பெரியார் பல்கலைக்கழகம்

PERIYAR UNIVERSITY

DEPARTMENT OF ZOOLOGY

Salem-636011, Tamil Nadu

NAAC "A++" Grade - State University – NIRF Rank 73, ARIIA- 10

M.Sc. ZOOLOGY PROGRAMME

[Choice Based Credit System (CBCS)

(For those admitted in the academic year 2023-2024 onwards)

OBE REGULATIONS AND SYLLABUS

(With effect from the academic year 2023-2024 onwards)

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1. Preamble

Zoology is central to our understanding of the world. Zoologists seek to discover the fundamental principles that pinpoint animal life focusing on the diversity, function and evolution of animals and thus providing the scientific basis for our knowledge regarding the life style, physiology, diseases and their curative measure in the natural environment by conducting research in insects to mammalian cells.

2. General Graduate Attributes

By studying this programme students get state of the art knowledge about the Zoology and also the opportunities available by studying this course. Student get the aptitude for most of the job oriented course opportunities as well as ability to get success in various competitive exams such as TNPSC, UPSC and Indian forest service etc.

3. Programme Specific Qualification Attributes

By studying this programme the students get the eligibility and capability to clear SET and CSIR NET in Zoology and get eligibility to become Assistant Professors in Zoology as well as NET qualified research scholars. The students also become entrepreneurs and develop their own business and give employment to others.

- **Knowledge and understanding level (K1 and K2)**

  This course imparts knowledge which will be helpful to clear the competitive examinations in the field of Zoology. Students can understand the nature, physiology, biochemical and evolutionary aspects of all animals.

- **Application level (K3)**

  On completion of this course students can start the clinical and diagnostic labs in the field of biomedicine. They will also be capable of opening sericulture, apiculture and aquaculture industries.

- **Analytical level (K4)**

  Students can analyze each and every aspects of pathophysiology and biochemical reaction in animals including human being.

- **Evaluation capability level (K5)**

  Students can evaluate environmental conditions, animal metabolism, and human pathological conditions.

- **Scientific or synthesis level (K6)**

  By studying this course they can develop new drugs and patenting skills. They can also develop new hybrids using genetic engineering.

4. Vision

This Department strives to create a suitable an environment that enables teaching and research to attain high levels of excellence (through Publications and Patents) and in which its members can achieve their full potential right from Molecular Cell Physiology to understanding and targeting diseases like cancer and vector borne diseases, impact of climate change on insect diversity and bat behavior, Cultivation to commercialization of earthworms etc. In addition to the routine work, the Faculties actively engaging in research and also have collaboration with other Universities/ Research Institutions at national as well as International level. So far the Department of Zoology received more than a Crore of Rupees as research grant from various funding agencies like DST, UGC etc.

5. Programme Objectives and Outcomes

Spelt the PEOs (Programme Educational Objectives), Programme Specific Objectives (PSOs) and Programme Outcomes (POs)

Programme Educational Objectives

- To train our stakeholders to transform their theoretical knowledge into practical for the benefit of our society.

Programme Specific Objectives

- To motivate our stake holders to adopt fundamental mathematical tools (statistics) and physical Principles (physics, chemistry) to the analysis of relevant biological situations.

- The outgoing students must be talented to identify the major groups of organisms (invertebrates and chordates) with an emphasis on animals and be able to classify them within a phylogenetic framework (Evolution).

- Students will be able to compare and contrast the characteristics of animals that differentiate them from other forms of life (Comparative Biology).

- Our Stake holders would be clever to explain how organisms function at the level of the gene, genome, cell, tissue (Genetics, Cell Biology, Molecular Biology), organ and organ-system. Drawing upon this knowledge, they will be able to give specific examples of the physiological adaptations, development, reproduction and behaviour of different forms of animals.

- To develop our students to apply their scientific knowledge to formulate testable hypotheses, gathering data that spell out these hypotheses, and analyzing those data to assess the degree to which their scientific work supports their society.

Outcome of the Programme

- Zoology program offered by Periyar University will mould our students to transform their theoretical knowledge into practical for the benefit of our Society by promoting agriculture and health care products. They will be the best academician cum Academic advisors for other institution. Our stake holders will get an opportunity to serve for our Government as Zoologist at ZSI, Entomologist in ICAR institutes, Aqua-culturist, Sericulture Specialist as an entrepreneur. There is an opportunity for our young minds to serve as conservators, Educators as Teacher, Professors, etc.

6. Candidate's eligibility for admission

Candidates who have qualified B.Sc., Zoology / Animal Science / Any other Degree related to Zoology / Life Sciences approved by the Syndicate of Periyar University, Salem.

7. Duration of the programme

The duration of the M.Sc. Zoology Course shall be over a period of **Two Years** from the commencement of the course. A student shall obtain the M.Sc. Degree in Zoology if he/she has registered, undergone and secured the required minimum credits for all the Core and Elective courses and completed the Project Work / Dissertation within the stipulated time.

8. M.Sc. Zoology Programme Structure-Course work, contact hours, credits and maximum internal and external marks for the students admitted from 2023-2024 onwards

Sem	Course Code	Title of Course Work	Contact Hr/Week	Credit	Int. Mark	Ext. Mark	Total Mark
I	23PZOC01	Structure and Function of Invertebrates	7	5	25	75	100
	23PZOC02	Comparative Anatomy of Vertebrates	7	5	25	75	100
	23PZOC03	Lab Course I	4	4	40	60	100
	23PZOE01	Biological Chemistry/Microbiology	6	3	25	75	100
	23PZOE02	Biostatistics/Bioinstrumentation	6	3	25	75	100
			30	**20**			**500**
II	23PZOC04	Cell and Molecular Biology	6	5	25	75	100
	23PZOC05	Developmental Biology	6	5	25	75	100
	23PZOC06	Lab Course II	4	4	40	60	100
	23PZOE03	Economic Entomology / Medical Parasitology	5	3	25	75	100
	23PZOE04	Research Methodology / Bioethics & Biosafety	5	3	25	75	100
	23PZONME1	Poultry farming / Apiculture	3	2	25	75	100
	23PZOHR01	Human Rights	1	1	25	75	100
			30	**23**			**700**
III	23PZOC07	Genetics	6	4	25	75	100
	23PZOC08	Evolution	6	4	25	75	100
	23PZOC09	Animal Physiology	6	4	25	75	100
	23PZOC10	Lab Course III	4	4	40	60	100
	23PZOE05	Medical Laboratory Techniques	5	3	25	75	100
	23PZONME2	Dairy Farming / Vermiculture	3	2	25	75	100
	23PZOI01	Internship/ Field Survey/ Industrial Activity	--	2	--	--	--
			30	**23**			**600**
IV	23PZOC11	Immunology	6	5	25	75	100
	23PZOC12	Ecology	6	5	25	75	100
	23PZOC13	Lab course IV	4	4	40	60	100
	23PZOCP1	Project *viva voce*	5	3	40	60	100
	23PZOE06	Aquaculture	5	3	25	75	100
	23PZOSE1	Animal Behaviour	4	4	25	75	100
	23PEX01	Extension Activity	-	1			
			30	**25**			**600**
		Total	**120**	**91**	**--**	**--**	**2400**

(For Project Report - 40 Mark, Viva voce -20 Mark)

Value Added Courses (Certificate will be issued separately – Through Online Mode) *				
Course Code	**Title of Course Work**	**Contact Hours**	**Marks**	**Credit**
23PZOVA01	3D Cell Biology & Tissue Engineering	36 hrs per course	100	2
23PZOVA02	Geno toxicology	36 hrs per course	100	2
23PZOVA03	Insect-Host Interaction	36 hrs per course	100	2
23PZOVA04	Medical Entomology	36 hrs per course	100	2
Add-on Courses (Certificate will be issued separately- Through Online Mode) *				
23PZOAO01	PCR Technology	36 hrs per course	100	2
23PZOAO02	Ornithology	36 hrs per course	100	2

Furthermore, The TANCHE, Govt. of Tamil Nadu, recommends the candidates to select one from value added courses and one from add-on courses and one from SWAYAM/MOOC platform if they desire. The fee for these course work will be prescribed by the Controller of Examinations in concurrence with the authorities of Periyar University. Separate certificate will be issued and these extra credits will be included in the Academic Bank of Credit (ABC) portal of the candidate.

9. Examinations

Examinations are conducted in semester pattern. The examination for the Semester I & III will be held in November/December and that for the Semester II and IV will be in the month of April/May in every academic year.

Candidates failing in any subject (both theory and practical) will be permitted to appear for such failed subjects in the same syllabus structure at subsequent examinations within next 5 years. Failing which, the candidate has to complete the course in the present existing syllabus structure.

10. Scheme for Evaluation and Attainment Rubrics

Evaluation will be done on a continuous basis and will be evaluated four times during the course work. The first evaluation will be in the 7^{th} week, the second in the 11^{th} week, third in the 16^{th} week and the end – semester examination in the 19^{th} week. Evaluation may be by objective type questions, short answers, essays or a combination of these, but the end semester examination is a University theory examination with prescribed question paper pattern.

Attainment Rubrics for Theory Courses

Internal *(Max. Marks - 25)*

S.No.	Approaches	Marks
1	Internal tests (Best two tests out of 3)	10
2	Attendance	5
3	Seminar	5
4	Assignment	5
Total		25

External *(Max. Marks - 75)*

Section	Approaches	Mark Pattern	K Level	CO Coverage
A	Objective Type (Answer all questions)	20X1 = 20 (Multiple Choice Questions)	✓	✓
B	Descriptive Type (100 to 200 words) (Answer any three out of five questions)	3X5 = 15 (Analytical type questions)	✓	✓
C	Essay Type (500 to 1000 words) (Answer all questions)	5X8 = 40 (Essay type questions)	✓	✓

Attainment Rubrics for Lab Courses

Internal *(Max. Marks-40)*

S.No.	Approaches	Marks
1	Practical tests (Best two tests out of 3)	30
2	Attendance	5
3	Record	5
Total		40

External *(Max. Marks - 60)*

Section	Approaches	Mark Pattern	K Level	CO Coverage
A	Major practical	1X20 = 20	✓	✓
B	Minor practical	1X10 = 10	✓	✓
C	Spotters	4X5 = 20	✓	✓
D	Viva-voce	10	✓	✓
Total		60		

Attainment Rubrics for Research

Internal *(Max. Marks - 40)*

S.No.	Approaches	Marks
1	Manual involvements in experiments	30
2	Attendance	10
Total		40

External *(Max. Marks - 60)*

S.No.	Approaches	Marks
1	Project Report	40
2	Viva voce	20
Total		60

11. Grading System

Evaluation of performance of students is based on ten-point scale grading system as given below.

Ten Point Scale			
Grade of Marks	**Grade points**	**Letter Grade**	**Description**
90-100	9.0-10.0	O	Outstanding
80-89	8.0-8.9	D+	Excellent
75-79	7.5-7.9	D	Distinction
70-74	7.0-7.4	A+	Very Good
60-69	6.0-6.9	A	Good
50-59	5.0-5.9	B	Average
00-49	0.0	U	Re-appear
ABSENT	0.0	AAA	ABSENT

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PERIYAR UNIVERSITY

DEPARTMENT OF ZOOLOGY

Salem-636011, Tamil Nadu

M.Sc. Zoology Course - SEMESTER-I

(This syllabus is applicable to the students who are admitted on or after 2023-2024 academic year onwards)

STRUCTURE AND FUNCTION OF INVERTEBRATES

Core Paper-01 **Paper Code: 23PZOC01**

Total Contact Hours: 84 **Credits: 5** **Weekly Contact Hours: 7**

Course Objectives:		
The main objectives of this course are:		
1.	To understand the concept of classification and their characteristic features of major group of invertebrates.	
2.	To realize the range of diversification of invertebrate animals.	
3.	To enable to find out the ancestors or derivatives of any taxon.	
4.	To know the functional morphology of system biology of invertebrates.	
Course I	**:**	**Core I**
Course title	**:**	**Structure and Function of Invertebrates**
Credits	**:**	**5**
Pre-requisite:		
Students should know the taxonomical classification of invertebrate animals in relation to their functional morphology.		
Expected Course Outcome:		
On the successful completion of the course, student will be able to**:**		
1.	Remember the general concepts and major groups in animal classification, origin, structure, functions and distribution of life in all its forms.	**K1 & K2**
2.	Understand the evolutionary process. All are linked in a sequence of life patterns.	**K2 & K4**
3.	Apply this for pre-professional work in agriculture and conservation of life forms.	**K3 & K5**
4.	Analyze what lies beyond our present knowledge of life process.	**K4 & K6**
5.	Evaluate and to create the perfect phylogenetic relationship in classification.	**K5 & K6**

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Units	
I	**Structure and function in invertebrates:** Principles of Animal taxonomy; Species concept; International code of zoological nomenclature; Taxonomic procedures; New trends in taxonomy
II	**Organization of coelom:** Acoelomates; Pseudocoelomates; Coelomates: Locomotion: Flagella and ciliary movement in Protozoa; Hydrostatic movement in Coelenterata, Annelida and Echinodermata
III	**Nutrition and Digestion:** Patterns of feeding and digestion in lower metazoan; Filter feeding in Polychaeta, Mollusca and Echinodermata. Respiration: Organs of respiration: Gills, lungs and trachea; Respiratory pigments; Mechanism of respiration
IV	**Excretion:** Organs of excretion: Nephridia and Malphigian tubules; Mechanisms of excretion. Nervous system: Primitive nervous system: Coelenterata and Echinodermata; Advanced nervous system: Annelida, Arthropoda (lnsecta) and Mollusca (Cephalopoda).
V	**Invertebrate larvae:** Larval forms of free-living invertebrates - Larval forms of parasites; Strategies and Evolutionary significance of larval forms. Minor Phyla: General characters.

Reading list

1. Barrington, E. J.W. 1979. Invertebrate Structure and Function. The English Language Book Society and Nelson, pp-765.

Recommended texts

1. Barnes, R. D. 1974. Invertebrate Zoology, (Second Edition), Holt-Saunders International Edition, pp-1024.
2. Barnes, R. S. K., P. Calow, P. J. W. Olive, D. W. Golding, J. J. Spicer. 2013. The Invertebrates: A Synthesis. Third Edition. John Wiles & Sons Inc., Hoboken. New Jersey, New Delhi.
3. Dechenik, J. A. 2015. Biology of Invertebrates (Seventh Edition). Published by McGraw Hill Education (India) Private Limited, pp-624.

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

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

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M.Sc. Zoology Course - SEMESTER-I

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COMPARATIVE ANATOMY OF VERTEBRATES

Core Paper-02 **Paper Code: 23PZOC02**

Total Contact Hours: 84 **Credits: 5** **Weekly Contact Hours: 7**

Course Objectives:		
The main objectives of this course are:		
1.	Exemplifying the vertebrate origin and the intermediary position of Prochordates between invertebrates and vertebrates.	
2.	Acquires the knowledge on evolution and adaptive radiation of Agnatha and Pisces.	
3.	Understanding knowledge about the first terrestrial vertebrates and the adaptive radiation of land animals	
4.	Imparting conceptual knowledge about the animal life in the air and their behaviour.	
5.	Understanding the origin and efficiency of mammals and evolutionary changes that occurred in the life of vertebrates.	
Course I	**:**	**Core II**
Course title	**:**	**Comparative Anatomy of Vertebrates**
Credits	**:**	**5**

Pre-requisite:		
Students with knowledge and comprehension on zoology.		
Expected Course Outcome:		
On the successful completion of the course, student will be able to**:**		
1.	Remember the general concepts and major groups in animal classification, origin, structure, functions and distribution of life in all its forms.	**K1 & K2**
2.	Understand the evolutionary process. All are linked in a sequence of life patterns.	**K2 & K4**
3.	Apply this for pre-professional work in agriculture and conservation of life forms.	**K3 & K5**
4.	Analyze what lies beyond our present knowledge of life process.	**K4 & K6**
5.	Evaluate and to create the perfect phylogenetic relationship in classification.	**K5 & K6**

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Units	
I	**Origin of vertebrates:** Concept of Protochordata; The nature of vertebrate morphology; Definition, scope and relation to other disciplines; Importance of the study of vertebrate morphology.
II	**Origin and classification of vertebrates**; Vertebrate integument and its derivatives. Development, general structure and functions of skin and its derivatives; Glands, scales, horns, claws, nails, hoofs, feathers and hairs.
III	**General plan of circulation in various groups;** Blood; Evolution of heart. Respiratory system: Characters of respiratory tissue; Internal and external respiration; Comparative account of respiratory organs.
IV	**Skeletal system:** Form, function, body size and skeletal elements of the body; Comparative account of jaw suspensorium, Vertebral column; Limbs and girdles.
V	**Sense organs:** Organs of Olfaction and taste; Lateral line system. Nervous system: Comparative anatomy of the brain in relation to its functions; Comparative anatomy of spinal cord; Nerves-Cranial, Peripheral and Autonomous nervous systems.

Reading list

1. Swayam Prabha https://www.swayamprabha.gov.in/index.php/program/archive/9
2. Yong, J. Z. 1981. The life of Vertebrates, English language Book society, London, pp-645.
3. Romer, A.S. 1971. The Vertebrate body, W.B.S. Saunders, Philadelphia, pp-600.

Recommended texts

1. Waterman, A.J. 1972. Chordate Structure and Function, MacMillan Co., New York, pp.587.
2. Parker T. J. and W. A. Haswell. 1962. A text book of Zoology, Vol. 2, Vertebrates, 7th Edition, Mac Millan Press, London, pp-750.
3. Ekambaranatha Ayyar and T. N. Ananthakrishnan. 2009. Manual of Zoology, Vol – II, S. Viswanathan Pvt. Ltd. Chennai.
4. Kotpal, R.L. 2019 Modern Text Book of Zoology Vertebrates, 4th Edition, Rastogi Publications, Meerut, pp-968.

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

*S - Strong; M - Medium; L – Low

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M.Sc. Zoology Course - SEMESTER-I

(This syllabus is applicable to the students who are admitted on or after 2023-2024 academic year onwards)

LAB COURSE I
(INVERTEBRATES & VERTEBRATES)

Core Paper-03 **Paper Code: 23PZOC03**

Total Contact Hours: 48 **Credits: 4** **Weekly Contact Hours: 4**

Course Objectives:		
The main objectives of this course are:		
1.	Understanding the different systems in invertebrates & vertebrates.	
2.	Learning about various animal species, their phylogenetic affinities and their adaptive features	
3.	Imparting conceptual knowledge about the salient features and functional anatomy.	
4.	Developing the skill in mounting techniques of the biological samples.	
5.	Gaining fundamental knowledge on the skeletal system	
Course I	**:**	**Core III**
Course title	**:**	**Lab Course-I: Invertebrates & Vertebrates**
Credits	**:**	**4**

Pre-requisite:
Basic knowledge on the animals living in different habitats

Expected Course Outcome:		
On the successful completion of the course, student will be able to**:**		
1.	Understand the structure and functions of various systems in animals	**K2 & K4**
2.	Learn the adaptive features of different groups of animals	**K1 & K2**
3.	Learn the mounting techniques	**K2 & K3**
4.	Acquire strong knowledge on the animal skeletal system	**K2 & K4**

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

INVERTEBRATES

Dissection

Earthworm : Nervous system
Cockroach : Nervous system
Prawn : Appendages, nervous and digestive systems
Grasshopper : Digestive system and mouth parts (virtual mode)
Crab : Nervous system (virtual mode)
Pila : Digestive and nervous systems (virtual mode)

Study of the following slides with special reference to their salient features and their modes of life

1. *Amoeba*
2. *Entamoeba histolytica*
3. *Paramecium*
4. *Hydra* with bud
5. Sporocyst – Liver fluke
6. *Cercaria* larva
7. *Tape worm (Scolex)*
8. *Ascaris* T. S.
9. Mysis of prawn

Spotters

1. Scorpion
2. *Penaeus indicus*
3. *Perna viridis*

Mounting

Earthworm : Body setae
Cockroach : Mouth parts

CHORDATES

Study the nervous system of Indian dog shark – Virtual mode only

1. Nervous system of *Scoliodon laticaudatus* – 5^{th} or Trigeminal nerve
2. Nervous system of *Scoliodon laticaudatus* – 7^{th} or Facial nerve
3. Nervous system of *Scoliodon laticaudatus* – 9^{th} and 10^{th} or Glossopharyngeal & Vagus nerve

Study of the following specimens with special reference to their salient features and their modes of life

1. *Amphioxus* sp. (Lancelet)
2. *Ascidia* sp. (sea squirt)
3. *Scoliodon laticaudatus* (Indian dog shark)
4. *Trygon* sp. (Sting ray)
5. *Torpedo* sp. (Electric ray)
6. *Arius maculatus* (Cat fish)
7. *Exocoetus poecilopterus* (Flying fish)
8. *Mugil cephalus* (Mullet)
9. *Tilapia mossambicus* (Tilapia)
10. *Dendrophis* sp. (Tree snake)

Spotters

1. Entire skeleton of human (Diagrammatic Presentation)
2. Skull of Dog and Rabbit
3. Hyoid apparatus of Frog
4. Pectoral girdle and sternum

5. Pelvic girdle
6. Fore limb
7. Hind limb

Mounting Scales of Fish

1. Cycloid scale
2. Ctenoid scale
3. Placoid scale

Text Books:

1. Lal, S.S. 2009. Practical Zoology, Rastogi Publications, pp-484.
2. Iuliis G. D. and D. Pulerà, 2007. The Dissection of Vertebrates: A Laboratory Manual. Academic Press, Imprint of Elsevier Publication, pp-416.
3. Verma, P.S. 2000. Manual of Practical Zoology: Chordates, S. Chand Publishing Company, pp-528

Reference Books:

1. Preeti, G., and C. Mridula, 2000. Modern Experimental Zoology, Indus International Publication.
2. Sinha, J., A. K. Chatterjeee, P. Chattopadhya. 2011. Advanced Practical Zoology, Arunabha Sen Publishers, pp-1070.

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

*S - Strong; M - Medium; L – Low

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M.Sc. Zoology Course - SEMESTER-I

(This syllabus is applicable to the students who are admitted on or after 2023-2024 academic year onwards)

BIOLOGICAL CHEMISTRY

Elective Paper-E01A **Paper Code: 23PZOE01A**

Total Contact Hours: 72 **Credits: 3** **Weekly Contact Hours: 6**

Course Objectives:		
The main objectives of this course are:		
1.	Students should know the fundamentals of biochemistry	
Course I	**:**	**Elective 01A**
Course title	**:**	**Biological Chemistry**
Credits	**:**	**3**

Pre-requisite:

Understanding fundamental properties of elements, atoms, molecules, chemical bonds, linkages and structure, composition, metabolism and functions of biomolecules.

Expected Course Outcome:

On the successful completion of the course, student will be able to:

I	Learn the structure, properties, metabolism and bioenergetics of biomolecules	**K1 & K3**
II	Acquire knowledge on various classes and major types of enzymes, classification, their mechanism of action and regulation	**K1 & K2**
III	Understand the fundamentals of biophysical chemistry and biochemistry, importance and applications of methods in conforming the structure of biopolymers	**K2 & K3**
IV	Comprehend the structural organization of and proteins, carbohydrates, nucleic acids and lipids	**K2 & K4**
V	Familiarize the use of methods for the identification, characterization and conformation of biopolymer structures	**K5 & K6**

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Units	
I	Basics of biophysical chemistry and biochemistry: Structure of atoms, molecules and chemical bonds - Principles of biophysical chemistry: pH, buffer, reaction kinetics, Thermodynamics.
II	Biomolecular interactions and their properties: Stabilizing interactions (Vander Waals, electrostatic, hydrogen bonding, hydrophobic interaction etc. - Composition, structure of biomolecules (carbohydrates, lipids, proteins, nucleic acids and

	vitamins).
III	Bioenergetics and enzymology: Bioenergetics, glycolysis, oxidative phosphorylation. Principles of catalysis, enzymes and enzyme kinetics, enzyme regulation, mechanism of enzyme action, isoenzymes.
IV	Structural conformation of proteins and nucleic acids: Conformation of proteins (Ramachandran plot, secondary, tertiary and quaternary structure; domains; motifs and folds) - Conformation of nucleic acids (A-, B-, Z-DNA), t-RNA, micro-RNA).
V	Stabilizing interactions in biomolecules: Stability of protein and nucleic acid structures - hydrogen bonding, covalent bonding, hydrophobic interactions and disulfide linkage.

Reading list

1. Berg, J. M., J. L. Tymoczko and L. Stryer 2012. Biochemistry. 5th Ed., W.H. Freeman & Co., New York, pp-1050.
2. Kuchel P.W. and G. B. Ralston 2008. Biochemistry. McGraw Hill (India) Private Limited, UP, pp-580.
3. McKee T. and J. R. McKee 2012. Biochemistry: The Molecular Basis of Life. (7th Edition). Oxford University Press, US, pp-793.
4. Nelson D.L. and M.M. Cox 2018. Lehninger's Principles of Biochemistry. (6th Edition). W. H. Freeman Publishers, New York, pp-1158.
5. Satyanarayana U. and U. Chakrapani 2020. Biochemistry. (3rd Edition). Books and Allied (P) Ltd. Calcutta, pp-695.
6. Ambika Shanmugam's – Fundamentals of Biochemistry for Medical students

Recommended texts

1. Buchanan, B.B., W. Gruissem and R.L. Jones 2015. Biochemistry and Molecular Biology of Plants. John Wiley and Sons Ltd., UK, pp-1280.
2. Murray, R.K., D.K. Granner, P.A. Mayes and V.W. Rodwell 2003. Harper's Illustrated Biochemistry (26th Edition), The McGraw-Hill Companies, Inc., USA, pp-704.
3. Palmer, T. 2004. Enzymes. Affiliated East-West Press Pvt. Ltd., New Delhi, pp-416.
4. Voet D. and J.G. Voet 2019. Biochemistry. (6th Edition). John Wiley & Sons (Asia) Pvt. Ltd., pp-1428.

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

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PERIYAR UNIVERSITY

DEPARTMENT OF ZOOLOGY

Salem-636011, Tamil Nadu

M.Sc. Zoology Course - SEMESTER-I

(This syllabus is applicable to the students who are admitted on or after 2023-2024 academic year onwards)

MICROBIOLOGY

Elective Paper-E02B **Paper Code: 23PZOE01B**

Total Contact Hours: 72 **Credits: 3** **Weekly Contact Hours: 6**

Course Objectives:

The main objectives of this course are:

- To provide students with the latest information in microbiological methods.
- To provide advanced knowledge, understanding, and critical judgment about the profession in microbiology.
- Acquire knowledge on the culture, isolation and control of microorganisms
- Learn the food preservation techniques and study microbes in food and water

Course I	**:**	**Elective 01B**
Course title	**:**	**Microbiology**
Credits	**:**	**3**

Pre-requisite:

Basic knowledge on microbes and microbial diseases

Expected Course Outcome:

On the successful completion of the course, student will be able to:

I	Able to recall the relationship of infections to symptoms, relapse and the accompanying pathology.	**K1 & K2**
II	To develop a heightened sense of understanding in students about the microscopic world around them.	**K3 & K4**
III	To understand and apply the physical and chemical control measure, explains mode of action of antibiotics and lists the microbial diseases in farm animals.	**K6 & K5**

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Units	
I	History and Scope of Microbiology: Difference between prokaryotic and eukaryotic microorganisms. Acellular microorganisms (Viruses, Viroids, Prions) and Cellular microorganisms (Bacteria) with emphasis on distribution and occurrence & morphology.
II	Culture and Characterization: Isolation and identification of bacteria. Techniques of pure culture methods. Phases of growth. Microbial control –

	Physical and chemical agents Methods of sterilization. Staining: Simple and differential staining; Gram staining and acid fast staining.
III	Microbial Genetics: Methods of genetic transfers – transformation, conjugation, transduction. Microbial Genomics: Genome project of *Escherichia coli* and *Yeast.* Metagenomics concepts and Significance.
IV	Host pathogen interaction: Definitions - Infection, Invasion, Pathogen, Pathogenicity, Virulence, Toxigenicity, Carriers, Opportunistic infections, Nosocomial infections. Transmission of infection. Bacterial diseases - Tuberculosis, Anthrax, Viral disease Polio, Hepatitis, Rabies, Dengue, AIDS, Influenza, Chikungunya,. Protozoan diseases - Amoebiasis and Malaria.
V	History and developments in Industrial Microbiology. Microbial fermentation Microbial production of Antibiotics: penicillin, streptomycin, Vitamin B12 Vaccines - genetic recombinant vaccines. Bioremediation- Principles and applications.

Reading list

1. Pelczar M J, Chan ECS and Kreig NR, 2020. Microbiology. Tata-McGraw Hill.

Recommended texts

2. Atlas RM, 2015. Principles of Microbiology. 2nd edition, McGraw-Hill.
3. Dubey RC and Maheswari DK ,2018. Textbook of Microbiology. S. Chand and Co.
4. Prescott LM , 2016. . Microbiology. 6th Edition. McGraw-Hill.
5. Stanier R, Ingraham J, Wheelis M and Painter P, 2014. General Microbiology. 5th Edition, Macmillan Press.
6. Kathleen Park Talaro and Barry Chess 2018. Foundations in Microbiology 10th Edition. Mc Graw Hill Education Publishers, USA.
7. Gerard J. Tortora, Berdell R. Funke, Christine L. Case, 2017. Microbiology: An Introduction, 12th Edition Pearson publishers, USA.

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

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

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PERIYAR UNIVERSITY

DEPARTMENT OF ZOOLOGY

Salem-636011, Tamil Nadu

M.Sc. Zoology Course - SEMESTER-I

(This syllabus is applicable to the students who are admitted on or after 2023-2024 academic year onwards)

BIOSTATISTICS

Elective Paper-E02A **Paper Code: 23PZOE02A**

Total Contact Hours: 72 **Credits: 3** **Weekly Contact Hours: 6**

Course Objectives:		
The main objectives of this course are:		
1.	Students should know basic concepts in Biostatistics.	
Course I	**:**	**Elective 02A**
Course title	**:**	**Biostatistics**
Credits	**:**	**3**
Pre-requisite:		
Students should be aware of importance of analysis of quantitative and qualitative information from biological studies.		

Expected Course Outcome:		
Upon completion of this course, Students would have		
I	Clear understanding of design and application of biostatistics relevant to experimental and population studies.	**K2 & K3**
II	Acquired skills to perform various statistical analyses using modern statistical techniques and software.	**K3 & K4**
III	Knowledge on the merits and limitation of practical problems in biological/ health management study as well as to propose and implement appropriate statistical design/ methods of analysis.	**K5 & K6**

K1- Remember; **K2**- Understand; **K3**- Apply; **K4**-Analyze; **K5**-Evaluate; **K6**- Create

Units	
I	Definition, scope and application of statistics; Primary and Secondary data. Tabulation of biological data: Types and applications. Variables: Definition and types. Frequency distribution: Construction of frequency, Graphic methods: Frequency polygon and ogive curve; Diagrammatic representation: Histogram, bar diagram, pictogram and pie chart.
II	Measures of central tendency: Mean, median and mode for continuous and discontinuous variables direct methods and short-cut method, Measures of dispersion: Range, variation, standard deviation direct method and step deviation method, standard error and coefficient of variation.
III	Probability: Theories and rules; Probability - Addition and multiplication theorem; Probability distribution: Properties and application of Normal, Binomial and Poisson

	distributions.
IV	Hypothesis testing: Student '*t*' test - paired sample and mean difference '*t*' tests. Correlation: Types - Karl Pearsons Co-efficient, Rank correlation, Significance test for correlation coefficient. Regression analysis: calculation of regression co-efficient, graphical representation and prediction.
V	Analysis of variance: one way and two way classification. Data analysis with comprehensive statistical software using Statistical Package for the Social Sciences (SPSS).

Reading list

1. Arora, P. N. and P. K. Malhan 1996. Biostatistics, Himalaya Publishing House, Mumbai, pp-447.
2. Gurumani, N 2005. Introduction to Biostatistics, M.J.P. Publishers, Delhi, pp-407.
3. Das, D. and A. Das 2004. Academic Statistics in Biology and Psychology, Academic Publisher, Kolkata, pp-363.
4. Palanichamy, S. and Manoharan, M 1990. Statistical Methods for Biologists, Palani Paramount Publications, Tamil Nadu, pp-264.

Recommended texts

1. Bailey, N. T. J. 1959. Statistical in Biology, English Universities Press, London, pp-48.
2. Sokal, R. R. and F. J. Rohlf, 1973. Introduction to Biostatistics, W.H. Freeman, London, pp-467.
3. Sokal, R.R. and F.J. Rohlf. 1981. Biometry: The principles and practice of statistics in biological research, San Francisco: W.H. Freeman, London, pp-859.
4. Zar, J.H. 1998. Biostatistical Analysis, Pearson Education (Singapore) Pvt. Ltd., Delhi, India, pp-660.
5. Bailey, N. T. J. 1994. Statistical Methods in Biology (Third Edition), Cambridge University Press, Cambridge, pp-255.
6. Wayne W. Daniel. Biostatistics: A Foundation for Analysis in the Health Sciences, John Wiley & Sons Inc, USA, pp-443.
7. Snedecor, G. W. and W. G. Cochran 1967. Statistical Methods (Sixth Edition), Oxford & IBH Publishing Co., New Delhi, pp-593.
8. Pagano, M. and K. Gauvreau. 2008. Principles of Biostatistics (Second Edition), Cengage Learning, New Delhi, pp-525.

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

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

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PERIYAR UNIVERSITY

DEPARTMENT OF ZOOLOGY

Salem-636011, Tamil Nadu

M.Sc. Zoology Course - SEMESTER-I

(This syllabus is applicable to the students who are admitted on or after 2023-2024 academic year onwards)

BIOINSTRUMENTATION

Elective Paper-E02B **Paper Code: 23PZOE02B**

Total Contact Hours: 72 **Credits: 3** **Weekly Contact Hours: 6**

Course Objectives:		
The main objectives of this course are:		
1.	Students should know basic concepts in Bioinstrumentation	
Course I	**:**	**Elective 02B**
Course title	**:**	**Bioinstrumentation**
Credits	**:**	**3**
Pre-requisite:		
Students should be aware of importance of analysis of quantitative and qualitative information from biological studies.		
Expected Course Outcome:		
Upon completion of this course, Students would have		

I	Applications of biophysics and principle involved in bio instruments	**K1 & K2**
II	Applications of bio instruments in the human	**K3 & K4**
III	Knowledge and practical skills of using instruments in biology and medical field	**K5 & K6**

K1- Remember; **K2**- Understand; **K3**- Apply; **K4**-Analyze; **K5**-Evaluate; **K6**- Create

Units	
I	History, scope and advancement in biomedical instrumentation. The needs for biomedical instrumentation: The scientific methods clinical diagnosis. Common medical measurements and their applications. Biosensor: Principle and applications. Impact of Nano technology in development of Biomedical instruments.
II	Instrumentation for cardiovascular measurements: The Heart and cardiovascular system, blood pressure, heart sounds. Principle, methods and applications of Electrocardiogram (ECG). Blood: Blood collection methods cell counts, Haemoglobinometer, Haemocytometer and Histological methods of WBC differential counts.
III	Lungs**:** Instrumentation for the mechanics of breathing, respiratory therapy equipment. Principle of thermometer and Ultra-sonic measurements. Neuronal sensory measurements. Psychophysiological measurement, Instruments for motor neuron responses, sensory neuron measurements. Equipment for behavioral analysis.
IV	Principle and applications of Electromyography (EMG), Electro-Oculogram (EOG),

	Electroretinogram (ERG), Magnetic Resonance Imaging (MRI), Positron Emission Tomography (PET).
V	Biomedical Instrumentation for testing kidney clearance, creatinine, kidney Imaging (Pyelogram). Types of dialysis-Hemodialysis, Peritorial dialysis, and kidney function test. Bone and Joints**:** Analysis of bone mineral density, joint friction and bone position testing. Clinical temperature measurements. Principle and functions of Goniometer and accelerometer for body movements.

Reading list

1. John G. Webster, 2004. Bioinstrumentation, John wiley and sons, Pvt.Ltd. Singapore.

Recommended texts

1. L Cromwell, F.J.Welbell and E.A. Pfeiffer.1980. Biomedical instrumentation and measurements. Second Edition. PHI publisher, New Jersey, USA.
2. Mandeep Singh. 2010. Introduction of Biomedical Instrumentation. PHI Learning Pvt. Ltd, New Delhi.

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

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

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PERIYAR UNIVERSITY

DEPARTMENT OF ZOOLOGY

Salem-636011, Tamil Nadu

M.Sc. Zoology Course - SEMESTER-II

(This syllabus is applicable to the students who are admitted on or after 2023-2024 academic year onwards)

CELL AND MOLECULAR BIOLOGY

Core Paper-04 **Paper Code: 23PZOC04**

Total Contact Hours: 72 **Credits: 5** **Weekly Contact Hours: 6**

Course Objectives:		
The main objectives of this course are:		
1.	To understand the ultrastructure and functions of basic components of prokaryotic and eukaryotic cells, especially macromolecules, membranes and organelles.	
2.	To realize involvement of various cellular components in accomplishing cell division.	
3.	To enable a successful performance in cell biology component of CSIR-UGC NET.	
4.	To understand the ultrastructure and functions of basic components of prokaryotic and eukaryotic cells, especially macromolecules, membranes and organelles.	
Course I	**:**	**Core IV**
Course title	**:**	**Cell and Molecular Biology**
Credits	**:**	**5**

Pre-requisite:
Students should have knowledge of the basic cellular structures and their salient functions in prokaryotic and eukaryotic cells.

Expected Course Outcome:		
Upon completion of this course, students could		
1.	Understand the general concepts of cell and molecular biology.	**K2**
2.	Visualize the basic molecular processes in prokaryotic and eukaryotic cells, especially relevance of molecular and cellular structures influencing functional features.	**K1 & K2**
3.	Perceive the importance of physical and chemical signals at the molecular level resulting in modulation of response of cellular responses.	**K3 & K4**
4.	Updated the knowledge on the rapid advances in cell and molecular biology for a better understanding of onset of various diseases including cancer.	**K5**
5.	Understand the general concepts of cell and molecular biology.	**K2**

K1- Remember; **K2**- Understand; **K3**- Apply; **K4**-Analyze; **K5**-Evaluate; **K6**- Create

Units	
I	General features of the cell: Basic structure of prokaryotic and eukaryotic cells - Protoplasm and deuteroplasm, cell theory; Diversity of cell size and shapes.
II	Cellular organization: Membrane structure and functions. Membrane model-lipid bilayer and membrane intracellular transport, Structure and functions of Intracellular organelles: Nucleus, mitochondria, Golgi bodies, lysosomes, and endoplasmic reticulum.
III	Cell division and Cell cycle: Mitosis and meiosis, their regulation, steps in cell cycle and control of cell cycle. Molecular biology of cell: Structure of DNA and RNA; Process of DNA replication, transcription and translation in pro- and eukaryotic cells; Genetic maps.
IV	Cell communication and cell signaling: Membrane- associated receptors for peptide and steroid hormones, signal transduction pathways. General principles of cell communication: extracellular space and matrix, interaction of cells with other cells and non-cellular structures.
V	Cancer cells: Characteristic features of normal and cancer cells; Carcinogens: types and cancer induction; Metastasis; Oncogenes and tumor suppressor genes, apoptosis; therapeutic interventions of uncontrolled cell growth.

Reading list

1. Plopper, G., D. Sharp, and E. Sikorski. 2015. Lewin's Cells (Third Edition), Jones & Bartlett, New Delhi, pp-1056
2. Plopper, G. 2013. Principles of Cell Biology, Jones & Bartlett, Maryland, pp-510

Recommended texts

1. Karp, G. 2016. Cell Biology (8th Edition), John Wiley & Sons, Singapore, pp-765.
2. Lodish, H., C. A. Kaiser, A. Bretscher, *et al*., 2019. Molecular Cell Biology (10th Edition), Macmillan, England, pp-1154
3. De Robertis, E.D.P. and E. M. F. De Robertis Jr, 2017. Cell and Molecular Biology. Info-Med, Hong Kong, pp-734
4. Abbas, A. K., A. H. Lichtman and S. Pillai, 2007, Cell and Molecular Immunology (Sixth Edition), Saunders, Philadelphia, pp-566
5. Loewy, A.G., P. Siekevitz and J. R. Menninger, *et al*., 1991, Cell Structure and Function (Third Edition), Saunders, Philadelphia, pp-947
6. Watson, J. D., N.H. Hopkins, J.W. Roberts, *et al*., 2010, Molecular Biology of the Gene (Fourth Edition), Benjamin/Cummings, California, pp-1163
7. Han, S. S. and J. Holmstedt. 1979, Cell Biology, McGraw Hill, pp-319.
8. Alberts, B., A. Johnson, J. Lewis, *et al*., 2020, Molecular Biology of the Cell (Sixth Edition), Garland Science, New York, pp-1342
9. Clark, D.P., 2005. Molecular Biology, Elsevier, China, pp-784
10. Tropp, B. 2008. Molecular Biology: Genes to Proteins (Third Edition), Jones & Bartlett, US.

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

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

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PERIYAR UNIVERSITY

DEPARTMENT OF ZOOLOGY

Salem-636011, Tamil Nadu

M.Sc. Zoology Course - SEMESTER-II

(This syllabus is applicable to the students who are admitted on or after 2023-2024 academic year onwards)

DEVELOPMENTAL BIOLOGY

Core Paper-05 **Paper Code: 23PZOC05**

Total Contact Hours: 72 **Credits: 5** **Weekly Contact Hours: 6**

Course Objectives:		
The main objectives of this course are:		
1.	Understand the process of gametogenesis, cleavage and gastrulation, embryonic development, extra embryonic membrane and placenta in various animals and human.	
2.	Learn the principles, methods and applications of cryo-preservation of gametes and embryo.	
Course I	**:**	**Core V**
Course title	**:**	**Developmental Biology**
Credits	**:**	**5**
Pre-requisite:		
Students have fundamental knowledge in developmental biology.		
Expected Course Outcome:		
On the successful completion of the course, student will be able to		

1.	Define the concepts of embryonic development	**K1**
2.	Observe various stages of cell divisions under microscope	**K2 & K3**
3.	Understand the formation of zygote	**K4**
4.	Differentiate the blastula and gastrula stages	**K4 & K5**
5.	Learn the distinguishing features of three different germ layers and formation of various tissues and organs	**K4**

K1- Remember; **K2**- Understand; **K3**- Apply; **K4**-Analyze; **K5**-Evaluate; **K6**- Create

Units	
I	Pattern of animal development: History of thoughts and conceptual developments - Theories. Gametogenesis: Origin of germ cells, spermatogenesis - Sperm morphology - type of sperms, Oogenesis. Composition and synthesis of yolk in invertebrates (Insects) and vertebrates.
II	Fertilization: Sperm aggregation, Sperm activation, Chemotaxis, Sperm maturation and capacitation in mammals, Acrosome reaction. Egg activation - Intracellular calcium release - Cortical reaction - Physiological polyspermy -

	Amphimixis – Parthenogenesis.
III	Cleavage and gastrulation: Pattern of embryonic cleavage, mechanisms of cleavage, Determinate and regulatory embryos, Factors affecting gastrulation, mechanisms and types of gastrulation in respective animal embryos (Amphibians and Chick); Fate maps - (Amphibian and Chick), Epigenesis and preformation – Formation of primary germ layers.
IV	Embryonic Development; Embryonic development of Chick. Organogenesis - Development of endodermal, mesodermal and ectodermal derivatives. Embryonic Induction and neurulation; Formation and migration of neural crest cells - types of neural crest cells and their patterning - primary and secondary neurulation.
V	Formation of extra embryonic membranes in mammalian. Post embryonic development metamorphosis: Endocrine control of metamorphosis in insect and amphibian - Endocrine control of moulting in crustaceans and insects - Neoteny and pedogenesis. Regeneration: Types of regeneration in planaria. Biochemical changes associated with regeneration. Induced ovulation in humans-GIFT, IVI, IVF– Cryopreservation of gametes/embryos.

Reading list

1. Balinsky, B. I. 1981. Introduction to Embryology (5th Edition), CBS College Publishers, New York, pp-782.
2. Gilbert. S. F. 2006. Developmental Biology, 8th Edition, INC Publishers, USA, pp-785.
3. Berrill, N.J. 1974. Developmental Biology, Tata Mc-Graw Hill Publications, New Delhi, pp-535.
4. Tyler, M.S. 2000. Developmental Biology - A Guide for Experimental Study, Sunderland, MA, pp-208.
5. Subramoniam, T. 2011. Molecular Developmental Biology (2nd Edition), Narosa Publishers, India, pp-364.
6. www.easybiologyclass.com › developmental-biology-e
7. www.studocu.com › document › lecture-notes › view
8. *ocw.mit.edu* › courses › 7-22-developmental-biology-f.

Recommended texts

1. Wilt, F.H. and N.K. Wessel. 1967. Methods in Developmental Biology, Thomas Y Crowell, New York.
2. Slack J.M.W. 2012. Essential Developmental Biology (3rd Edition), Wily-Blackwell Publications, USA, pp-496.
3. Mari-Beffa, M. and J. Knight. 2005. Key Experiments in Practical Developmental Biology, Cambridge University Press, UK, pp-404.

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

*S - Strong; M - Medium; L – Low

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PERIYAR UNIVERSITY

DEPARTMENT OF ZOOLOGY

Salem-636011, Tamil Nadu

M.Sc. Zoology Course - SEMESTER-II

(This syllabus is applicable to the students who are admitted on or after 2023-2024 academic year onwards)

LAB COURSE II
(CELL BIOLOGY AND DEVELOPMENTAL BIOLOGY)

Core Paper-06 **Paper Code: 23PZOC06**

Total Contact Hours: 48 **Credits: 4** **Weekly Contact Hours: 4**

Course Objectives:		
The main objectives of this course are:		
1.	Practical course aims at demonstrating significant cellular and molecular biological principles, quantitative and analytical approaches that enable the students to translate the theoretical foundation in cell biology, genetics and developmental biology into practical understanding.	
Course I	**:**	**Core VI**
Course title	**:**	**Lab Course-II: Cell Biology and Developmental Biology**
Credits	**:**	**4**
Pre-requisite:		
Students should have acquired basic knowledge relevant to this particular lab course.		
Expected Course Outcome:		
Upon completion of this lab course, students		

1.	Acquire knowledge to differentiate the cells of various living organisms and become aware of physiological processes of cells e.g. cell divisions, various stages of fertilization and embryo development.	**K2**
2.	Understand and observe as well as correctly identify different cell types, cellular structures using different microscopic techniques.	**K3**
3.	Develop handling - skills through the wet-lab course.	**K6**
4.	Learn the method of culturing of *Drosophila* and identification of their wild and mutant strains	**K1 & K2**
5.	Acquire skills to perform human karyotyping and chromosome mapping to identify abnormalities	**K1 & K2**

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

CELL AND MOLECULAR BIOLOGY

1. Determination of cell size using micrometer
2. Mitosis in root meristematic cells of plants
3. Detection of polytene chromosome in salivary gland cells of the Chironomous larvae.
4. Detection of sex chromatin using buccal epithelial cells (Barr Body)
5. Isolation and identification of genomic DNA from eukaryotic tissue by agarose gel electrophoresis (AGE) – Demonstration only.

DEVELOPMENTAL BIOLOGY

1. Observation of motility of cattle sperm
2. Observation and whole mount preparation of the chick blastoderm
3. Chick embryonic stage - 24 hours of development
4. Chick embryonic stage - 48 hours of development
5. Chick embryonic stage - 72 hours of development
6. Chick embryonic stage - 96 hours of development

SPOTTERS

1. Mammalian Ovum
2. Mammalian Sperm
3. Blastula of Frog
4. Gastrula of Frog
5. Different types of placenta
6. Cryocane (Photograph)

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

*S - Strong; M - Medium; L – Low

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Salem-636011, Tamil Nadu

M.Sc. Zoology Course - SEMESTER-II

(This syllabus is applicable to the students who are admitted on or after 2023-2024 academic year onwards)

ECONOMIC ENTOMOLOGY

Elective Paper-E03A **Paper Code: 23PZOE03A**

Total Contact Hours: 60 **Credits: 3** **Weekly Contact Hours: 5**

Course Objectives:		
The main objectives of this course are:		
1.	Students should acquire a fairly good understanding about the life of insects and their classification.	
Course I	**:**	**Elective 03A**
Course title	**:**	**Economic Entomology**
Credits	**:**	**3**

Pre-requisite:

The students with a basic background in biological sciences with a special emphasis on the study of insects including systematic, beneficial insects, destructive insects, integrated pest management and insects of medical and veterinary importance.

Expected Course Outcome:

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

I	Understand taxonomy, classification and life of insects in the animal kingdom.	**K1 & K2**
II	Know the life cycle, rearing and management of diseases of beneficial insects.	**K2 & K3**
III	Know the type of harmful insects, life cycle, damage potential and management of pests including natural pest control	**K2 & K3**
IV	Recognize insects which act as vectors causing diseases in animals and human.	**K2 & K4**
	Overall understanding on the importance of insects in human life.	**K2 & K6**

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** -Create

Units	
I	Overview of insects and insect taxonomy: Insects and their biological success - Man and insects; Basic concepts in Insect Taxonomy and classification.
II	Beneficial insects: Silkworms - types, life history, disease management and rearing methods - Types of honey bees, life history, social organization (colonies and caste system), honey bee care and management of bee hive - Lac insects-life history, lac cultivation.

III	Destructive insects: Insect pests - definition - Categories of pests - Types of damage to plants by insects - Causes of pest outbreak - Economic threshold level. Pests of paddy, cotton, sugarcane, vegetables, coconut and stored grains cereals.
IV	Pest management/Control strategies: Methods and principles of pest control - Natural control, Artificial control, Merits and demerits or limitations of these methods in pest control. Integrated pest management - Concepts and practice.
V	Vector biology: Vectors of veterinary and public health importance – Mosquitoes, Tse Tse fly and Housefly as potential vectors of human diseases-control measures

Reading list

1. Ayyar, L.V. R. 1936. Hand book of Economic Entomology for South India. Narendra Publishing House. New Delhi, pp- 528.
2. Vasantharaj David, B. and V.V. Ramamurthy. 2016. Elements of Economic Entomology, Eighth Edition, Brillion Publishing, New York, pp-400.
3. Ross. H.H. 1965. A Text Book of Entomology, John Wiley & Sons Inc., New York, pp-746.

Recommended texts

1. Chapman, R.F., S.J. Simpsonand A.E.Douglas. 2012. The Insects: Structure and Function, Fifth Edition, Cambridge University Press, pp-959.
2. Imms, A.D., O.W.Richards and R.G. Davies (Eds.) IMMS' General Textbook of Entomology, Volume I: Structure, Physiology and Development, pp-418; Volume 2: Classification and Biology, pp-934, Springer Netherlands.
3. Daly, H.V., J.T. Doyen and P.R. Ehrlich. 1978. Introduction to Insect Biology and Diversity. Mc Graw-Hill Kogakusha Ltd., Tokyo, pp-564.
4. Hill, D.S. 1974. Agricultural Insect Pests of the Tropics and Their Control. Cambridge University Press, New York, pp-746.
5. Krishnaswami, S. 1973. Sericulture Manual, Vol. I & II, Silkworm rearing, FAO Agricultural Science Bulletin, Rome.
6. Mani, M.S. 1982. General Entomology. Oxoford & IBH Publishing Co., pp-912.
7. Wigglesworth, V.B. 1972. The Principles of Insect Physiology, ELBS & Chapman and Hall, London, pp-827.

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

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

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PERIYAR UNIVERSITY

DEPARTMENT OF ZOOLOGY

Salem-636011, Tamil Nadu

M.Sc. Zoology Course - SEMESTER-II

(This syllabus is applicable to the students who are admitted on or after 2023-2024 academic year onwards)

MEDICAL PARASITOLOGY

Elective Paper-E03B **Paper Code: 23PZOE03B**

Total Contact Hours: 60 **Credits: 3** **Weekly Contact Hours: 5**

Course Objectives:		
The main objectives of this course are:		
1.	To gain basic understanding about Zoonotic Diseases and also impart knowledge on parasitic vectors.	
Course I	**:**	**Elective 03B**
Course title	**:**	**Medical Parasitology**
Credits	**:**	**3**
Pre-requisite:		
The students with a basic background in biological sciences with a special emphasis on the understanding about Zoonotic diseases including medically important human parasites.		
Expected Course Outcome:		
On the successful completion of the course, student will be able to		

I	Students will get knowledge about the different types of Parasites and their transmission.	**K1 & K2**
II	Students will impart knowledge about the life cycle and control measures of various protozoan parasites causing human diseases.	**K2 & K3**
III	Students will understand about the life cycle and control measures of various helminth parasites causing human diseases.	**K2 & K3**
IV	To know the life cycle of vectors, disease spread and control measures.	**K2 & K4**
V	Overall understanding on microbial zoonosis, their transmission, epidemiology and prevention.	**K2 & K6**

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** –Create

	Units
I	Introduction to parasitism of man: Definition of Parasites/Parasitology. Classification of Parasites. Inter relationship between host and parasitic. Parasitic infection, mode of transmission host specificity and parasitic adaptation.
II	Protozoan parasites- Entameoba-Geographical distribution. Transmission Pathogenecity and Prevention measure. Malarial Parasites Types, Geographical distribution, Vectors - Female Anopheles Mosquito of **malarial parasites**, Life cycle, public health importance Prevention and control and prophylaxis.
III	Nematode parasites - *Taenia solium*, *Fasciola hepatica*, *Wuchereria bancrofti* Geographical distribution. Transmission, Pathogenecity public health importance and Prevention measures.
IV	Vectors and Vector born diseases; Mosquitoes and flies, Anopheles and Aedis - life cycle and disease spread, control measures. Diseases spread by sand flies, fleas, ticks, mites, and their control measures.
V	Bacterial zoonosis – Plague and Anthrax, Geographical distribution, Transmission Pathogenisis, Pathology, Diagnostic Methods and Prevention and control measure. Virals zoonosis- Rabies - Geographical distribution, Transmission Pathogenisis, Pathology, Diagnostic Methods and Prevention and control measure.

Reading list

1. Bhattacharya, D (2018) Text book of Parasitology, Wave books, New Delhi, India
2. Bose, M. (2017) Parasitosis and Zoonosis, New central book agency, Kolkata, India
3. Chatterjee, K. D., (2019) Parasitology Protozoology and Helminthology, CBS publishers, India

Recommended texts

1. Coleman, M. 2022 , Human Parasitology, KAUFMAN PRESS, USA
2. Ghosh, S. 2019, Paniker's Textbook of Medical Parasitology , Jaypee Brothers Medical Publishers, India
3. Loker, E.S. &Hofkin, B. V 2015, Parasitology: A conceptual approach, Garland Science, USA
4. Riedel, S., Morse, S. A.,Mietzner T. A.,& S. Miller 2019, Jawetz Melnick &Adelbergs Medical Microbiology, McGraw Hill Publisher, India
5. Shymasundary, K & Rao, K. H. 2012, Medical parasitology, MJP publishers, Chennai, India

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

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

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(This syllabus is applicable to the students who are admitted on or after 2023-2024 academic year onwards)

RESEARCH METHODOLOGY

Elective Paper-E04A **Paper Code: 23PZOE04A**

Total Contact Hours: 60 **Credits: 3** **Weekly Contact Hours: 5**

Course Objectives:		
The main objectives of this course are:		
1.	Students understand the basic principle, methodology and applications of widely used instruments in biological sciences.	
Course I	**:**	**Elective 04A**
Course title	**:**	**Research Methodology**
Credits	**:**	**3**
Pre-requisite:		
Students should know the fundamentals of basic methods employed in experimental biology.		

Expected Course Outcome:		
On the successful completion of the course, student will be able to		
1.	To understand and improve the art of scientific writing.	**K1**
2.	To analyse the raw data and its interpretation	**K2**
3.	Principles and applications of reliable methods and instruments	**K2 & K4**
4.	Understand the testing of hypothesis and interprets the results	**K3 & K5**

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6-** Create

Units	
I	Scope – Identification and selection of research problem – Methods of literature collection: Experimental and Designing of methodology – Planning and execution of investigations – Methods of editing and abstracting, Preparation of manuscript and proof reading – Research ethics - Plagiarism - Thesis writing.
II	Preparation and presentation of research papers for journals - Refereed journals - Symposia and conferences– Impact factor – H-index – Citation index – Patents, Copyright – Preparation of research proposals - Funding agencies: TNSCST, UGC, DST, DBT, ICMR and CSIR.
III	Microscopy: Principles and applications - Phase contrast microscope, Electron microscopy: SEM, TEM, Chromatography: Principles and Applications - TLC, HPLC, Electrophoresis: Principles and Applications –

	Agarose Gel and SDS-PAGE
IV	Tracer techniques: Radiation measuring devices – Geiger Muller counter, Scintillation Counter - Principles and Applications. Spectroscopy: UV-Vis, FTIR, NMR – Principles and applications.
V	Statistical methods and application:–Test of significance – Student's 't' test , Chi – Square test, 'F' test – ANOVA – one way, two way and multiple way – Correlation - regressions. SPSS Package -Statistical analysis using Microsoft EXCEL program.

Reading list

1. Pearse, A.G. 1968. Histochemistry: Theoretical and Applied, Vol. I, Third Edition, J & A Churchill Ltd, pp-758.
2. Lillie, R.D. 1954. Histopathologic Technic and Practical Histochemistry, Second Edition, Blakiston, New York, pp-715.
3. Hoppert, M. 2003. Microscopic Techniques in Biotechnology, Wiley-VCH GmbH, Weinheim, Germany, pp-330.

Recommended texts

1. Anderson, J., B.H. Durstan and M. Poole. (1977). *Thesis and Assignment Writing*, Wiley Eastern, New Delhi.
2. Chandler, D.E. and R.W. Robertson. (2009). *Bio-imaging Current Concepts in Light and Electron Microscopy*, Jones & Bartlet Publishers, Sandburry, USA.
3. Day, R.A. (1992). *How to Write and Publish a Scientific Paper.* Cambridge University Press.
4. Devadas, R.P. (1976). *A Handbook of Methodology of Research*, S.R.K. Vidyalaya Press, Chennai
5. Ebel, H.F., C.Bliefert and W.E. Russey. (1988). *The Art of Scientific Writing*, VCH, Weinheim.
6. Gurumani, N. (2008). *Research Methodology for Biological Science*, MJP Publishers, Chennai.
7. Kothari, R.C. (2013). *Research Methodology, Methods and Techniques*, Wishwa Prakasam Publication, II Edition.
8. Reily, M .J. (2019*). Bioinstrumentation.* CBS Publishers& Distributors
9. Ross, R. (2017). *Research an Introduction*, Harper and Row Publications.

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

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

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PERIYAR UNIVERSITY

DEPARTMENT OF ZOOLOGY

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M.Sc. Zoology Course - SEMESTER-II

(This syllabus is applicable to the students who are admitted on or after 2023-2024 academic year onwards)

BIOETHICS AND BIOSAFETY

Elective Paper-E04B **Paper Code: 23PZOE04B**

Total Contact Hours: 60 **Credits: 3** **Weekly Contact Hours: 5**

Course Objectives:		
The main objectives of this course are:		
1.	Students should acquire a fairly good understanding about the life of insects and their classification.	
Course I	**:**	**Elective 04B**
Course title	**:**	**Bioethics and Biosafety**
Credits	**:**	**3**
Pre-requisite:		
This course helps to adhere to the ethical practices appropriate to the discipline at all times and to adopt safe working practices relevant to the bioindustries & field of research		
Expected Course Outcome:		
On the successful completion of the course, student will be able to		
I	Students will gain awareness about Intellectual Property Rights (IPRs) to take measure for the protecting their ideas	**K1 & K2**
II	They will able to devise business strategies by taking account of IPRs	**K2 & K3**
III	They will be able to assist in technology upgradation and enhancing competitiveness.	**K2 & K3**
IV	They will acquire adequate knowledge in the use of genetically modified organisms and its effect on human health	**K2 & K4**
V	They will gain more insights into the regulatory affairs.	**K2 & K6**

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** -Create

Units	
I	Biosafety: Introduction, Historical prospective, objectives, risk assessment in biotechnological research and their regulation, physical and biological contaminants, field trial and planned introduction of GMOs, Biosafety guidelines in India, Biosafety levels for animal and microbial researches.
II	Bioethics: Introduction, Ethical issues related to biotechnology, legal and socioeconomic impacts of biotechnology, health and safety issues, possible benefits of successful cloning, Ethical concerns of gene cloning, hazards of environmental engineering, Ethical issues in Human Cloning and stem cell research.

III	Intellectual Property Right: Introduction, intellectual property: trade secret, patent, copyright, patent law, Choice and management of IPRs, advantage and limitations of IPRs.
IV	Patents and patent processing: Introduction, Essential requirements, International scenario of patents, patenting of biological materials, significance of patents in India, Patent application, Procedures and granting, protection of biotechnological inventions, Patent Act (1970), Patent (Amendments) Act (2002).
V	Regulatory framework in Biotechnology: Regulation of RDT research, Regulatory framework in India governing GMOs, Recombinant DNA Guidelines (1990), Revised Guidelines for Research in Transgenic ANIMALS (1998). Roles of Institutional Biosafety Committee, Ethical implications of biotechnological products and techniques. Social and ethical implications of biological weapons.

Reading list

1. Entrepreneurship: New Venture Creation : David H. Holt
2. Patterns of Entrepreneurship : Jack M. Kaplan
3. Entrepreneurship and Small Business Management: C.B. Gupta, S.S. Khanka, Sultan Chand & Sons.

Recommended texts

1. Sateesh MK 2010 Bioethics and Biosafety, I. K. International Pvt Ltd.
2. Sree Krishna V 2007 Bioethics and Biosafety in Biotechnology, New age International publishers.
3. Sateesh MK 2010 Bioethics and Biosafety, I. K. International Pvt Ltd.
4. The law and strategy of Biotechnological patents by Sibley. Butterworth publications.
5. Intellectual property rights – Ganguli – Tat McGraw-Hill
6. Biotechnology-B. D. Singh- Kalyani Publications

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

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

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(This syllabus is applicable to the students who are admitted on or after 2023-2024 academic year onwards)

POULTRY FARMING

Non Major Course-NM1A **Paper Code: 23PZONM1A**

Total Contact Hours: 48 **Credits: 2** **Weekly Contact Hours: 3**

Course Objectives:		
The main objectives of this course are:		
1.	Students should know basic concepts in Vermiculture.	
Course I	**:**	**Non Major Course- NME 1A**
Course title	**:**	**Poultry Farming**
Credits	**:**	**2**
Pre-requisite:		
Students should be aware of economic and cultural importance of Poultry farming.		
Expected Course Outcome:		
Upon completion of this course, Students would have		

I	To understand the various practices in Poultry farming. To know the needs for Poultry farming and the status of India in global market.	**K2 & K3**
II	To be able to apply the techniques and practices needed or Poultry farming.	**K1, K2 & K3**
III	To know the difficulties in Poultry farming and be able to propose plans against it.	**K5 & K6**

K1- Remember; **K2**- Understand; **K3**- Apply; **K4**-Analyze; **K5**-Evaluate; **K6**- Create

Units	
I	General introduction to poultry farming - Definition of Poultry - Past and present scenario of poultry industry in India - Principles of poultry housing - Poultry houses - Systems of poultry farming
II	Management of chicks - growers and layers - Management of Broilers. - Preparation of project report for banking and insurance.
III	Poultry feed management-Principles of feeding, Nutrient requirements for different stages of layers and broilers - Feed formulation and Methods of feeding.
IV	Poultry diseases-viral, bacterial, fungal and parasitic (two each); symptoms, control and management; Vaccination programme.
V	Selection, care and handling of hatching eggs - Egg testing. Methods of hatching.- Brooding and rearing -. Sexing of chicks. - Farm and Water Hygiene - Recycling of poultry waste.

Reading list

1. Sreenivasaiah., P. V., 2015. Textbook of Poultry Science. 1st Edition. Write & Print Publications, New Delhi 2.

2. Jull A. Morley, 2007. Successful Poultry Management. 2nd Edition. Biotech Books, New Delhi"
3. Hurd M. Louis, 2003. Modern PoultryF arming. 1st Edition. International Book Distributing Company, Lucknow."
4. Life and General Insurance Management"

Recommended texts

1. Ismail, S.A., 1997. Vermitechnology, The biology of earthworms, Orient Longman, India.
2. http://www.asci-india.com/BooksPDF/Small%20Poultry%20Farmer.pdf
3.https://nsdcindia.org/sites/default/files/MC_AGR-Q4306_Small-poultry-farmer-.pdf
4. http://ecoursesonline.iasri.res.in/course/view.php?id=335
5. https://swayam.gov.in/nd2_nou19_ag09/preview

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

*S - Strong; M - Medium; L – Low

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M.Sc. Zoology Course - SEMESTER-II

(This syllabus is applicable to the students who are admitted on or after 2023-2024 academic year onwards)

APICULTURE

Non Major Course-NM1B **Paper Code: 23PZONM1B**

Total Contact Hours: 48 **Credits: 2** **Weekly Contact Hours: 3**

Course Objectives:		
The main objectives of this course are:		
1.	Students should know basic concepts in Apiculture.	
Course I	**:**	**Non Major Course-NME 1B**
Course title	**:**	**Apiculture**
Credits	**:**	**2**
Pre-requisite:		
Students should be aware of importance of honey bees and their impacts on the ecosystem.		
Expected Course Outcome:		
Upon completion of this course, Students would have		
I	Clear understanding of morphology, life cycle, characteristics of honey bees and bee keeping.	**K1, K2 & K3**
II	Acquired skills to perform bee keeping from managing colonies of bees in order to harvest honey and other Bee related by-products in different setups and as an Entrepreneurial venture.	**K3, K4 & K5**
III	Knowledge on the harvesting, preserving and processing of bee products and identification of the appropriate markets to sell the produce.	**K5 & K6**

K1- Remember; **K2**- Understand; **K3**- Apply; **K4**-Analyze; **K5**-Evaluate; **K6**- Create

Units	
I	Introduction to Apiculture. History, classification, types, life cycle of different species of Honey Bees and their behavioural patterns. Social organization of bee colony
II	Bee-keeping system, tools and equipments needed for bee keeping. Types of bee hives, structure and functional features. Criteria for site selection for apiculture and factors affecting them.
III	Identification and characteristics and Preventive measures to be taken against of different bee enemies. Diseases affecting honey bees and their control measures. Colony collapse disorder and its management.
IV	Bee products, uses and importance- Honey, Royal jelly, Propolis, Pollen and Bee venom. Harvesting, Processing, Packaging and Marketing of bee products.
V	Apiculture industry around the World and Role of Central Bee Research & Training institute in India. Apiculture as an Entrepreneurial venture.

Reading list

1. Singh, D., Singh, D. Pratap. 2006. A Handbook of Beekeeping. AGROBIOS (INDIA)

2. Sharma P.L. and Singh, S.H. Book of Bee keeping.
3. Cherian and Ramanathan, S. Bee keeping in south India.
4. Prospective in Indian Apiculture - R.C. Mishra.

Recommended texts

1. Caron, D.W. 2013 (revised from 1999). Honey Bee Biology and Beekeeping. Wicwas Press. Cheshire, CT, 368 pp.
2. Kaspar, R., C. Cook, and M. D. Breed. 2018. Animal Behaviour 142: 69-76.
3. Hendriksma, H. P., A. L. Toth, and S. Shafir. 2019. Individual and Colony Level Foraging decisions of Bumble Bees and Honey Bees in Relation to Balancing of Nutrient Needs. Frontiers in Ecology and Evolution 7: 177.
4. Steinhauer, N. et al. 2018. Drivers of Colony Loss. Current Opinion in Insect Science 26: 142-148.
5. Technology and value addition of Honey - Dr. D. M. Wakhle and K. D. Kamble.
6. ABC & XYZ of Bee culture - A. I. Root.

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

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

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M.Sc. Zoology Course - SEMESTER-III

(This syllabus is applicable to the students who are admitted on or after 2023-2024 academic year onwards)

GENETICS

Core Paper-07 **Paper Code: 23PZOC07**

Total Contact Hours: 72 **Credits: 4** **Weekly Contact Hours: 6**

Course Objectives:		
The main objectives of this course are:		
1.	Understanding DNA as genetic material, fine structure of DNA & RNA molecules, as well as physico-chemical properties of macromolecules.	
2.	Gain insight into sequential events occurs during protein synthesis.	
3.	Learn the structure and function of chromosome and chromosomal basis of genetic disorders.	
4.	To acquire knowledge about microbial genetics	
5.	To provide information about rDNA technology and its application.	
Course I	**:**	**Core VII**
Course title	**:**	**Genetics**
Credits	**:**	**4**

Pre-requisite:		
Basic knowledge on molecular biology and genetics		
Expected Course Outcome:		
On the successful completion of the course, student will be able to		
1.	Explain the organization and functions of genetic material in the living system.	**K1 & K2**
2.	Understand various sequential processes in protein synthesis	**K1 & K2**
3.	Explicate the structures and functions of chromosomes and identify the diseases caused by the chromosomal abnormalities.	**K2 & K4**
4.	Able to distinguish lytic and lysogenic cycle and explain the mechanisms of genetic recombination of the microbes.	**K2 & K5**
5.	Understand the principle and application of rDNA technology for the welfare of human being.	**K2 & K3**

K1- Remember; **K2**- Understand; **K3**- Apply; **K4**-Analyze; **K5**-Evaluate; **K6**- Create

Units	
I	Structure, properties and functions of genetic materials: DNA as the genetic Materials - Basic structure of DNA and RNA, alternate and unusual forms of DNA - Physical and Chemical properties of nucleic acid, base properties.
II	**G**enetic code - Methods of deciphering the genetic code and general features of the code word dictionary. Chromosomal genetics: Molecular structure of chromosomes - Variation in chromosome number and structure [Chromosomal syndromes].

III	Microbial Genetics: Genetics of Virus - Viral chromosome, Lytic cycle, Lysogenic cycle - Bacterial genetics-Bacterial genome - Gene transfer mechanisms in bacteria and virus - conjugation, transduction and transformation
IV	Recombinant DNA technology: Vectors - types - Techniques used in recombinant DNA technology - generation of DNA fragments - Restriction endonucleases, DNA modifying enzymes, Ligases
V	Introduction of rDNA into host cell - calcium chloride mediated gene transfer - *Agrobacterium* mediated DNA transfer, electroporation, microinjection, liposome fusion, particle gun bombardment.

Reading list

1. Gardner, E. J., M. J. Simmons and D.P. Snustad. 2006. Principles of Genetics. 8th Edition, John Wiley & Sons. INC. New York, pp-740.
2. Brooker, R. J. 2014. Genetics: Analysis and Principles. 5th Edition, McGraw Hill Publsiher, pp-880.
3. Russell, P.J. 2005. Genetics: A Molecular Approach (2nd Edition). Pearson/Benjamin Cummings, San Francisco, pp-850.
4. https://onlinecourses.swayam2.ac.in/cec21_bt02/preview
5. https://www.khanacademy.org/science/high-school-biology/hs-molecular-genetics/hs-rna-and-protein-synthesis/a/the-genetic-code

Recommended texts

1. Griffiths, A. J. F., H. J. Muller, D. T. Suzuki, R. C. Lewontin and W. M. Gelbart. 2012. An Introduction to Genetic Analysis. 11th Edition, W. H. Greeman. New York.
2. Snustad, D.P., Simmons, M.J. 2015. Principles of Genetics, John Wiley Publications, pp-784.
3. Watson, J. D., T. A. Baker, S. P. Bell, Alexander Gann, Michael Levine, Richard Losick. 2003. Molecular Biology of the Gene, (5^{th} Edition). Cold Spring Harbor Laboratory Press, pp-912.
4. Klug, W. S. and M. R. Cummings, C. A. Spencer. 2005. Concepts of Genetics, Benjamin - Cummings Publishing Company.
5. Harti, D. L. 2002. Essential Genetics, A Genomic Perspective, Jones & Bartlet.
6. Krebs, J. E., E.S. Goldstein, S.T. Kilpatrick. 2018. Lewin's Genes XII, Jones & Bartlet Publisher, pp-613.
7. Watson, J. D., T. A. Baker S. P. Bell, A. Cann, M. Levine and R. Losick, 2014. Molecular Biology of Gene 7th Edition, Pearson Education RH Ltd. India.

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

*S - Strong; M - Medium; L – Low

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PERIYAR UNIVERSITY

DEPARTMENT OF ZOOLOGY

Salem-636011, Tamil Nadu

M.Sc. Zoology Course - SEMESTER-III

(This syllabus is applicable to the students who are admitted on or after 2023-2024 academic year onwards)

EVOLUTION

Core Paper-08 **Paper Code: 23PZOC08**

Total Contact Hours: 72 **Credits: 4** **Weekly Contact Hours: 6**

Course Objectives:		
The main objectives of this course are:		
1.	To critically analyze the concepts of evolution in order to	
2.	Understand the factors responsible for origin and generation of diversity among living beings and	
3.	To develop strategies for sustenance of life on this planet	
4.	To critically analyze the concepts of evolution in order to	
Course I	**:**	**Core VIII**
Course title	**:**	**Evolution**
Credits	**:**	**4**
Pre-requisite:		
Students shall have basic knowledge on the diversity of animals, biology including morphological, anatomical, physiological and embryological features of various phyla and their environment.		
Expected Course Outcome:		
On the successful completion of the course, student will be able to		

1.	To understand the concept of evolution. It provides a comprehensive account of evidences to support concept of evolution and different theories for exploring the mechanism of evolution.	**K1 & K3**
2.	Study the origin of eukaryotic cells; Evolution of unicellular eukaryotes; Anaerobic metabolism, photosynthesis and aerobic metabolism.	**K1 & K2**
3.	Understand the major events in the evolutionary time scale; Origins of unicellular and multi-cellular organisms.	**K2 & K3**
4.	Comprehend the origin of new genes and proteins; Gene duplication and divergence.	**K2 & K4**
5.	Appreciate the concepts and rate of change in gene frequency through natural selection, migration and random genetic drift	**K4 & K5**

K1- Remember; **K2**- Understand; **K3**- Apply; **K4**-Analyze; **K5**-Evaluate; **K6**- Create

Units	
I	Emergence of evolutionary thoughts: Lamarck and Darwin – concepts of variation, adaptation, struggle, fitness and natural selection – Mendalism - Spontaneity of mutations - The evolutionary synthesis
II	Origin of cells and unicellular evolution: Origin of basic biological molecules - Abiotic synthesis of organic monomers and polymers - Concept of Oparin and Haldane - Experiment of Miller (1953) - The first cell - Evolution of

	prokaryotes - Origin of eukaryotic cells - Evolution of unicellular eukaryotes - Anaerobic metabolism, photosynthesis and aerobic metabolism
III	Paleontology and evolutionary history: The evolutionary time scale - Eras, periods and epoch - Major events in the evolutionary time scale - Origins of unicellular and multi cellular organisms - Stages in primitive evolution including *Homo sapiens*
IV	Molecular evolution: Molecular divergence - Molecular tools in phylogeny, classification and identification - Protein and nucleotide sequence analysis - Origin of new genes and proteins - Gene duplication and divergence
V	Population genetics - Hardy-Weinberg Law - concepts and rate of change in gene frequency through natural selection, migration and random genetic drift, Adaptive radiation, Speciation - Allopatric and Sympatric. Convergent evolution, Co-evolution, Altruism and evolution.

Reading list

1. Bergstrom, C. T. and L. A. Dugatkin. 2012. Evolution, Second MEDIA Edition. W.W. Norton & Company, International Student Edition, pp-756.
2. Jobling, M., E. Hollox, M. Hurles, T. Kivisild and C. T. Tyler Smith. 2014. Human Evolutionary Genetics. Second Edition. Garland Sciences, London, pp-650.
3. Veer Bala Rostogi, 2018. Organic Evolution (Evolutionary Biology), Thirteenth Edition Vinoth Kumar Jain, Scientific International (Pvt.) Ltd, New Delhi, pp-590.
4. https://www.flipkart.com/books/evolution~contributor/pr?sid=bks
5. http://www.evolution-textbook.org/
6. https://onlinelibrary.wiley.com/journal/15585646
7. http://darwin-online.org.uk/

Recommended texts

1. Strickberger. M. W. 2000. Evolution. Third Edition, Jones Bartlett Publishers, pp-722.
2. Hall B. K. and B. Hallgrimsson. 2014. Strickberger's Evolution. Fifth Edition, Bartlett Learning, An Ascend Learning Company, pp-642.
3. Barton, N.H., D. Briggs, J.A. Eisen David, D.B. Goldstein and N.H. Patel. 2007. Evolution. Cold Spring Harbor Laboratory Press, pp-833.

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

*S - Strong; M - Medium; L – Low

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PERIYAR UNIVERSITY

DEPARTMENT OF ZOOLOGY

Salem-636011, Tamil Nadu

M.Sc. Zoology Course - SEMESTER-III

(This syllabus is applicable to the students who are admitted on or after 2023-2024 academic year onwards)

ANIMAL PHYSIOLOGY

Core Paper-09 **Paper Code: 23PZOC09**

Total Contact Hours: 72 **Credits: 4** **Weekly Contact Hours: 6**

Course Objectives:		
The main objectives of this course are:		
1.	Students acquire the basic knowledge on physiology of different organs in animals and human.	
2.	Understand the functions of different systems such as digestion, excretion, blood circulatory system, respiration and nervous system of animal relating them to structure and functions of various organs.	
Course I	**:**	**Core IX**
Course title	**:**	**Animal Physiology**
Credits	**:**	**4**
Pre-requisite:		
Students should know the fundamentals of structure and functions of organs and organ systems of animals.		
Expected Course Outcome:		
On the successful completion of the course, student will be able to		

1.	Understand the functions of different systems of animals	**K1**
2.	Learn the comparative anatomy of heart structure and functions	**K2**
3.	Know the transport and exchange of gases, neural and chemical regulation of respiration	**K2 & K4**
4.	Acquire knowledge on the organization and structure of central and peripheral nervous systems	**K3 & K5**

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Units	
I	Digestive system: Digestion, absorption, energy balance, BMR. Respiratory system: Comparison of respiration in different species, anatomical considerations, exchange of gases, neural and chemical regulation of respiration.
II	Blood and circulation: Blood corpuscles, haemopoiesis and formed elements, plasma function, blood volume, blood volume regulation, blood groups, haemoglobin, immunity, haemostasis. Cardiovascular system : Comparative anatomy of heart structure, myogenic heart, specialized tissue,
III	Nervous system: Neurons, action potential, gross neuro-anatomy of the brain and spinal cord, central and peripheral nervous system, neural control of muscle tone and posture. sense organs: Vision, hearing and tactile response.
IV	Excretory system: Comparative physiology of excretion, kidney, urine

	formation, urine concentration, waste elimination, micturition, regulation of water balance, blood volume, blood pressure, electrolyte balance, acid-base balance.
V	Endocrinology and reproduction: Endocrine glands, basic mechanism of hormone action, hormones and diseases; reproductive processes, gametogenesis, ovulation, neuroendocrine regulation.

Reading list

1. Prosser C. L. 1991, Comparative Animal Physiology. Part A: Environmental and Metabolic Animal Physiology. Wiley-Liss Publishers, pp-592
2. Hoar, S.W. 1983, General and Comparative Physiology, Prentice Hall Publication, pp-928.
3. Randall, D., W. Burggren, K. French and R. Eckert. 2001, Animal Physiology Mechanisms and Adaptations, New York : W.H. Freeman and Co., pp-
4. Nelson K. S. 1997. Animal Physiology: Adaptation and Environment, Cambridge University Press, pp- 617.
5. Dantzler, W.H. 1997. Comparative Physiology (Handbook of Physiology), Volumes I and II. Edited by William H. Dantzler. pp - 1824 Published for the American Physiological Society by Oxford University Press Inc., New York. Oxford University Press Canada, Toronto.
6. https://swayam.gov.in/nd1_noc20_bt42/preview
7. https://www.classcentral.com/course/swayam-animal-physiology-12894
8. https://swayam.gov.in/nd1_noc20_hs33/preview

Recommended texts

1. Shepherd, G. M. 1994. Neurobiology, OUP USA Publsiher, pp-774.
2. Hainsworth , F.R. 1981. Animal Physilogy: Adaptation in function, Addison Wesley Longman Publishers, pp-669.
3. Mcfarland, D. 1999. Animal Behaviour: Psychobiology, Ethology and Evolution, Longman Publisher, pp-592.
4. Gorden, M.S. *et al.*, 1977. Animal Physiology: Principles and Adaptation, New York, Third Edition.
5. Ahearn, G.A. *et al*., 1988. Advances in Comparative and Environmental Physiology – 2, Springer Publishers, pp-252.
6. Hill, R.W. 1976. Comparative Physiology of Animals: Environmental Approach, Longman Higher Education Publisher, pp-656.
7. Withers, P.C. 1992. Comparative Animal Physiology, Brooks/Cole Publisher, pp-900.

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

*S - Strong; M - Medium; L – Low

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PERIYAR UNIVERSITY

DEPARTMENT OF ZOOLOGY

Salem-636011, Tamil Nadu

M.Sc. Zoology Course - SEMESTER-III

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LAB COURSE III
(GENETICS, EVOLUTION & ANIMAL PHYSIOLOGY)

Core Paper-10 **Paper Code: 23PZOC10**

Total Contact Hours: 48 **Credits: 4** **Weekly Contact Hours: 4**

Course Objectives:		
The main objectives of this course are:		
1.	To learn on the transmission of heritable traits.	
2.	To have hands on experience in handling of hormone related disorders.	
3.	To study the significance of vestigial organs in humans.	
Course I	**:**	**Core X**
Course title	**:**	**Lab Course-III: Genetics, Evolution & Animal Physiology**
Credits	**:**	**4**
Pre-requisite:		
To learn on the transmission of heritable traits. To have hands on experience in handling of hormone related disorders. To study the significance of vestigial organs in humans.		
Expected Course Outcome:		
On the successful completion of the course, student will be able to**:**		

1.	Understand the transmission of different heritable traits.	**K2, K3 & K4**
2.	Students will identify endocrine and pheromone glands in mammals and insects.	**K2 & K3**
3.	Students will learn on vestigial organs and their role in evolution.	**K2 & K3**

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

GENETICS

1. Observation of Mendelian traits
2. Identification of Human Syndromes – Specimen/Photograph
3. Study on polygenic inheritance – Specimen/Photograph
4. Pedigree Analysis of Genetic Disorder (Hemophilia and Night Blindness)

EVOLUTION

1. Identification of Vestigial organs
2. Study of fossils and living fossils from models/pictures
3. Problems related to changes in allelic frequencies using Hardy-Weinberg Law
4. Study of Homology and Analogy(Pictures)

ANIMAL PHYSIOLOGY

1. Pregnancy testing for HCG in urine samples
2. Identification of Thyroidism
3. Identification of Endocrine glands in mammals (Specimen)
4. Identification of Endocrine glands in insect (Specimen)

Text Books:

1. Nigam SC, Nigam SC andOmkar (2006) Experimental Animal Physiology and Biochemistry, New Age International.
2. Lal, S.S. 2009. Practical Zoology, Rastogi Publications, pp-484.
3. Verma, P.S. 2000. Manual of Practical Zoology: Chordates, S. Chand Publishing Company, pp-528

Reference Books:

3. Preeti, G., and C. Mridula, 2000. Modern Experimental Zoology, Indus International Publication.
4. Sinha, J., A. K. Chatterjeee, P. Chattopadhya. 2011. Advanced Practical Zoology, Arunabha Sen Publishers, pp-1070.

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

*S - Strong; M - Medium; L – Low

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PERIYAR UNIVERSITY

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(This syllabus is applicable to the students who are admitted on or after 2023-2024 academic year onwards)

MEDICAL LABORATORY TECHNIQUES

Elective Course – E05 **Paper Code: 23PZOE05**

Total Contact Hours: 48 **Credits: 3** **Weekly Contact Hours: 5**

Core industry module:

Course Objectives:		
The main objectives of this course are:		
1.	Students should understand the different protocols and procedures to collect clinical samples.	
Course I	**:**	**Elective Course 05**
Course title	**:**	**Medical Laboratory Techniques**
Credits	**:**	**3**
Pre-requisite:		
Students should have a basic knowledge about medical laboratories and the works carried out by them.		
Expected Course Outcome:		
Upon completion of this course, Students would have		

I	Understand protocols and procedures to collect clinical samples for blood analysis and to study human physiology.	**K2 & K3**
II	Explain the characteristics of clinical samples and demonstrate skill in handling clinical equipment.	**K3, K4 & K5**
III	Evaluate the hematological and histological parameters of biological samples.	**K3, K4, K5 & K6**

K1- Remember; **K2**- Understand; **K3**- Apply; **K4**-Analyze; **K5**-Evaluate; **K6**- Create

Units	
I	Laboratory safety - toxic chemicals and biohazards waste- biosafety level- good laboratory practice – collection and processing of different specimens.
II	Principle and operating mechanism of lab equipments- Incubator, Hot air oven, and Autoclave, p^H meter, Centrifuge, Laminar air flow, PCR. Diagnostic application of DNA fingerprinting and the plotting techniques.
III	Analysis blood specimen for different disease- Anemia, Parasitic infection, Bacterial infection, CSF Cerebro spinal fluid examination method. Stool examination for parasitic infection. Complete urine examination microbial and biochemical use of MRI and CT SCAN for diagnosis of disease test.
IV	Cardiovascular system- Blood pressure - Pulse - regulation of heart rate, cardiac shock. Heart sounds, Electrocardiogram (ECG) - significance - ultra sonography- Electroencephalography (EEG).

V	Handling and labeling of histology specimens - Tissue processing - processing of histological tissues for paraffin embedding, block preparation. Microtome's – types of microtome- sectioning, staining - staining methods - vital staining - mounting- problems encountered during section cutting and remedies - Frozen section techniques- freezing microtome.

Reading list

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

Recommended texts

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

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

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

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DAIRY FARMING

Non Major Elective course-2A **Paper Code: 23PZONME2A**

Total Contact Hours: 24 **Credits: 2** **Weekly Contact Hours: 3**

Course Objectives:		
The main objectives of this course are:		
1.	Students should know basic concepts in Vermiculture	
Course I	**:**	**Non Major Course NME 2A**
Course title	**:**	**Dairy Farming**
Credits	**:**	**2**
Pre-requisite:		
Students should be aware of economic and cultural importance of Dairy farming.		
Expected Course Outcome:		
Upon completion of this course, Students would have		

I	To understand the various practices in Dairy farming. To know the needs for Dairy farming and the status of India in global market.	**K2 & K3**
II	To be able to apply the techniques and practices needed for Dairy farming.	**K1, K2 & K3**
III	To know the difficulties in Dairy farming and be able to propose plans against it.	**K5 & K6**

K1- Remember; **K2**- Understand; **K3**- Apply; **K4**-Analyze; **K5**-Evaluate; **K6**- Create

Units	
I	Introduction to Dairy Farming- Advantages of dairying- Classification of breeds of cattle-Indigenous and exotic breeds- Selection of dairy cattle. Breeding-artificial insemination-Dairy cattle management-General Anatomy.
II	Construction of Model Dairy House - Types of Housing - Different Managemental Parameters - Winter Management - Summer Management
III	Feedstuffs available for livestock- Roughages -Concentrates - Energy rich concentrates - Protein rich concentrates - Mineral Supplements - Vitamin Supplements - Feed additives - Feeding management - Calves Feeding - Feeding of adults - Feeding of pregnant dairy animals - Feeding pregnant heifer.
IV	Milk-Composition of milk-milk spoilage-pasteurization - Role of milk and milk products in human nutrition – Dairying as a source of additional income and employment.
V	Contagious disease - Common Bacterial - Protozoal - Helminth and Viral Diseases - Parasitic Infestation - Vaccination - Biosecurity.

Reading list

1.The Veterinary Books for Dairy Farmers by Roger W. Blowey.
2. Hand Book of Dairy Farming by Board Eiri.
3. Handbook of animal husbandry TATA, S.N ed., ICAR 1990
4. Prabakaran, R. 1998. Commercial Chicken production. Published by P. Saranya, Chennai.
5. Hafez, E. S. E., 1962. Reproduction in Farm Animals, Lea &Fabiger Publisher.

Recommended texts

1. https://agritech.tnau.ac.in/farm_enterprises/Farm%20enterprises_%20Dairy%20unit.html
2. https://www.google.co.in/search?tbo=p&tbm=bks&q=inauthor:%22Tata,+S.N.,+ed%22
3. 15. James. N. Marner, 1975. Principles of dairy processing, wiley eastern limited, New Delhi.
4. Baradach, JE. Ryther. JH. and, MC larney WO., 1972. Aquaculture. The farming and Husbandry of Freshwater and Marine Organisms. Wiley InterScience, NewYork.

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

*S - Strong; M - Medium; L – Low

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VERMICULTURE

Non Major Elective course-2B **Paper Code: 23PZONME2B**

Total Contact Hours: 24 **Credits: 2** **Weekly Contact Hours: 3**

Course Objectives:		
The main objectives of this course are:		
1.	Students should know basic concepts in Vermiculture.	
Course I	**:**	**Non Major Elective course NME 2B**
Course title	**:**	**Vermiculture**
Credits	**:**	**2**
Pre-requisite:		
Students should be aware of economic and cultural importance of Vermiculture.		
Expected Course Outcome:		
Upon completion of this course, Students would have		

I	To understand the various practices in vermiculture. To know the needs for Vermiculture and the status of India in global market.	**K2 & K3**
II	Able to apply the techniques and practices needed for vermiculture.	**K1, K2 & K4**
III	To know the difficulties in Vermiculture and be able to propose plans against it.	**K5 & K6**

K1- Remember; **K2**- Understand; **K3**- Apply; **K4**-Analyze; **K5**-Evaluate; **K6**- Create

Units	
I	Earthworms - Taxonomic position, external features, Reproductive system-Male & Female copulation, fertilization and cocoon formation. Vermitechnology- Definition, history, growth and development in India.
II	Vermiculture - definition, common species for culture; Environmental parameters; culture methods - indoor and outdoor cultures - monoculture and polyculture - merits and demerits.
III	Vermicomposting of wastes in field pits, ground heaps, tank method, roof shed method, static pile windrows, top fed windrows, wedges & bin method, harvesting the vermicompost, storage.
IV	Applications of vermiculture - Vermiculture Bio-technology, vermicomposting, use of vermi-castings in organic farming / horticulture, earthworms for management of municipal/selected biomedical solid wastes; as feed/bait for capture/culture fisheries; forest regeneration.
V	Potentials and constraints for vermiculture in India. Marketing the products of vermiculture - quality control, market research, marketing techniques – creating the demand by awareness and demonstration, advertisements, packaging and transport, direct marketing. Economic importance of Earthworms.

Reading list

1. Sultan Ahmed Ismail, 2005. The Earthworm Book, Second Revised Edition. Other India Press, Goa, India.
2. Bhatnagar & Patla, 2007. Earthworm vermiculture and vermin-composting, Kalyani Publishers,New Delhi
3. Mary Violet Christy, 2008. Vermitechnology, MPJ Publishers, Chennai.
4. Aravind Kumar, 2005.Verms & Vermitechnology, A.P.H. Publishing Corporation, New Delhi.
5. Ismail, S.A., 1997. Vermitechnology, The biology of earthworms, Orient Longman, India.

Recommended texts

1. https://agritech.tnau.ac.in/sericulture/
2. https://www.agrifarming.in/vermiculture-process-techniques-worm-farming
3. 11. Edwards, C.A., and Bother, B., 1996. Biology of earthworms, Chapman Hall Publication company.

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

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

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INTERNSHIP/ FIELD SURVEY/ INDUSTSRIAL ACTIVITY

Internship/ Field Survey/ Industrial Activity **Paper Code: 23PZOI01**

Credits: 2

Course Objectives:		
The main objectives of this course are:		
1.	To gain research knowledge.	
2.	To know how to execute independent research.	
Course I	**:**	**Internship/ Field Survey/ Industrial Activity**
Course title	**:**	**Internship/ Field Survey/ Industrial Activity**
Credits	**:**	**2**
Pre-requisite:		
To gain research knowledge and to know how to execute independent research.		
Expected Course Outcome:		
Upon completion of this lab course, the students		
1.	At the completion of this course, students will be able to do independent research at national and international standard.	K3, K4, K5, K6

K1- Remember; **K2**- Understand; **K3**- Apply; **K4**-Analyze; **K5**-Evaluate; **K6**- Create

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PERIYAR UNIVERSITY

DEPARTMENT OF ZOOLOGY

Salem-636011, Tamil Nadu

M.Sc. Zoology Course - SEMESTER-IV

(This syllabus is applicable to the students who are admitted on or after 2023-2024 academic year onwards)

IMMUNOLOGY

Core Paper-11 **Paper Code: 23PZOC11**

Total Contact Hours: 72 **Credits: 5** **Weekly Contact Hours: 6**

Course Objectives:		
The main objectives of this course are:		
1.	To impart conceptual understanding of functional organization of immune system and its responsiveness in health and disease.	
2.	To enable a successful performance in Immunology component of CSIR-UGC NET.	
Course I	**:**	**Core XI**
Course title	**:**	**Immunology**
Credits	**:**	**5**

Pre-requisite:
Students would have basic knowledge in animal science, particularly functional anatomy, cell biology and developmental biology.

Expected Course Outcome:		
Students would have acquired clear knowledge on		
1.	Various basic concepts in immunology and organization of immune systems.	K2
2.	Mechanisms of immune response in health and their defects in various diseases.	K2 & K4
3.	The application of immunological principles in biomedical sciences including blood transfusion, tissue grafting and organ transplantation.	K3 & K5
4.	Vaccinology and its importance in disease management	K3

K1- Remember; **K2**- Understand; **K3**- Apply; **K4**-Analyze; **K5**-Evaluate; **K6**- Create

Units	
I	Introduction to Immunology and Scope of immunology, External (first line / innate) defense system. Internal (second line / acquired) immune system. cellular and humoral immune components- distribution, salient functions- primary and secondary immune responses. Types of immunity: innate and acquired types.
II	Antigens: Definition, characteristic features and classification; Antigenicity versus immunogenicity; Adjuvants: definition, types and applications.
III	Major effector components of cellular immune system: Lymphocytes - types,

	morphology, , B and T cell receptors, Antigen presenting cells: antigen processing and presentation, MHC molecules and their immunologic significance
IV	Humoral immune system: Antibodies - Primary structure, classification, variants and antigen-antibody interactions; Structural and functional characteristics of various antibody classes. Complement system - Components, three major activation pathways. Definition and salient functional features of Cytokines, Interleukins and Interferons.
V	Diseases and immune responses: Hypersensitivity: definition, Types I to IV and immune manifestations; Auto-immune diseases and Immunodeficiency diseases: types including SCID and consequences; Viral (HIV). Vaccines: types, preparations, efficacies and recent developments.

Reading list

1. Kuby, J. 1997. Immunology. W. H. Freeman & Co., New York, pp-670.
2. Male, D. J. Brostoff, D. B. Roth and I. Roitt. 2006. Immunology (7th edition), Mosby / Elsevier, Philadelphia, pp-472
3. Abbas, A. K and A. H. Lichtman. 2007. Cellular and Molecular Immunology (6th edition), W. B. Saunders, Philadelphia, pp-564
4. Coica, R. Sunshine, G. 2015. Immunology (Seventh Edition), Wiley Blackwell, UK, pp-406.

Recommended texts

1. Weir, D.M and J. Stewart. 1997. Immunology, Churchill Livingstone, London, pp-362
2. Janeway, C.A and P. Travers. 1997. Immunology, Garland Publ. Inc., London, pp-904
3. Peakman,M and D. Vergani. 1997. Basic and Clinical Immunology, Churchill Livingstone, London, pp-366
4. Parham, P. 2009. The Immune System (Third Edition), Garland Science, USA, pp-506
5. Weissman, I. Hood, L. Wood, W. 1978. Essential Concepts in Immunology, the Benjamin/Cummings, California, pp-165.
6. Hood, L. Weissman, I. Wood, W. Wilson, J. 1984. Immunology (Second Edition), the Benjamin/Cummings, California, pp-558.
7. Coica, R and Sunshine, G. 2009. Immunology A Short Course (Sixth Edition), John Wiley & Sons, USA, pp-391.
8. Doan, T. Melvold, R. Viselli, S. *et al*., 2013. Immunology (Second Edition), Lippincott Williams & Wilkins, Maryland, pp-376.
9. Owen, J. A. Punt, J. Stanford, S. A. 2013. Kuby Immunology (7th Edition), Macmillan, England, pp-692.

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

*S - Strong; M - Medium; L – Low

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PERIYAR UNIVERSITY

DEPARTMENT OF ZOOLOGY

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M.Sc. Zoology Course - SEMESTER-IV

(This syllabus is applicable to the students who are admitted on or after 2023-2024 academic year onwards)

ECOLOGY

Core Paper-12 **Paper Code: 23PZOC12**

Total Contact Hours: 72 **Credits: 5** **Weekly Contact Hours: 6**

Course Objectives:		
The main objectives of this course are:		
1.	Knowing the ecology and climatic changes at world level and its impact on natural resources.	
2.	Understanding the contributing factors for pollution in the environment and the ways in controlling and restoring to natural conditions	
Course I	**:**	**Core XII**
Course title	**:**	**Ecology**
Credits	**:**	**5**

Pre-requisite:		
Students should know about the fundamentals and studied the ecology of living organisms.		
Expected Course Outcome:		
On the successful completion of the course, student will be able to		
1.	Learn about the ecosystem, biotic communities and utilizing the energy processing	**K2**
2.	Study the various community and population and population control	**K2 & K3**
3.	Understand the fundamentals of climatic conditions and its impact on environment	**K2 & K6**
4.	Realizing the nature of pollution and the ways for its control/reduction	**K4 & K5**
5.	Impact of environmental studies on solid waste management	**K2 & K6**

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Units	
I	The Environment: Physical environment; biotic environment; biotic and abiotic interactions. Habitat and niche: Concept of habitat and niche; niche width and overlap; fundamental and realized niche; resource partitioning; character displacement.
II	Population ecology: Characteristics of a population; population growth curves; population regulation; life history strategies (*r* and *K* selection); concept of

	metapopulation-demes and dispersal, interdemic extinctions, age structured populations -action taken to control population explosion.
III	Species interactions: Types of interactions, interspecific competition, herbivory, carnivory, pollination, symbiosis. Community ecology: Nature of communities; community structure and attributes. Ecological succession: Types.
IV	Ecosystem: Structure and function; energy flow and mineral cycling (CNP); Structure and function of some Indian ecosystems: terrestrial (forest, grassland) and aquatic (fresh water, marine, estuarine). Bio-geographical zones of India.
V	Applied ecology: Environmental pollution; global environmental change; Conservation biology: Principles of conservation, major approaches to management, Indian case studies on conservation/management strategy (Project Tiger, Biosphere reserves).

Reading list

1. Sharma, P.D. 2009. Ecology and Environment, Rastogi Publication, India, pp-616.
2. Calabrese, E.J. 1978. Pollutants and High-Risk Groups, John Wiley, pp-286.
3. Raven, P.H. and L.R. Berg, G.B. Johnson, 1993. Environment, Saunders College Publishing, pp-579.
4. Cunningham, W. P. and B. W. Saigo, 1999. Environmental Science, McGraw Hill Boston, 5th Edition.
5. Online courses.nptel.ac.in / noc 19 - g e 23/preview
6. Class central.com/course/swayam -ecology - and environment – 14021.

Recommended texts

1. Odum, E.P. 1893. Basic Ecology, Saunders & Co., Philadelphia, pp-383.
2. Barth, R.R. 2002. Environmental Impact Assessment, New Age International Publishers, New Delhi, India, pp-425.
3. United Nations Environment Programme (UNEP). 1995. Global Biodiversity Assessment, Cambridge University Press, pp-1140.

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

*S - Strong; M - Medium; L – Low

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LAB COURSE IV
(IMMUNOLOGY AND ECOLOGY)

Core Paper-13 **Paper Code: 23PZOC13**

Total Contact Hours: 48 **Credits: 4** **Weekly Contact Hours: 4**

COURSE OBJECTIVES:

Course Objectives:		
The main objectives of this course are:		
1.	To analyze environmental parameters.	
2.	To evaluate the physiochemical content of water .	
3.	To know the methodology of immunity	
Course I	**:**	**Core XIII**
Course title	**:**	**Lab Course-IV IMMUNOLOGY AND ECOLOGY**
Credits	**:**	**4**
Pre-requisite:		
To learn on the transmission of heritable traits. To have hands on experience in handling of hormone related disorders. To study the significance of vestigial organs in humans.		
Expected Course Outcome:		
On the successful completion of the course, student will be able to**:**		

1.	Understand the physico chemical parameters of water	**K2, K3 & K4**
2.	Students will identify various types of blood groups	**K2 & K3**
3.	Students will learn on advance immunological tests	**K2 & K3**

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

IMMUNOLOGY

1. Demonstration of lymphoid organs
2. Histological study of spleen, thymus and lymph nodes through slides/photographs
3. Preparation of stained blood film to study various types of blood cells
4. Ouchterlony's double immune-diffusion method
5. ABO blood group determination

6. Demonstration

a) ELISA

b) Immunoelectrophoresis

ENVIRONMENTAL SCIENCE:

1. Measurement of pH in a given sample.

2. Determination of dissolved oxygen in a water sample.

3. Determination of amount of free CO2 in a water sample.

4. Determination of total alkalinity of a water sample.

5. Measurement of turbidity in a given sample of water.

6. Estimation of calcium in water sample.

7. Total count of planktons (Fresh water or marine water planktons)

8. Identification of planktons – fresh water and marine water (Qualitative)

9. Identification – Secchi disc, Rainwater gauge and Respirometer.

Text Books:

1. *Manual of Clinical Immunology*. Front Cover. *Noel R. Rose*, Herman Friedman. American Society for *Microbiology*, 1976 - Allergy and *Immunology* - 932 pages ...
2. *Manual of Clinical Laboratory Immunology*. 1997 *Rose, Noel R.*,Conway De MacArio, Everly ,Folds, James D.
3. Environmental science - A practical manual Ramesh Thatikunta, Swarajya Lakshmi and Prabhu Prasadini April 2018 Publisher: BS Publications.
4. A *Practical Manual for Ecology*. Ratna Book Distributors, Kathmandu. Zobel, D.B., Behan, M.J., Jha, P.K. and Yadav, U.R.K. (1987).

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

*S - Strong; M - Medium; L – Low

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PROJECT WORK AND VIVA VOCE

Project Work **Paper Code: 23PZOCP1**

Total Contact Hours: 108 **Credits: 7** **Weekly Contact Hours: 9**

Course Objectives:		
The main objectives of this course are:		
1.	To gain research knowledge.	
2.	To know how to execute independent research.	
Course I	**:**	**Project Work**
Course title	**:**	**Project Work and Viva Voce**
Credits	**:**	**7**
Pre-requisite:		
To gain research knowledge and to know how to execute independent research.		
Expected Course Outcome:		
Upon completion of this lab course, the students		
1.	At the completion of this course, students will be able to do independent research at national and international standard.	K3, K4, K5, K6

K1- Remember; **K2**- Understand; **K3**- Apply; **K4**-Analyze; **K5**-Evaluate; **K6**- Create

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AQUACULTURE

Elective Paper-06A **Paper Code: 23PZOE06**

Total Contact Hours: 60 **Credits: 3** **Weekly Contact Hours: 5**

Course Objectives:		
The main objectives of this course are:		
1.	Students should know basic concepts in Aquaculture.	
Course I	**:**	**Elective 06A**
Course title	**:**	**Aquaculture**
Credits	**:**	**3**
Pre-requisite:		
Students should know the fin fishes and shell fishes of commercially important candidate species.		
Expected Course Outcome:		
Upon completion of this course, Students would have		

I	To develop knowledge on the fish farm and their maintenance. Understand the methods of fish seed and feed production and develops knowledge on hatchery techniques	**K1 & K2**
II	To apply the knowledge about different culture methods in aquaculture and gain knowledge on fish and shrimp breeding techniques and larval culture	**K3 & K4**
III	Identifies the different fishes diseases, diagnosis and their management strategies. Understands Ornamental fishes and central aquaculture organizations	**K5 & K6**

K1- Remember; **K2**- Understand; **K3**- Apply; **K4**-Analyze; **K5**-Evaluate; **K6**- Create

Units	
I	Importance of aquaculture. Freshwater aquaculture- Brackishwater aquaculture- Mariculture. Topography, site selection - water quality - soil condition and quality – structure and construction of culture pond. Water quality management for aquaculture.
II	Procurement of seed from natural resources - collection methods. Artificial seed production. Induced breeding technique, larval rearing, packing and transportation. Classification of fish feed- Artificial feeds. Types, Feed - formulation - feeding methods. Live feed- Microalgae, Rotifer, Artemia and their culture.

III	Shrimp hatchery technology - Hatchery design, brood stock management, spawning, larval rearing. Shrimp culture technology - extensive culture methods semi- intensive - intensive culture methods - Brackish water fish culture. Edible and Pearl oyster culture - Types of Seaweeds - species and methods of culture – by-products
IV	Fish and Shrimp diseases and health management – infectious diseases - Bacterial, Fungal, Viral, Protozoan; Diseases diagnosis, prevention and control measures.
V	Types of ornamental fishes (freshwater and marine), their breeding behavior and biology. Setting and maintenance of Central aquaculture research organizations- CMFRI, CIBA, CIFT, CIFA, CIFE, MPEDA and its activities.

Reading list

1. Pillay, T. V. R. 1990. Aquaculture: Principles and Practices. Blackwell Scientific Publications Ltd.
2. Santhanam, R. 1990. Fisheries Science. Daya Publishing House.
3. Sinha, V.R. P. and Srinivastava, H. C. 1991. Aquaculture Productivity. Oxford and IBH Publications CO., Ltd., New Delhi.
4. Yadav, B. N. 1997. Fish and fisheries. Daya Publishing house, New Delhi.

Recommended texts

1. Das M. C. and Patnaik, P. N. 1994 Brackish water culture. Palani Paramount Publications, Palani, T. N.
2. Day, F 1958. Fishes of India , VoL I and Vol. II. William Sawson and Sons Ltd., London.
3. Jhingran, V. G. 1991. Fish and Fisheries of India. Hindustan Publishing Co., India
4. Maheswari. K. 1983 Common fish disease and their control. Institute of Fisheries Education, Powarkads (M.P).

Mapping with Programme Outcomes*										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	M	M	S	S	S	M	M	S
CO2	S	S	S	M	S	S	S	M	S	S
CO3	S	S	S	S	S	S	S	S	S	M
CO4	S	S	M	S	S	S	S	M	M	S
CO5	S	S0	M	S0	M	S	M	L	S	S

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

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ANIMAL BEHAVIOUR

Skill Enhancement Course-01 **Paper Code: 23PZOSE1**

Total Contact Hours: 48 **Credits: 4** **Weekly Contact Hours: 4**

Course Objectives:		
The main objectives of this course are:		
1.	Students should understand basic concepts in Animal behaviour.	
Course I	**:**	**Skill Enhancement Course [SEC] - 1**
Course title	**:**	**Animal behaviour**
Credits	**:**	**4**
Pre-requisite:		
Students should be aware of ecology and the animals in their respective environments.		
Expected Course Outcome:		
Upon completion of this course, Students would have		

I	Recall and record genetic basis and evolutionary history of behaviour.	**K1 & K2**
II	Analyse and identify innate, learned and cognitive behaviour and differentiate between various mating systems.	**K3 & K4**
III	Classify movement and migration behaviors and explain environmental influence upon behavior.	**K1, K4 & K5**

K1- Remember; **K2**- Understand; **K3**- Apply; **K4**-Analyze; **K5**-Evaluate; **K6**- Create

Units	
I	Single and Polygenic inheritance of behaviour, Heritability of behaviour, Natural selection and behaviour, Frequency distribution of phenotypes, Darwinian fitness, Evolution of adaptive strategies.
II	Sexual selection, Altruism, Sexual strategy and social organisation, Animal perception, Neural control of behaviour, Sensory processes and perception, Visual adaptations to unfavourable environments.
III	Co-ordination and Orientation, Homeostasis and Behaviour, Physiology and Behaviour in changing environments, Animal Learning, Conditioning and Learning, Biological aspects of learning, Cognitive aspects of learning.
IV	Instinct and learning, Displacement activities, Ritualization and Communication, Decision making behaviour in Animals, Complex behaviour of honey bees, Languages and mental representation, non-verbal communication in human, mental images and Intelligence.
V	Concept of central and peripheral clock system; Circadian pacemaker system in invertebrates, Photoreception and photo- transduction; Molecular bases of seasonality; The relevance of biological clocks for human welfare - Clock function (dysfunction).

Reading list

1. David McFarland, 1985.Animal Behaviour, Longman Scientific & Technical, UK.576pp.

2. Harjindra Singh, 1990. A Text Book of Animal Behaviour, Anomol Publication, 293pp.
3. Hoshang S. Gundevia and Hare Goving Singh, 1996. Animal Behaviour, S.Chand&Co, 280pp.
4. Shukla, J. P 2010, Fundamentals of Animal Behaviour, Atlantic, 587pp.
5. Vinod Kumar, 2002. Biological Rhythms. Narosa Publishing House, Delhi.

Recommended texts

1. Michael D. Breed and Janice Moore, 2012. Animal Behaviour, Academic Press, USA, 359pp.
2. Aubrey Manning and Martin Stamp Dawkins, 2012. An Introduction to Animal Behaviour, 6th Edition, Cambridge University Press, UK. 458pp.
3. Davis E.Davis, 1970. Integral Animal Behaviour, Mac Millan Company,London, 118pp.
4. Jay, C. Dunlap, Jennifer, J. Loros, Patricia J. De Coursey (ed). 2004. Chronobiology Biological time Keeping, Sinauer Associates Inc, Publishers, Sunderland, MA.

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

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

VALUE-ADDED COURSES

(Any one)

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3D CELL CULTURE AND TISSUE ENGINEERING

(Extra Credit Paper: Online Mode Certificate Course)

Value Added Course-01 **Paper Code: 23PZOVA01**

Total Contact Hours: 24 **Credits: 2** **Weekly Contact Hours: 2**

Course Objectives:		
The main objectives of this course are:		
1.	Main objective is to provide in-depth knowledge on the vector insects that cause various diseases to human and animals	
Course I	**:**	**Value Added Course [VAC] - I**
Course title	**:**	**3D Cell Culture and Tissue Engineering**
Credits	**:**	**2**
Pre-requisite:		
Main objective is to provide in-depth knowledge on the vector insects that cause various diseases to human and animals		

Expected Course Outcome:		
Upon completion of this course, Students would have		
I	Strong foundation on the disease transmitting insects will be laid.	**K1 & K2**
II	You will be an expert and public advisor in insect transmitted diseases.	**K3 & K4**
III	Study on this topic fits you for leading pesticide companies and advisor for insect pest management.	**K1, K4 & K5**
IV		**K3 & K4**
V		**K4 & K5**

K1- Remember; **K2**- Understand; **K3**- Apply; **K4**-Analyze; **K5**-Evaluate; **K6**- Create

Units	
I	History and Scope for Animal cell culture. Evolution of 3D cell culture techniques. Comparison of 2D and 3D cell culture. Applications of Cell culture in Drug discovery, Disease diagnosis and treatment.
II	Laboratory setup of 3 D cell culture – Principle and applications of Microfluidic System, CO_2 incubator, Live Cell Imaging Microscope and Confocal Microscope. Significance of 3D Bioprinting and types of Bio-inks.
III	3D Cell culture methods: Hanging drop, Non-adhesive wells, Rotating wall vessel, Micro-fluidics, Magnetic levitation, Aqueous two-phase system. Advantage and disadvantage of

	3D cell culture methods.
IV	Hydrogel preparation and utilization for Scaffold culture, scaffold-free culture, culturing on natural polymers and synthetic polymers. Tissue Engineering: Types and Applications.
V	Applications of 3D Cell Culture: Drug Designing, Orgonoids, Disease modeling, Bio-banking and Precision Medicine, Regenerative Medicine and Assembloids. Current Scenario of Organ on chip and human on chip research in tissue engineering and Translational medicine.

Reading list

1. Mark J. Suto et al., 2012. 3D Cell Culture. First Edition, Elsevier Publication, USA.
2. Jose A. Andrades, 2013. Regenerative Medicine and Tissue Engineering, Intech open access.

Recommended texts

1. Xiaowen Wu et al., 2021. Recent Advances in Three-Dimensional Stem Cell Culture Systems and Applications. Stem Cell International.
2. Amanda Marchini and Fabrizio Gelain, 2021. Synthetic scaffolds for 3D cell cultures and organoids: applications in regenerative medicine. Crit Rev Biotechnol. 1-19. 2021. 1932716.

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

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

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(This syllabus is applicable to the students who are admitted on or after 2023-2024 academic year onwards)

GENOTOXICOLOGY

(Extra Credit Paper: Online Mode Certificate Course)

Value Added Course-02 **Paper Code: 23PZOVA02**

Total Contact Hours: 24 **Credits: 2** **Weekly Contact Hours: 2**

Course Objectives:		
The main objectives of this course are:		
1.	Students should understand basic concepts in Genotoxicology.	
Course II	**:**	**Value Added Course [VAC] - II**
Course title	**:**	**Genotoxicology**
Credits	**:**	**2**
Pre-requisite:		
Students should understand basic concepts in Genotoxicology.		
Expected Course Outcome:		
Upon completion of this course, Students would have		
I	Students can understand genetic toxicology, genetic damages, genotoxic agents and their biological effects in humans.	**K1 & K2**
II	Students can understand different genotoxic carcinogens and various assays in genetic toxicity.	**K3 & K4**
III	Various genetic tests used in chromosomal abnormalities will be known.	**K1, K4 & K5**
IV	Assays to study gene mutations including mammalian cells in culture.	**K3 & K4**
V	Genotoxic agents in agriculture especially pesticides using various plant assays will be known.	**K4 & K5**

K1- Remember; **K2**- Understand; **K3**- Apply; **K4**-Analyze; **K5**-Evaluate; **K6**- Create

Units	
I	Role of genetic toxicology in health effect testing – DNA damage and repair – Mutagenesis and carcinogenesis – Consequence of genotoxicity in humans.
II	Classification of genotoxic agents – Genotoxic carcinogens. *In vitro* clastogenecity – mammalian chromosomal aberration assay; micronucleus assay (human lymphocytes); *In vivo* clastogenicity – rodent dominant lethal test and mouse heritable translocation assay.
III	Chromosome aberration – mammalian spermatogonial chromosome aberration test, *in vivo* chromosomal aberration tests – rodent bone marrow chromosomal effects. DNA damage – Sister chromatid exchange in mammalian cells.
IV	Gene mutation in *Saccharomyces cervisiae*; *in vitro* cytogenetic assay – mitotic recombination in *S. cerevisiae*. Comet assay, Mammalian cells in culture – CHO *HGPRT* gene mutation assay, V79 *HGPRT* gene mutation assay.
V	Genotoxic agents in agro-ecosystem – mutagenicity and carcinogenicity of pesticides.

	Plant dependent mutation assays – *Allium cepa* assay, *Vicia faba* assay.

Reading list

1. Brusick, D. 2013. Principles of Genetic Toxicology. Springer Publications.
2. Proudlock, R. 2016. Genetic Toxicology Testing – A Laboratory Manual. Elsevier-Academic Press.

Recommended texts

1. Fleck, R.F. 2012. Genetic Toxicology: An Agricultural Perspective. Springer Verlag.
2. EHC 240: Principles for Risk Assessment of Chemicals in Food. A joint publication of the Food and Agriculture Organization of the United Nations and the World Health Organization. 2009. 752pp.

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

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

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PERIYAR UNIVERSITY

DEPARTMENT OF ZOOLOGY

Salem-636011, Tamil Nadu

M.Sc. Zoology Course

(This syllabus is applicable to the students who are admitted on or after 2023-2024 academic year onwards)

INSECT- HOST INTERACTION

(Extra Credit Paper: Online Mode Certificate Course)

Value Added Course-03 **Paper Code: 23PZOVA03**

Total Contact Hours: 24 **Credits: 2** **Weekly Contact Hours: 2**

Course Objectives:		
The main objectives of this course are:		
1.	To gain knowledge about the insect plant interaction communication	
Course III	:	**Value Added Course [VAC] - III**
Course title	**:**	**Insect-Host Interaction**
Credits	**:**	**2**
Pre-requisite:		
To gain knowledge about the insect plant interaction communication		
Expected Course Outcome:		
Upon completion of this course, Students would have		

I	At the end of the semester, students will be able to understand pest insects	**K1 & K2**
II	Gain knowledge about monitoring insect pests and control measures	**K3 & K4**
III	Transmission of diseases and pest management	**K1, K4 & K5**
IV	Application of vector management	**K3 & K4**
V	Various types of insect vectors and analysis of component	**K4 & K5**

K1- Remember; **K2**- Understand; **K3**- Apply; **K4**-Analyze; **K5**-Evaluate; **K6**- Create

Units	
I	Classification of Insects. External morphology of Insects- Life cycle of insects – Types of metamorphosis.
II	Insects as vectors of plant pathogens. Important insect vectors and their characteristics; mouth parts and feeding processes of important insect vectors. Efficiency of transmission.
III	Transmission of plant viruses and fungal pathogens. Relation between viruses and their vectors.
IV	Transmission of bacterial pathogens by insects. Epidemiology and management of insect transmitted diseases through vector management.
V	Cultural, Chemical, Mechanical, biological pest management.

Reading list

1 Aslam Khan Md, Wasim Ahmad, 2019.Microbes for Sustainable Insect Pest Management, Springer publications

2 Gullan, P.J., Cranston, P.S., 2014. The Insects: An Outline of Entomology, 5thEdition, Wiley publications

3 Snodgrass, 2004. Principles Of Insect Morphology, Cbs Publishers, India.

4 Chapman, R.F., Simpson, S.J., Douglas, A.E., 2013.The Insects: Structure And Function, 5th Edition, Cambridge University Press.

Recommended texts

1. Imms, A.D., Richards, O.W., Davies, R.G., 1977. IMMS' General Textbook of Entomology, Structure, Physiology and Development. Springer publications
2. Oakeshott, J., Whitten, M.J., 1993. Molecular Approaches to Fundamental and Applied Entomology. Springer publications
3. Ananthakrishnan, T.N., 2007.Dimensions of Molecular Entomology, Universities Press, Hyderabad, India
4. Basu AN. 1995. Bemisiatabaci (Gennadius) - Crop Pest and Principal Whitefly Vector of Plant Viruses. Oxford & IBH, New Delhi.
5. Harris KF & Maramarosh K. (Eds.).1980. Vectors of Plant Pathogens. Academic Press, London.
6. Maramorosch K & Harris KF. (Eds.). 1979. Leafhopper Vectors and Plant Disease Agents. Academic Press, London.
7. Youdeovei A & Service MW. 1983. Pest and Vector Management in the Tropics. English Language Books Series, Longman, London.

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

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

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M.Sc. Zoology Course

(This syllabus is applicable to the students who are admitted on or after 2023-2024 academic year onwards)

MEDICAL ENTOMOLOGY

(Extra Credit Paper: Online Mode Certificate Course)

Value Added Course-04 **Paper Code: 23PZOVA04**

Total Contact Hours: 24 **Credits: 2** **Weekly Contact Hours: 2**

Course Objectives:		
The main objectives of this course are:		
1.	Main objective is to provide in-depth knowledge on the vector insects that cause various diseases to human and animals	
Course IV	**:**	**Value Added Course [VAC] - IV**
Course title	**:**	**Medical Entomology**
Credits	**:**	**2**
Pre-requisite:		
Main objective is to provide in-depth knowledge on the vector insects that cause various diseases to human and animals		

Expected Course Outcome:		
Upon completion of this course, Students would have		
I	Strong foundation on the disease transmitting insects will be laid.	**K1 & K2**
II	You will be an expert and public advisor in insect transmitted diseases.	**K3 & K4**
III	Study on this topic fits you for leading pesticide companies and advisor for insect pest management.	**K1, K4 & K5**
IV		**K3 & K4**
V		**K4 & K5**

K1- Remember; **K2**- Understand; **K3**- Apply; **K4**-Analyze; **K5**-Evaluate; **K6**- Create

Units	
I	**Introduction to Disease Transmitting Insects:** Classification of Vectors - Human vectors and Animal vectors. Vector borne diseases and control. Forensic application of insects
II	**Insect morphology and metamorphosis**: Structure of egg, larvae, pupa and adult insects. Types of mouthparts, Antennae, wings and legs. Types of metamorphosis in insects.
III	**Mosquitoes and mosquito borne diseases** - Mosquito life cycle. Mosquito feeding behavior. Anopheles, Aedes and Culex.
IV	**Other Vectors and vector borne diseases:** Sand files, Bugs – Human bugs, lice & fleas.

	Life cycle of Housefly and Cockroach.
V	**Vector Control** –Integrated vector control program. Chemical, Physical and Botanical control. Synthesis of Metal Nanoparticles for insect vector control.

Reading list

1. Mike Service, 2008. Medical Entomology for Students. Cambridge University Press, R. F. Chapman, 1998. The *Insects:* Structure and Function. Cambridge University Press.
2. Isaac Ishaaya, Subba Reddy Palli, A. Rami Horowitz, 2012. Advanced Technologies for Managing Insect Pests. Springer.
3. B.F. Eldridge, J.D. Edman, 2003. Medical Entomology: A Textbook on Public Health and Veterinary Problems Caused by Arthropods**.** Springer.

Recommended texts

1. Chapman, M. W. Service, Hall 1993. Mosquito Ecology: Field Sampling Methods. Chapman & Hall publishers.
2. Arun Kumar; Heidi M. Mansour; Adam Friedman; Eric R. Blough 2013. Nanomedicine in Drug Delivery. CRC Press.
3. B. K. Tyagi, 2008. Vector-borne diseases: epidemiology and control. Scientific Publishers.

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

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

ADD-ON COURSES

(Any one)

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PERIYAR UNIVERSITY

DEPARTMENT OF ZOOLOGY

Salem-636011, Tamil Nadu

M.Sc. Zoology Course

(This syllabus is applicable to the students who are admitted on or after 2023-2024 academic year onwards)

PCR TECHNOLOGY

(Extra Credit Paper: Online Mode Certificate Course)

Add-On Course-01 **Paper Code: 23PZOAO01**

Total Contact Hours: 24 **Credits: 2** **Weekly Contact Hours: 2**

Course Objectives:		
The main objectives of this course are:		
1.	To provide knowledge on the concept of PCR and its uses and to identify various diseases using PCR Technology.	
Course I	**:**	**Add-On Course [AOC] - I**
Course title	**:**	**PCR Technology**
Credits	**:**	**2**
Pre-requisite:		
To provide knowledge on the concept of PCR and its uses and to identify various diseases using PCR Technology.		

Expected Course Outcome:		
Upon completion of this course, Students would have		
I	Understand the basic principle of PCR reaction and types and uses of PCR Machine.	**K1 & K2**
II	Diagnose various diseases causing culprits at gene level.	**K3 & K4**
III	Understand various applications of PCR techniques in industries & Clinical Laboratories.	**K4 & K5**
IV	Processing of Biopsy samples using PCR Kit.	**K4**
V	Become an entrepreneur by developing PCR kit.	**K4 & K5**

K1- Remember; **K2**- Understand; **K3**- Apply; **K4**-Analyze; **K5**-Evaluate; **K6**- Create

Units	
I	History, scope and future prospects of polymerase chain reaction- Invention of PCR Machine and advances in PCR Instrumentation, Working principle of PCR.
II	Types and Evolution of PCR: qPCR, RT-PCR, Ong PCR, Nested PCR, Inverse PCR, Hot Start PCR, Multiplex PCR, and Solid State PCR.
III	Sample preparation and handling of chemicals and reagents in PCR laboratory- Bio-safety measures, Good Laboratory Practices.
IV	Processing of biopsy samples-DNA/RNA isolation and identification of DNA/RNA fragments-Agarose and Polyacrylamide Gel Electrophoresis.

V	Applications of PCR- Pros and cons of PCR technique –Identification of communicable diseases (Bacterial and viral disease), determination of non-communicable diseases (Cancer and neurological disorders).

Reading list

1. Kannan S, Krishnan M, Thirumurugan, R, Archunan G, 2012. Methods in Molecular Biology, SUV Press.
2. Sarah Maddocks and Rowena Jenkins 2016.Understanding PCR 1st Edition A Practical Bench-Top Guide Academic Press.

Recommended texts

1. Mark A. Behlke, Kornelia Berghof-Jäger, Tom Brown , 2019. Polymerase Chain Reaction: Theory and Technology Publisher: Caister Academic Press.
2. Thomas Weissensteiner Tania Nolan Stephen A. Bustin , Hugh G. Griffin Annette Griffin 3003 PCR Technology: Current Innovations, Second Edition (Weissensteiner, PCR Technology) CRC Press
3. Henry A. Erlich PCR Technology: Principles and Applications for DNA Amplification Palgrave Macmillan, London

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

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

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PERIYAR UNIVERSITY

DEPARTMENT OF ZOOLOGY

Salem-636011, Tamil Nadu

M.Sc. Zoology Course

(This syllabus is applicable to the students who are admitted on or after 2023-2024 academic year onwards)

ORNITHOLOGY

(Extra Credit Paper: Online Mode Certificate Course)

Add-On Course-02 **Paper Code: 23PZOAO02**

Total Contact Hours: 24 **Credits: 2** **Weekly Contact Hours: 2**

Course Objectives:		
The main objectives of this course are:		
1.	To know about the diversity of birds in and around Periyar University.	
Course II	**:**	**Add-On Course [AOC] - II**
Course title	**:**	**Ornithology**
Credits	**:**	**2**
Pre-requisite:		
To know about the diversity of birds in and around Periyar University.		
Expected Course Outcome:		
Upon completion of this course, Students would have		

I	Identify the birds present in and around Periyar University.	**K1, K2 & K3**
II	Learn on devices used for bird watching.	**K2 & K3**
III	Recognize the birds through the calls emitted by them.	**K4 & K5**
IV	Understand the conservation status of birds in India	**K3 & K4**
V	To get placement in conservation agencies.	**K4 & K5**

K1- Remember; **K2**- Understand; **K3**- Apply; **K4**-Analyze; **K5**-Evaluate; **K6**- Create

Units	
I	Introduction: Ornithology- Evolution and Classification of birds- Importance and Conservation of birds- Bird as a pollinator, as a controller of insects and pests- Bird hotspots in India.
II	Bird Habitats Bird Counting/ Census-Bird Watching: Identification of Birds in flight, Identification through Calls and songs. Equipments used for Bird Watching.
III	Breeding behaviour of birds- Territoriality, Nest building behaviour, Egg laying and clutch size, Incubation and feeding young, weaning of young one and Brood parasitism.
IV	Activity recording and Ethogram- Flying, Walking, Eating, Perching on trees or wires, Drinking water, Singing, Nesting, Preening, Moulting, Bathing, Dust bath, Flocking, Roosting etc.,
V	Bird Migration: Causes of Migration-Origin of Migration-Significance of Migration-Disadvantages of Migration. Great Ornithologists of India and World & Societies concern

	with the conservation of birds.

Reading list

1. Ali, S., Ripley, B.S 1990. A hand book of Birds of Indian sub-continent, Oxford University Press.

Recommended texts

1. Grimmet, R., Inskipp, T aand Nameer, P.O. 2007. Birds of southern India, BNHS, Bombay.
2. Kazmierezak, K and van Perlo, B. 2000. A field guide to the birds of Indian subcontinent, Yale University Press, USA.

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

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

EXPANSION FOR PROGRAM OBJECTIVES (POs)

PO1 : Will get opportunity to work at Zoological Survey of India as a Taxonomist, Animal Conservator / Wild Life Warden

PO2 : To undertake research in the broad spectrum of Zoology at advance level and boost-up the knowledge to appear for CSIR NET/SET.

PO3 : To become Teacher / Professor / academician / Government Employee / Scientist in Pesticide industries / Zoological Museum / Zoological Parks

PO4 : Supports to face competitive exams and will be an entomologist, scientist in various funding agencies, Forensic Science Laboratories.

PO5 : Will become entrepreneur to start Sericulture, Apiculture, Oyster culture, Fishery industries and clinical laboratories.

12. Credit Calculation

Method of teaching	Hours	Credits
Lecture	1	1
Tutorial/Demonstration	1	1
Practical/Internship/self-Learning	2	1