abzymes and synzyme. Enzyme kinetics - principles of enzyme kinetics - Michaelis-Menten kinetic equation.
Unit V THERMODYNAMICS AND ENERGETICS (8 Lectures)	Thermogenesis - definition – laws of thermodynamics - thermodynamics of biological reactions - role of thermodynamics in intermediary metabolism – redox reactions - standard redox potentials. Energetics - relevance of entropy and enthalpy in biological systems.

Defining the Course Outcomes (NOT Unit-wise)

At the end of the course, the students will have the ability to		
CO1	Understand the major interactive forces on biomolecules.	Disciplinary Knowledge/ Communication Skills/ Research-related Skills/ Scientific Reasoning
CO2	Explain the metabolism of biomolecules and their functions.	Disciplinary Knowledge/ Critical Thinking/ Problem Solving/ Analytical Reasoning/ Research-related Skills/ Scientific Reasoning
CO3	Highlight the enzymatic role of molecules and their reactions.	Disciplinary Knowledge/ Critical Thinking/ Problem Solving/ Analytical Reasoning/ Research-related Skills/ Scientific Reasoning
CO4	Correlate physiological and biochemical pathways.	Disciplinary Knowledge/ Critical Thinking/ Problem Solving/ Analytical Reasoning/ Research-related Skills/ Scientific Reasoning/ Reflective Thinking/ Self-directed learning/
CO5	Discuss and solve the thermodynamic principles and problems respectively.	Disciplinary Knowledge/ Problem Solving/ Analytical Reasoning/ Research-related Skills/ Scientific Reasoning/ Reflective Thinking/ Self-directed learning
K1 - Knowledge; K2 - Understanding; K3 - Practice; K4 – Analysis; K5 - Synthesis; K6 – Creation; K7- Evaluation		

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	S	S	M	M	S	M	S	L	S
CO2	S	M	M	S	S	S	S	M	M	M
CO3	M	S	M	M	S	S	M	S	L	S
CO4	M	S	S	L	M	M	M	S	S	S
CO5	S	M	M	L	M	S	M	S	M	S
S-Strong; M-Medium; L-Low										

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1. BIOPHYSICS AND BIOSTATISTICS

Course Code		Course Type	Core		L	T	P	C	Academic Year	2026 - 2027
					4	-	-	4		
Pre-requisite	Basic knowledge in statistics									

Course Objectives:

- Explain core concepts in ecology.
- Summarize our ecological understanding of environmental problems.
- Interpretation and processing of data.
- To develop skill in understanding and handling molecular science.
- Advancements in bioinstrumentation.

Detailed Course Content:

Unit I SCOPE OF BIOPHYSICS IN BIOLOGY (8 Lectures)	Scope of Biophysics in Biology - structure and properties of atoms and molecules- chemical bonds – types – molecular interactions - atomic and molecular orbitals – X-ray diffraction
Unit II PROPERTIES, PRINCIPLES AND APPLICATIONS (7 Lectures)	Properties of natural light. Photoelectric effect – Photodynamic sensitization – Effect of UV light and ionizing radiations – Detection – Disintegration – Measurement of radio activity – Gieger Muller counter – Isotopes as tracers - Free energy from electromagnetic waves - Natural radiations.
Unit III DATA IN BIOSTATISTICS (7 Lectures)	Sample – methods of sampling. Variables and its types. Frequency distribution. Descriptive statistics: measures of central tendency – mean and other means, median and mode. Measures of Dispersion – Range, Standard deviation uses and calculation. Co-efficient of variations and standard error. Measures of Skewness and Kurtosis. Correlation analysis Pearson and Rank correlation. Regression analysis based on biological data.
Unit IV	Probability – Definition – Additional theorems and

PROBABILITY DISTRIBUTION (8 Lectures)	multiplication theorem of probability with simple problems related to this. Probability distribution - Binomial, Poisson and normal distribution and its properties. Testing the hypothesis t-test, chi square test and goodness of fit, F test and ANOVA (one way and two-way analysis).
Unit V STATISTICAL PACKAGES (8 Lectures)	SPSS-data editor - Creating, coding variables. Output viewer, Exploring data with SPSS - Graphics and diagrammatic representations with SPSS, Application of SPSS in biological Sciences. Simple statistics with statistical packages – SPSS.

Defining the Course Outcomes (NOT Unit-wise)

At the end of the course, the students will have the ability to		
CO1	Investigate specific cases of environmental pollution or natural challenges, and their impact.	Disciplinary Knowledge/ Communication Skills/ Research-related Skills/ Scientific Reasoning
CO2	Apply chemistry, biology, molecular biology and microbiology skill to environment issues.	Disciplinary Knowledge/ Critical Thinking/ Problem Solving/ Analytical Reasoning/ Research-related Skills/ Scientific Reasoning
CO3	The students will be capable of interpreting and understanding the basis of molecular biology.	Disciplinary Knowledge/ Critical Thinking/ Problem Solving/ Analytical Reasoning/ Research-related Skills/ Scientific Reasoning
CO4	The learner will be trained in preparing solutions and handling instruments at basic level.	Disciplinary Knowledge/ Critical Thinking/ Problem Solving/ Analytical Reasoning/ Research-related Skills/ Scientific Reasoning/ Reflective Thinking/ Self-directed learning/
CO5	The course will develop the research aptitude of the students.	Disciplinary Knowledge/ Problem Solving/ Analytical Reasoning/ Research-related Skills/ Scientific Reasoning/ Reflective Thinking/ Self-directed learning
K1 - Knowledge; K2 - Understanding; K3 - Practice; K4 – Analysis; K5 - Synthesis; K6 – Creation; K7- Evaluation		

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	S	S	M	M	S	M	S	L	S
CO2	S	M	M	S	S	S	S	M	M	M
CO3	M	S	M	M	S	S	M	S	L	S
CO4	M	S	S	L	M	M	M	S	S	S
CO5	S	M	M	L	M	S	M	S	M	S
S-Strong; M-Medium; L-Low										

References:

1. Ackerman, E., Ellis, L.B. and Williams, L.E. 1979. Biophysical Science. Prentice hall of India, New Jersey, USA.
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DISCIPLINE CENTRIC ELECTIVE COURSE 4

2. WILDLIFE BIOLOGY AND CONSERVATION

Course Code		Course Type	Core		L	T	P	C	Academic Year	2026 - 2027
					4	1	-	4		
Pre-requisite	Basic knowledge about wildlife									

Course Objectives:

- To impart knowledge to understand the importance of studying wildlife and its resources.
- To investigate and share the techniques associated with wildlife and habitat assessment and usage of field equipment.
- To highlight the behavior of different wild animals and make them understand their significance.
- To identify and clarify the conflicts associated with wildlife, environmental impact, and mitigation measures.
- To explore and share different conservation measures to be followed for various wildlife threats.

Detailed Course Content:

Unit I WILDLIFE IN INDIA (8 Lectures)	Wildlife - definition - causes of wildlife depletion - economic importance of wildlife -need for wildlife conservation. International Union for Conservation of Nature (IUCN) - threat categories – endangered - threatened. India as a mega wildlife diversity country - endemic species of fishes - amphibians - reptiles - birds - mammals. Forests in India - identification - dendrology. Deforestation and its impacts - forest inventory – Sustainable Forest Management (SFM).
Unit II WILDLIFE MANAGEMENT TECHNIQUES (7 Lectures)	Habitat manipulation - food - water - shade improvement. Impact and removal of invasive alien species. Making observations -records - field notes and datasheets. Planning census – total counts - sample counts – basic concepts and applications - direct count (transect methods, point counts, visual encounter survey, waterhole survey) -indirect count (call count, track and signs, pellet count, pugmark) - capture - recapture techniques. Wildlife photography - types of cameras - camera traps. Field equipments - binoculars - altimeter -

	pedometer - field compass. Sound recording and media players - activity recording – weight measurement -radio collaring - Global Positioning Systems (GPS) and Geographic Information Systems (GIS).
Unit III ETHOLOGY IN WILDLIFE (7 Lectures)	Introduction - instinctive behaviour - classical and modern concepts - fixed action pattern and ritualization. Learning – imprinting-habituation. Analysis of behaviour pattern – taxis - kinesis and reflexes. Methods of studying animal behavior. Biological rhythms and bird migration. Types of animal communications. Optimal Foraging behaviour. Origin and significance of play - courtship - display - sexual selection and parental care in mammals and birds. Social behaviour of elephants and lion.
Unit IV HUMAN-WILDLIFE CONFLICTS (8 Lectures)	Basic concepts - reason for conflicts - identification of damages caused by wild animals and control measures. Chemical restraints - advantages and disadvantages – case studies – elephant - tiger - leopard. Translocation of wild animals – principles - methods - applications.
Unit V CONSERVATION OF WILDLIFE (8 Lectures)	Introduction – definition – formation - management and administration - <i>in-situ</i> and <i>ex-situ</i> conservation - wildlife sanctuaries - national parks - tiger reserves and biosphere reserves. Wildlife Projects - tiger and elephant. Zoos and zoological parks - definition - aims of zoos- formation and management - Central Zoo Authority (CZA)of India. Captive breeding - aims -principles - methods. Role of government and non-governmental organizations in conservation. Overview of Wildlife (Protection) Act, 1972. Eco-restoration and ecotourism programs. Antipoaching operations.

Defining the Course Outcomes (NOT Unit-wise)

At the end of the course, the students will have the ability to		
CO1	Acquire knowledge of wildlife conservation and its importance.	Disciplinary Knowledge/ Communication Skills/ Research-related Skills/ Scientific Reasoning
CO2	Understand the basic concepts and applications related to wildlife risk	Disciplinary Knowledge/ Critical Thinking/ Problem Solving/ Analytical Reasoning/ Research-related Skills/ Scientific

	assessment.	Reasoning
CO3	Perceive knowledge of communication behavior in animals.	Disciplinary Knowledge/ Critical Thinking/ Problem Solving/ Analytical Reasoning/ Research-related Skills/ Scientific Reasoning
CO4	Recognize the wildlife damages and its preventive measures.	Disciplinary Knowledge/ Critical Thinking/ Problem Solving/ Analytical Reasoning/ Research-related Skills/ Scientific Reasoning/ Reflective Thinking/ Self-directed learning/
CO5	Comprehend the importance /role of reserves and zoological parks in wildlife conservation.	Disciplinary Knowledge/ Problem Solving/ Analytical Reasoning/ Research-related Skills/ Scientific Reasoning/ Reflective Thinking/ Self-directed learning
K1 - Knowledge; K2 - Understanding; K3 - Practice; K4 – Analysis; K5 - Synthesis; K6 – Creation; K7- Evaluation		

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	S	S	M	M	S	M	S	L	S
CO2	S	M	M	S	S	S	S	M	M	M
CO3	M	S	M	M	S	S	M	S	L	S
CO4	M	S	S	L	M	M	M	S	S	S
CO5	S	M	M	L	M	S	M	S	M	S
S-Strong; M-Medium; L-Low										

References:

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4. <https://www.traffic.org/> (wildlife trade)
5. https://cites.org/eng/prog/imp/Wildlife_forensics (Wildlife Forensics)
6. <https://ntca.gov.in/reintroduction/#reintroducing-tigers-2> (Tiger reintroduction)

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Course Code		Course Type	Core		L	T	P	C	Academic Year	2026 - 2027
					3	-	-	3		
Pre-requisite	Basic knowledge in sericulture									

Course Objectives:

- To make them understand the history and socio-economical aspects of sericulture.
- To highlight the classification and morphology of silkworms.
- To enrich theoretical and practical knowledge about the description of mulberry cultivation and pest management.
- To make them learn and understand disease management in sericulture.
- To provide various methodologies followed for the reeling and rearing of sericulture.

Detailed Course Content:

Unit I HISTORY AND OVERVIEW OF SERICULTURE (8 Lectures)	Origin and history of sericulture - environmental impacts - temperate and tropical climate for sericulture practice. Advantages and characteristics of sericulture. Current status of sericulture in India - income and employment generation - role of women in sericulture. National Sericulture Project (NSP) – overview - future scope of sericulture. Role of state - Department of Sericulture (Karnataka, Tamil Nadu, Andhra Pradesh, West Bengal) - role of research organizations and NGOs in sericulture development.
Unit II MORICULTURE AND DISEASE MANAGEMENT (7 Lectures)	Biology of mulberry - description and mulberry cultivation in India – selection and preparation of land - cultivation of mulberry – mulberry varieties – different methods of plantation – organic and inorganic manure application- mulberry crop protection. Disease of mulberry leaf - leaf spot - leaf rust - leaf blight, mulberry root - rot and root knot disease. Mulberry pest management - (Mealy bug – <i>Maconellicoccus hirsutus</i>), (hairy caterpillar - <i>Spilosoma obliqua</i>), (Stem griddler - <i>Sthenias grisator</i>), (Jassid – <i>Amrasca biguttula</i>) - preventive and control measures.
Unit III TAXONOMY AND ANATOMY	Silkworm taxonomy - classification of silkworms based on number of larval moults - (moultinism) and generations produced (voltinism) – Vanya - Tasar - Muga - Eri. Morphology

OF SILKWORM (7 Lectures)	and life cycle of silk worm (<i>Bombyx mori</i>) - Organization of larvae – pupae and moth. Structure of the silk gland and importance. Silkworm anatomy – digestive system of larva. Circulatory system - larva - pupa and adult.
Unit IV FARMING PRACTICES (8 Lectures)	Silkworm rearing house - disinfection of rearing houses and appliances used for rearing - feeding – moulting - egg production. Silk worm pests - uzi fly - ants and demisted beetles. Diseases of silk worm - Bacterial (Flacherie) - Fungal (Muscardine) – Protozoan (Pebrine) and Viral (Grasserie) diseases and its preventive measures.
Unit V POST COCOON TECHNOLOGIES (8 Lectures)	Introduction - cocoon stifling (sun drying, steam stifling, hot air stifling) - storage of cocoon - sorting of cocoons. Concept of difference reeling machines - reeling operation - reeling end formation. Harvesting of cocoon (stifling, storage and sorting). Reeling methods – reeling and re-reeling. Silk examination - cleaning - lacing - bookmarking and grading of silk.

Defining the Course Outcomes (NOT Unit-wise)

At the end of the course, the students will have the ability to		
CO1	Understand the economic and ecological impacts and income generation by sericulture as an agro-based industry.	Disciplinary Knowledge/ Communication Skills/ Research-related Skills/ Scientific Reasoning
CO2	Enrich the knowledge about the basic biology of silkworm production.	Disciplinary Knowledge/ Critical Thinking/ Problem Solving/ Analytical Reasoning/ Research-related Skills/ Scientific Reasoning
CO3	Expertise in taxonomy, morphology, and identifying life cycle stages of the silkworm.	Disciplinary Knowledge/ Critical Thinking/ Problem Solving/ Analytical Reasoning/ Research-related Skills/ Scientific Reasoning
CO4	Relate the strategies involved in the sericulture management system.	Disciplinary Knowledge/ Critical Thinking/ Problem Solving/ Analytical Reasoning/ Research-related Skills/ Scientific Reasoning/ Reflective Thinking/ Self-directed learning/
CO5	Acquire knowledge about	Disciplinary Knowledge/ Problem Solving/

	the technologies and the role of government and nongovernmental sectors in sericulture.	Analytical Reasoning/ Research-related Skills/ Scientific Reasoning/ Reflective Thinking/ Self-directed learning
K1 - Knowledge; K2 - Understanding; K3 - Practice; K4 – Analysis; K5 - Synthesis; K6 – Creation; K7- Evaluation		

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	S	S	M	M	S	M	S	L	S
CO2	S	M	M	S	S	S	S	M	M	M
CO3	M	S	M	M	S	S	M	S	L	S
CO4	M	S	S	L	M	M	M	S	S	S
CO5	S	M	M	L	M	S	M	S	M	S
S-Strong; M-Medium; L-Low										

References:

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POULTRY FARMING

Course Code		Course Type	Core		L	T	P	C	Academic Year	2026 - 2027
					-	-	-	2*		
Pre-requisite	Basic knowledge in poultry science									

Course Objectives:

- To provide information about poultry and its importance.
- To give an idea of self-employment opportunities to the students.
- To make them understand the role of different research organizations and funding agencies promoting poultry farming.
- To know about the economic importance of poultry and its products.
- To study the management strategies of poultry farming.

Detailed Course Content:

Unit I POULTRY PRODUCTION (8 Lectures)	Introduction - poultry production in India - economic importance of poultry production – common breeds of poultry - American class - English class - Asiatic class and Indian class. Important characters of modern breeds of poultry. Economic traits of meat – nomenclature of breeds of fowl - classification of fowls - selection of breeds. Housing and equipment – general principles of building poultry sheds - deep litter system - laying cages.
Unit II BROODING AND REARING (7 Lectures)	Natural and artificial brooding – methods of brooding - brood temperature - space and duration - feed - water -space allowance – vaccination. Management of growers - layers - broilers – summer and winter management - debeaking and culling. Poultry manure – volume - composition - value and disposal.
Unit III FEED COMPOSITION AND NUTRIENTS (7 Lectures)	Feeds for grower and layers - feed additives – usage of food additive – impact on human health. Food stuffs for poultry in relation to protein - amino acids - minerals (Ca and P) - vitamins and fibre content. Feed formulations for chicks - growers - layers and broilers. Nutritive value of egg - factors affecting egg size - storage and preservation of egg - marketing - incubation and hatching of eggs. Annual egg production in India.

Unit IV PREVENTION AND CONTROL OF DISEASES (8 Lectures)	Introduction - common bacterial - viral - fungal - protozoan and nematodes diseases – symptoms- prevention - control and treatment. Arthropod pests - ticks - mites and lice affecting poultry and their control measures.
Unit V POULTRY MARKETING (8 Lectures)	Introduction - processing -preservation - grading - storage and marketing of eggs and meat. Economics of poultry production – problems in poultry production units to examine first hand rearing and business operation status.

Defining the Course Outcomes (NOT Unit-wise)

At the end of the course, the students will have the ability to		
CO1	Understand the importance and strategies to be followed in poultry rearing and marketing.	Disciplinary Knowledge/ Communication Skills/ Research-related Skills/ Scientific Reasoning
CO2	Perceive the methods involved for brooding and its management.	Disciplinary Knowledge/ Critical Thinking/ Problem Solving/ Analytical Reasoning/ Research-related Skills/ Scientific Reasoning
CO3	Enrich knowledge about feed formulation and requirements for poultry farming.	Disciplinary Knowledge/ Critical Thinking/ Problem Solving/ Analytical Reasoning/ Research-related Skills/ Scientific Reasoning
CO4	Comprehend disease management strategies implemented during poultry farming.	Disciplinary Knowledge/ Critical Thinking/ Problem Solving/ Analytical Reasoning/ Research-related Skills/ Scientific Reasoning/ Reflective Thinking/ Self-directed learning/
CO5	Create awareness about skill development for the welfare of the people.	Disciplinary Knowledge/ Problem Solving/ Analytical Reasoning/ Research-related Skills/ Scientific Reasoning/ Reflective Thinking/ Self-directed learning
K1 - Knowledge; K2 - Understanding; K3 - Practice; K4 – Analysis; K5 - Synthesis; K6 – Creation; K7- Evaluation		

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	S	S	M	M	S	M	S	L	S
CO2	S	M	M	S	S	S	S	M	M	M
CO3	M	S	M	M	S	S	M	S	L	S
CO4	M	S	S	L	M	M	M	S	S	S
CO5	S	M	M	L	M	S	M	S	M	S
S-Strong; M-Medium; L-Low										

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Related Online Contents:

1. https://www.ed.ac.uk/studying/postgraduate/degrees/index.php?r=site/view&edition=2020&id=963&gclid=Cj0KCQjwupD4BRD4ARIsABJMmZ_XpKfi8gb eMI9vcZHVbaEQGPFO6m6VShUoeMifidyCiNbSo4utM8caAoUVEALw_wcB (The University of Edindurgh) 69
2. http://catalog.sfasu.edu/preview_program.php?catoid=1&poid=349&returnto=31(Stephen F. Austin University, Texas)
3. <https://thepoultrypunch.com/2020/10/modern-innovations-in-poultryfarming/>
4. <https://www.nature.com/articles/s41392-019-0089-y>
5. <https://www.frontiersin.org/articles/10.3389/fgene.2018.00456/full>
6. <https://pubmed.ncbi.nlm.nih.gov/24915369/>
7. <https://www.fao.org/3/al839e/al839e00.pdf>
8. <https://www.frontiersin.org/articles/10.3389/fvets.2020.00516/full>

PROJECT

The candidate shall be required to take up a Project Work by group or individual and submit it at the end of the final year. The Head of the Department shall assign the Guide who, in turn, will suggest the Project Work to the students in the beginning of the final year. A copy of the Project Report will be submitted to the University through the Head of the Department on or before the date fixed by the University.

The Project will be evaluated by an internal and an external examiner nominated by the University. The candidate concerned will have to defend his/her Project through a Viva-voce.

ASSESSMENT/EVALUATION/VIVA VOCE:**1. PROJECT REPORT EVALUATION (Both Internal & External)**

- | | | |
|------|--|------------|
| I. | Plan of the Project | - 20 marks |
| II. | Execution of the Plan/collection of
Data / Organisation of Materials /
Hypothesis, Testing etc. and
presentation of the report. | - 45 marks |
| III. | Individual initiative | - 15 marks |

2. Viva-Voce / Internal & External - 20 marks

TOTAL	- 100 marks
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PASSING MINIMUM:

Project	Vivo-Voce 20 Marks 40% out of 20 Marks (i.e. 8 Marks)	Dissertation 80 Marks 40% out of 80 marks (i.e. 32 marks)
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A candidate who gets less than 40% in the Project must resubmit the Project Report. Such candidates need to defend the resubmitted Project at the Viva-voce within a month. A maximum of 2 chances will be given to the candidate.
