



பெரியார் பல்கலைக்கழகம்

PERIYAR UNIVERSITY  
DEPARTMENT OF ZOOLOGY

Salem-636011, Tamil Nadu

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

SUTHANTHRA THIRUNAL AMUDHA PERUVIZHA  
TAMIL NADU



**M.Sc. ZOOLOGY PROGRAMME**  
**[Choice Based Credit System (CBCS)]**

**OBE REGULATIONS AND SYLLABUS**  
*(Effective from the academic year 2022- 2023 and thereafter)*

# **M. Sc. ZOOLOGY**

## **OBE REGULATIONS AND SYLLABUS**

(With effect from the academic year 2022-2023 onwards)

### **1. Preamble**

Department of Zoology was started in the year 2012 with M.Sc., M.Phil., and Ph.D. courses. This Department strives to create a suitable 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. 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 conducive atmosphere that enables teaching and research to attain high levels of excellence 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. Further explores the impact of climate change on insect diversity and bat behavior, Cultivation to commercialization of earthworms etc. In addition to the routine work, the Faculty members are actively engaging in research and also have collaborate with other Universities/ Research Institutions at national as well as International level.

***Teaching and Research are the Two Eyes” of the Department to promote future Zoologists from Periyar University.***

#### 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.

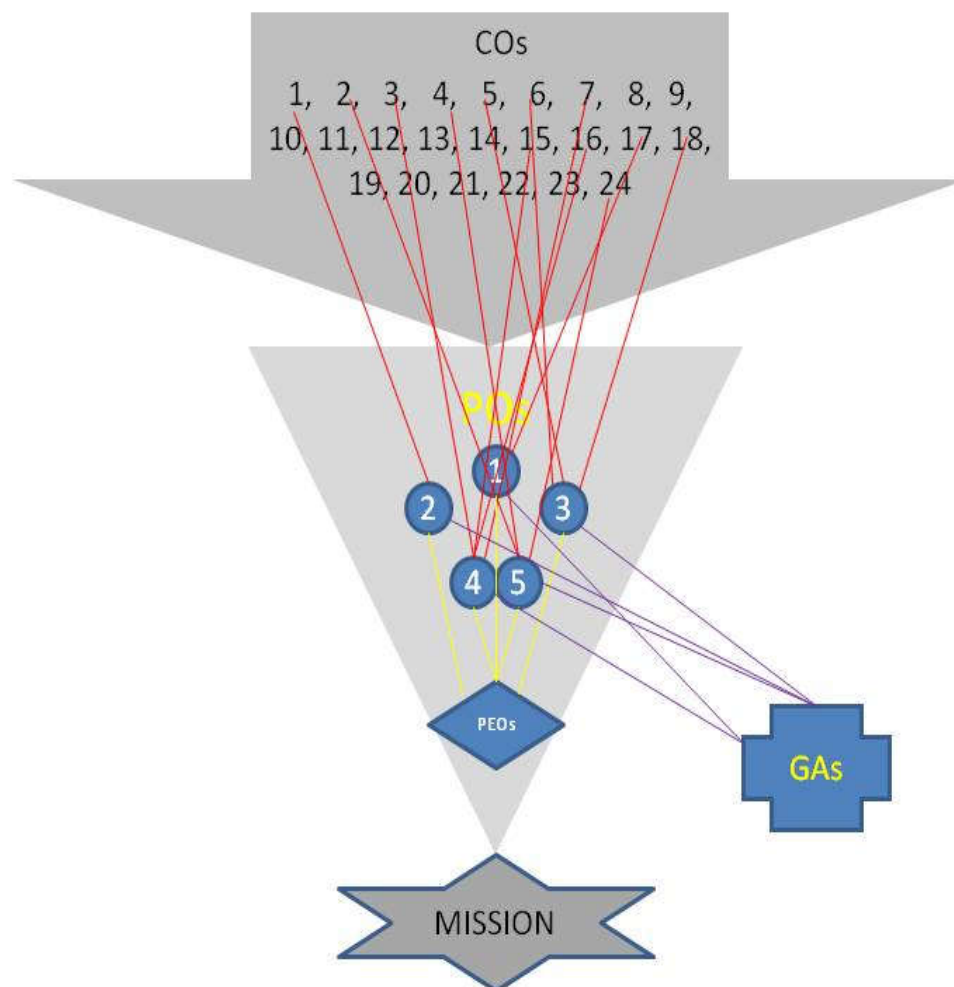
##### **Programme Specific Objectives**

- 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, Aquaculturist, Sericulture Specialist as an entrepreneur. There is an opportunity for our young minds to serve as conservators, Educators as teacher, professors etc.



Mission is the Programme Specific Objectives, GAs – Graduate attributes (general)

## 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. CBCS- Structure of the Programme

The programme structure comprises of two parts.

Course Component	No. of Courses	Hours of Learning	Marks	Credits
<b>Part A (Credit Courses)</b>				
Core Courses	15	1080 (72 hrs per course)	1500	60
Core Practical	3	324 (108 hrs per course)	300	12
Elective Courses	4/8	288 (72 hrs per course)	400	16
Supportive Courses	1	72 (72 hrs per course)	100	4
Supportive SWAYAM MOOC Course	1	-	-	2
Human Rights	1	-	-	2
<b>Sub total</b>	<b>25</b>	<b>1764</b>	<b>2300</b>	<b>96</b>
Project Work	1	270 (18 hrs per week/course)	200	4
Field visit	1	-	50	-
Industry oriented course (Sericulture)	1	36 (36 hrs per course)	100	1
Seminar Paper	1	-	-	1
<b>Total</b>	<b>29</b>	<b>2070</b>	<b>2650</b>	<b>102</b>
<b>Value added Courses (Certificate will be issued separately – Through Online Mode)*</b>				
3D Cell Biology & Tissue Engineering	1	36 hrs per course	100	2
Poultry Science	1	36 hrs per course	100	2
Genotoxicology	1	36 hrs per course	100	2
Regenerative Medicine	1	36 hrs per course	100	2
Insect-Host Interaction	1	36 hrs per course	100	2
Medical Entomology	1	36 hrs per course	100	2
<b>Total</b>	<b>6</b>	<b>--</b>	<b>600</b>	<b>12</b>
<b>Add-on Courses (Certificate will be issued separately- Through Online Mode)*</b>				
Vermiculture	1	36 hrs per course	100	2
PCR Technology	1	36 hrs per course	100	2
Ornithology	1	36 hrs per course	100	2
<b>Total</b>	<b>3</b>	<b>--</b>	<b>300</b>	<b>6</b>
<b>Internship (Compulsory)</b>				
Internship/ Summer training	1	15 to 20 days training in other institute during the Vacation (before third semester)	100	1

\*Students choice to earn extra credits

**9. Curriculum structure for each semester as per your courses alignment and CBCS –  
Scheme of Examinations semester wise structure for the students admitted in the  
academic year 2022–2023 onwards**

Subject code	Title of the paper	Weekly contact hrs	Credits	Internal Marks	External Marks	Total Marks
<b>SEMESTER-I</b>						
22ZOOC01	Invertebrates	4	4	25	75	100
22ZOOC02	Chordates	4	4	25	75	100
22ZOOC03	Cell and Molecular Biology	4	4	25	75	100
22ZOOC04	Biochemistry	4	4	25	75	100
22ZOOC05	Molecular Genetics	4	4	25	75	100
22ZOOP01	Lab Course-I (Core papers I-V)	6	3	40	60	100
22ZOEE01	Elective: Microbiology	4	4	25	75	100
22ZOEE02	Elective: Bioethics and Biosafety					
	Total	<b>30</b>	<b>27</b>	<b>190</b>	<b>510</b>	<b>700</b>
<b>SEMESTER-II</b>						
22ZOOC06	Animal Physiology	4	4	25	75	100
22ZOOC07	Developmental Biology	4	4	25	75	100
22ZOOC08	Evolution	4	4	25	75	100
22ZOOC09	Behavioural Ecology	4	4	25	75	100
22ZOOC10	Stem Cell Biology	4	4	25	75	100
22ZOOP02	Lab Course-II (Core papers VI-X)	6	3	40	60	100
22ZOEE03	Elective: Vermitechnology					
22ZOEE04	Elective: Bat Ecology	4	4	25	75	100
MOOC Course	Swayam – Mooc Course	-	-	-	-	-
22ZOOI01	Internship (Compulsory – during the vacation period between 15-20 days)	-	-	-	-	-
22XXH01	Human Rights	-	2	25	75	100
	Total	<b>30</b>	<b>29</b>	<b>215</b>	<b>585</b>	<b>800</b>
<b>SEMESTER-III</b>						
22ZOOC11	Immunology	4	4	25	75	100
22ZOOC12	Animal Cell Culture and Nanobiotechnology	4	4	25	75	100
22ZOOC13	Principles of Ecology	4	4	25	75	100
22ZOOC14	Biology of Cancer	4	4	25	75	100
22ZOOP03	Lab Course-III (Core papers XI-XIV)	6	3	40	60	100
22ZOEE05	Elective: Aquaculture and Fishery Biology					
22ZOEE06	Elective: Medical Parasitology	4	4	25	75	100
22ZOOS01	Supportive: Cancer Therapeutics					
22ZOOS02	Supportive: Vermiculture & Vermicomposting	4	4	25	75	100
	Total	<b>30</b>	<b>27</b>	<b>190</b>	<b>510</b>	<b>700</b>
<b>SEMESTER-IV</b>						
22ZOOC15	Research Methodology	4	4	25	75	100
22ZOEE07	Elective: Molecular Oncology	4	4	25	75	100
22ZOEE08	Elective: Statistical Tools for Life Sciences					
22ZOOFV01	Field Visit/Industrial Visit (before completion of the program)	--	-	50	--	50
22ZOOIO01	Industry oriented paper - Sericulture	2	1	25	75	100
22ZOOPR01	Project work and <i>viva voce</i>	19	4	100	100(50+50) Int+Ext	200
22ZOOSP01	Seminar Paper	1	1	-	50	50
	Total	<b>30</b>	<b>14</b>	<b>225</b>	<b>375</b>	<b>600</b>
	<b>CUMULATIVE TOTAL</b>	<b>120</b>	<b>97</b>	<b>820</b>	<b>1980</b>	<b>2800</b>

Only one Soft core /and one Elective paper should be selected / semester.

\*Students should submit Field Visit/Industrial Visit Report and to be evaluated by the faculty deputed by the Head of the Department.

## 10. 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.

## 11. 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<sup>th</sup> week, the second in the 11<sup>th</sup> week, third in the 16<sup>th</sup> week and the end – semester examination in the 19<sup>th</sup> 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	K1 to K6 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	<i>viva voce</i>	20
Total		60

**12. 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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**M.Sc. Zoology Course - SEMESTER-I**

(This syllabus is applicable to the students who are admitted on or after 2022-2023 academic year onwards)

**Core Paper-01**

**Total Contact Hours: 72**

**Credits: 4**

**Paper Code: 22ZOOC01**

**Weekly Contact Hours: 4**

### INVERTEBRATES

#### **Course objectives:**

- The students will classify the invertebrate upto order level.
- Understand the feeding and respiratory mechanisms in invertebrates.
- Learn the mechanism of chemical coordination and reproduction in invertebrates.

#### **Course outcome:**

At the end of the semester, students will be able to

- Classify invertebrates based on their morphology.
- Know the feeding mechanisms of invertebrates.
- Get the knowledge about chemical coordination and reproduction in invertebrates.

**UNIT I:** General Classification of invertebrates upto order level. Importance of molecular taxonomy in identification of invertebrates. Minor Phyla: *Sipunculoidea*, *Echiuroidea*, *Priapuloida*, *Tardigrada*, *Pentastomida*, and *Pogonophora*. Salient features of Minor Phyla. The lophophorates and its associated phyla *Phoronida*, *Brachiopoda*, *Entoprocta*, and *Bryozoa*, type of food collecting organ in the lophophore. Reproduction and Development in minor phyla. The essential role of minor phyla in Molecular studies of animal evolution. Molecular taxonomy.

(14 Hours)

**UNIT II: Nutrition:** Nutrition in Protozoan, Sponges, Coelenterates and Platyhelminthes - Filter Feeding in Polychaetes and Mollusca. **Respiration:** Respiratory organs – Gills, gill book, book lungs, parapodia, trachea, water vascular system with reference to respiration.

(14 Hours)

**UNIT III: Excretion:** Excretory organs and excretory products in invertebrates. **Circulatory system** - Circulation in Invertebrates – open and closed system. **Receptors:** Mechano reception – Chemoreception – Photoreception.

(14 Hours)

**UNIT IV: Nervous System:-** Primitive types - Coelenterates, Echinoderms and Hemichordates. Advanced types - Metameric nervous system-Giant nerve fibres- Molluscan nervous system-Nervous system and Learning in Cephalopods. Chemical co-ordination - neurohumors, neurohormones, endocrine regulation of moulting in crustaceans and insects, pheromones and allelochemicals.

(15 Hours)

**UNIT V: Chemical Co-ordination:** Hormones and neurohormones -Endocrine regulation in annelids, crustaceans, insects, and Molluscs -Pheromones and Allelochemicals.  
**Reproduction:** Asexual reproduction in Protozoans and Polychaetes. Unity in the early development of Metazoa- Protostomia and Deuterostomia. Phylogeny of invertebrates.

(15 Hours)

**Correlation of Programme objectives with course outcomes**

COURSE OUTCOME	PO1	PO2	PO3	PO4	PO5
• Develop skills in Taxonomy	✓	✓	✓	✓	
• Understand Physiology of Invertebrates	✓	✓	✓	✓	
• Learn the interaction between invertebrates and its ecosystem	✓	✓	✓	✓	✓

**Unit wise programme specific qualification attributes**

Unit	Unit Title	Intended Learning Chapters	Hours of Instruction
<b>INVERTEBRATES</b>			
I	General Classification & Locomotion	K1, K2	14.4
II	Nutrition & Respiration	K1, K2	14.4
III	Excretion, Circulation and receptors	K1, K2	14.4
IV	Nervous System	K1, K2	14.4
V	Chemical Co-ordination and Reproduction	K1, K2, K3	14.4

**REFERENCE BOOKS**

1. Veer Bala Rastogi (2017) Invertebrate Zoology, Kedar Nath Ram Nath Publications, India.
2. Kotpal R.L (2014), Modern Text Book of Zoology – Invertebrates, (2016 Ed) Rastogi Publications, India.
3. Robert D. Barnes (2006) Invertebrate Zoology, 7<sup>th</sup> Edition, Academic Internet Pub Incorporated.
4. Barrington E J W (2012) Invertebrate Structure and Function, (2<sup>nd</sup> Ed) Affiliated East-West Press Pvt. Ltd. India
5. Pechenik J.A. (2005) Biology of The Invertebrates, Mc Graw Hill publications, India.



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Core Paper-02

Total Contact Hours: 72

Credits: 4

Paper Code: 22ZOOC02

Weekly Contact Hours: 4

### CHORDATES

#### Course objectives:

- Motivate the students to learn the classification of chordates.
- Facilitate the students to know about the salient features of fishes and reptiles.
- To make the students to understand the adaptations in aves and mammals.

#### Course outcome:

At the end of the semester, students will be able to

- Classify chordates based on their morphology.
- Differentiate fishes and amphibians based on the morphology.
- Enumerate the adaptations of birds and mammals for terrestrial life.

#### UNIT I

Origin of and outline classification of Chordates and classification, Interrelationship of Hemichordata, Urochordata and Cephalochorda and their relationship with other deuterostomes. Evolution and adaptive radiations of vertebrates. Geological time scale and fossils.

(14 Hours)

#### UNIT II

Vertebrate integument and its derivatives: skin structure and functions, glands, scales, horns, claws, nails, hoofs, feathers and hairs, evolution of heart, Evolution of aortic arches, Comparative anatomy and evolution of respiratory organs, Urinogenital system, Organs of Olfaction and brain in relation to its functions

(14 Hours)

#### UNIT III

Type study of *Amphioxus*. General characters and outline classification of **Pisces** up to order level. Type study: Shark General Characters and outline classification of Amphibia up to order level. Origin of Amphibia, External characters of Frog. Biology and adaptive features of Anura, Urodela and Apoda. Parental care in Amphibia.

(14 Hours)

#### UNIT IV

General characters and classification of Reptiles up to order level. Skulls of Reptiles. Morphology of *Calotes*. Origin and adaptive radiation in Reptilia – Extinct Reptiles. General characters and outline classification of Aves up to order level. Extinct Reptiles. Identification and study of Poisonous and non-poisonous snakes of India. Type study: Pigeon. *Archaeopteryx*, Significance of *Archaeopteryx*, Migratory Birds.

(15 Hours)

## UNIT V

General characters and outline classification of Mammals up to order level. Prototheria, Metatheria and Eutheria. Type study: Rabbit. Importance of Marsupial Mammals. Exoskeleton structures of birds and mammals, Dentition in and ruminant stomach in Mammals and Echolocation in bats. Vertebrate Fossils: *Archaeopteryx* and Mesozoic mammals.

(15 Hours)

### Correlation of Programme objectives with course outcomes

COURSE OUTCOME	PO1	PO2	PO3	PO4	PO5
• Understand taxonomy of Vertebrates	✓	✓	✓	✓	
• Understand physiology of Vertebrates	✓	✓	✓	✓	
• Know the Evolutionary relationship	✓	✓	✓	✓	
• Awareness on poisonous and non-poisonous snakes	✓	✓	✓	✓	

### Unit wise programme specific qualification attributes

Unit	Unit Title	Intended Learning Chapters (K1, K2)	Hours of Instruction
I	Origin of Chordates and classification of Prochordates	K1, K2	14.4
II	Pisces & Amphibia	K1, K2	14.4
III	Reptilia	K1, K2	14.4
IV	Aves	K1, K2	14.4
V	Mammalia	K1, K2	14.4

### Reference books:

1. Kotpal, R.L. (2015). Modern Textbook of Zoology Vertebrates. Fifth Edition, Rastogi Publications, Meerut, India.
2. Jordan, E.L. and Verma, P.S. (2013). Chordate Zoology. Fourteenth Edition, S. Chand & Company, New Delhi, India.
3. Prasad, S.N. and Kashyap, V. (2012). A Textbook of Vertebrate Zoology. Fourteenth Edition, New Age International Pvt., Limited, India
4. F. Harvey Pough, Christine M. Janis, John B. Heiser (2012), Vertebrate Life (9th Edition), Pearson Publisher, India.
5. Ekambaranatha Ayyar, M. and Ananthkrishnan, T.N. (2003). A Manual of Zoology, Part-II (Chordata). Viswanathan Printers and Publishers, Chennai, India.
6. Kent, G.C. and Carr, R.K. (2001). Comparative Anatomy of the Vertebrates. Ninth Edition, McGraw Hill Book Company, India.
7. Libbie Henrietta Hyman, 1992, Hyman's Comparative Vertebrate Anatomy, University of Chicago Press, US.
8. J. Z. Young, Marion Nixon (1981). The Life of Vertebrates, Oxford University Press, London
9. A.J. Waterman (1971). Chordate Structure and Function, Collier Macmillan Ltd., UK



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**M.Sc. Zoology Course - SEMESTER-I**

(This syllabus is applicable to the students who are admitted on or after 2022-2023 academic year onwards)

**Core Paper-03**

**Total Contact Hours: 72**

**Credits: 4**

**Paper Code: 22ZOOC03**

**Weekly Contact Hours: 4**

**CELL AND MOLECULAR BIOLOGY**

**Course objectives:**

- To enable the students to gain basic and comprehensive knowledge in the multidisciplinary science of eukaryotic cell biology.
- To develop in-depth knowledge on molecular basis of cell functions.

**Course outcome:**

At the end of the semester, students will be able to

- Develop basic knowledge and skills in cell and molecular biology and become aware of the complexity and harmony of the cell.
- Understand how the study of cell biology has resulted in medical advance.

**UNIT - I**

Discovery of cell: Cell theory, Basic structure of prokaryotic and eukaryotic cell, Cell Cycle, and regulations. Cell division: mitosis- Stages and Significance. Meiosis -Stages and their significance, Formation of Synaptonemal Complex and their function. Significance of 2020 Nobel Prize for Discovery of Hepatitis C Virus and 2021 Nobel Prize for Discoveries of membrane receptor for temperature and touch.

(14 Hours)

**UNIT - II**

Ultra-structure and functions of Plasma membrane – Fluid Mosaic model theory- Transport mechanism- Exocytosis, Endocytosis, Simple Diffusion. Active Transport Mechanism: Structural Components of ion channels and their functions – ATPase Dependent Na/K ion transport, Ca<sup>2+</sup> Transport mechanism in Insulin Secretion and Neurotransmitter secretion. Micro bodies peroxisomes and Glyoxysome.

(14 Hours)

**UNIT – III**

Nucleus: ultrastructure of nuclear membrane, Nucleolus, Nucleoplasm and Chromatin fibers, Microtubules, microfilaments – Cilia and Flagella, Ribosome and Golgi bodies, Lysosome, Endoplasmic reticulum. Mitochondria. Cell Signaling: Types, organization of cell signals and their receptors. Functions of Ion channel coupled receptors – secondary messengers. Amplifiers, Integrators. 2016 Nobel Prize for discovery of Autophagy and 2013 Nobel Prize for the discoveries of machinery regulating Vesicle traffic, a major transport system in our cell.

(15 Hours)

#### UNIT – IV

The Exosome: Exosome Research Importance, Extracellular Vesicles – Structure and Composition, Mechanism of formation of Exosomes in cells, Circulation of Exosomes, Heterogeneity of Exosomes, Signal Transduction. Immune response and exosomes. Current scenario of Circulating DNA Research. Mechanism of cell aging and senescence. Comparison of Cell death: Necrotic and apoptotic cells.

(14 Hours)

#### UNIT - V

DNA replication – semi conservative and rolling circle models. Enzymes involved in DNA replication: types and their functions. Transcription and Translation in eukaryotes: RNA polymerase – types, properties, and functions–Transcription process in Eukaryotes. DNA to Nascent RNA and to mature RNA mediated by splicing mechanism. Protein Synthesis: mRNA serve as Template, Interaction of mRNA and rRNA, mRNA and RNA Polymerase, Participation of tRNAs in Translation and post translational modifications and their biological importance.

(15 Hours)

#### Correlation of Programme objectives with course outcomes

COURSE OUTCOME	PO1	PO2	PO3	PO4	PO5
• Develop skills in cell biology		✓	✓	✓	
• To gain knowledge and practical skill related to clinical laboratories		✓	✓	✓	
• To establish knowledge on molecular biology		✓	✓	✓	

#### Unit wise programme specific qualification attributes

Unit	Unit Title	Intended Learning Chapters (K1, K2)	Hours of Instruction
I	Discovery of cell & Cell division	K1, K2, K3, K5	14.4
II	Cell organelles	K1, K2, K3, K5	14.4
III	Nucleus & Signal Transduction Pathways	K1, K2, K3, K5	14.4
IV	Nucleic Acid & Mutations	K1, K2, K3, K6	14.4
V	DNA replication & Protein Synthesis	K1, K2, K3, K6	14.4

#### REFERENCE BOOKS:

1. Cooper, G.M. (2020). The Cell – A Molecular Biological Approaches. ASM Press, Washington.
2. Lodish H, Kaiser CA, Brasher A, Amon A, Berk A, Kreger M, Ploegh H and Scott MP (2019). Molecular Cell Biology, 7<sup>th</sup> edition, Garland Publishing, Inc. New York.
3. Alberts B, Johnson A, Lewis J, Raff M, Roberts K and Walter P (2018). Essential Cell Biology. Garland Science, New York
4. De Robertis EDP and De Robertis EMF (2018). Cell and Molecular Biology. Lippincott Williams and Wilkins, USA.

5. Gupta PK (2021). Cell and Molecular Biology. Rastogi Publications, Meerut.
6. Karp G (2017). Cell and Molecular Biology: Concepts and Experiments. 6<sup>th</sup> edition, John Wiley and Sons Ltd. New York.
7. Lewin B (2021). Genes XIII Oxford University Press, Oxford.
8. Walker JM and Gingold EB (2018). Molecular Biology and Biotechnology. Panima University Press, Oxford Publishing Co., New Delhi.
9. Thorpe N O (2000). Cell Biology, John Wiley and Sons, New York.
10. Turner PC McLennan AG Bates AD and White MRH (2007). Instant Notes Molecular Biology. Viva Books Pvt. Ltd., New Delhi.
11. Thomas Pollard, William Earnshaw, Jennifer Lippincottt Schwartz, Graham Johnson, (2017). Cell Biology, 3<sup>rd</sup>Edition, Elsevier Publisher, USA.



பெரியார் பல்கலைக்கழகம்

PERIYAR UNIVERSITY

DEPARTMENT OF ZOOLOGY

Salem-636011, Tamil Nadu

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

SUTHANTHIRA THIRUNJAL AMUDHA PERUVIYHA  
TAMIL NADU



### M.Sc. Zoology Course - SEMESTER-I

(This syllabus is applicable to the students who are admitted on or after 2022-2023 academic year onwards)

Core Paper-04

Total Contact Hours: 72

Credits: 4

Paper Code: 22ZOOC04

Weekly Contact Hours: 4

### BIOCHEMISTRY

#### Course objectives:

- ❖ To enable the students to learn the biological phenomena at the molecular level.
- ❖ To provide a basic and advanced understanding of the principles of *Biochemistry*.
- ❖ To acquire knowledge on the fundamental chemical principles that governs complex biological systems.

#### Course outcome:

At the end of the semester, students will be able to

- ❖ Acquire a concrete foundation in biological chemistry.
- ❖ Get job opportunity in Biochemical Industries, Clinical Laboratories, Research and Development Laboratories for higher studies.

#### UNIT I

Atoms: Chemical Composition of living matter. Biological importance of water. Buffers and its Physiological properties. Handerson and Hasselbach's Equation. Carbohydrates: Classification, structure and function. Carbohydrate metabolism: Anabolism – Glycogenesis and Gluconeogenesis. Catabolism – Glycolysis, Kreb's cycle and Glycogenolysis. Electron Transport Chain. Metabolic disorder: Diabetes and their biomedical significance. Cell sensing – Adaptation to oxygen availability (Noble laureate William Kaelin Jr, Sir Peter Ratcliffe and Gregg Semenza).

(15 Hours)

#### UNIT II

Amino acids: Structure and classification of amino acids. Essential amino acids and Non-essential amino acids, glycoenic and ketogenic amino acids. Proteins: Classification of proteins. Primary, Secondary, Tertiary and Quaternary structure of protein. Principle and applications of Ramachandran's plot. Protein purification and analysis: Centrifugation, Chromatography and Electrophoresis. Enzymes: mechanism of enzyme action, enzyme kinetics, enzyme inhibitors.

(15 Hours)

#### UNIT III

Lipids: Structure and Classification of Lipids. Types of fatty acid oxidation: Beta, alpha, omega and peroxysomal oxidation. Ketosis, biosynthesis of fatty acids. Triglycerides and



Cholesterol: Structure & function, Cholesterol biosynthesis. Biomedical importance of lipids in Obesity.

(14 Hours)

#### UNIT IV

Ribosome structure and functions (Contribution of the Nobel laureate Venkatraman Ramakrishnan) Nucleic acids: Structure and functions of RNA and DNA. Synthesis and degradation of purine and pyrimidine (De novo and salvage pathways). Syndromes associated with nucleic acid metabolism: Aicardi-Goutières syndrome (AGS), Lesch-Nyhan syndrome and GOUT Disease.

(14 Hours)

#### UNIT V

Hormones – Peptide and Non-peptide mammalian hormones, receptors, feedback loops, signaling cascades, secondary messengers as hormones, steroid hormone receptor and gene action. Insect pheromones. The biochemistry of Learning, Memory and Thinking.

(14 Hours)

#### Correlation of Programme objectives with course outcomes

COURSE OUTCOME	PO1	PO2	PO3	PO4	PO5
<ul style="list-style-type: none"> <li>Priority is given to our stake holders in clinical laboratories</li> <li>Students can understand biochemical reactions taking place in our body</li> <li>Can develop private R&amp;D laboratories to train the students</li> </ul>		✓	✓	✓	
		✓	✓	✓	
		✓	✓	✓	✓

#### Unit wise programme specific qualification attributes

Unit	Unit Title	Intended Learning Chapters (K1, K2)	Hours of Instruction
I	Atoms & Carbohydrates	K1, K2, K3, K4	14.4
II	Amino acids, Proteins & Enzymes	K1, K2, K3, K4, K5	14.4
III	Lipids	K1, K2, K3, K4, K5	14.4
IV	Porphyryns & Nucleic acids	K1, K2, K3	14.4
V	Signal transduction	K1, K2, K3, K4, K5, K6	14.4

#### REFERENCE BOOKS

- Victor W. Rodwell, David Bender, Kathleen M. Botham, Peter J. Kennelly, P. Anthony Weil (2017) Harper's Illustrated Biochemistry. McGraw Hill Publications, India.
- Lehninger, A. L., Nelson, D. K., and Cox, M. M. (2021) Principles of Biochemistry, Macmillan learning publications, UK.
- Lubert L. Stryer, Jeremy M. Berg, John L. Tymoczko, Gregory J. Gatto (2018) Biochemistry. W. H. Freeman and Company, New York.
- Voet. D. Judith, G. Voet, Charlotte W. Pratt. (2016) Fundamentals of Biochemistry: Life at the Molecular Level, John Wiley & Sons Inc. New York.
- Satyanarayanan, U and Chakrapani U (2019). Essentials of Biochemistry, Uppala Author – Publisher Interlinks, Vijayawada, India.



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SUTHANTHRA THIRUNAL AMUDHA PERUVIZHA  
TAMIL NADU



### M.Sc. Zoology Course - SEMESTER-I

(This syllabus is applicable to the students who are admitted on or after 2022-2023 academic year onwards)

Core Paper-05

Total Contact Hours: 72

Credits: 4

Paper Code: 22ZOOC05

Weekly Contact Hours: 4

### MOLECULAR GENETICS

#### Course objectives:

- To explore molecular genetic concepts from scientific and societal perspectives.
- To learn the molecular process of gene expression.
- To understand the structural and numerical aberrations of chromosomes.
- To know the role of genes in human health and development.

#### Course outcome:

On successful completion of this course, the student will be:

- The students will understand the concepts of Mendelian, Non-mendelian, molecular genetic concepts.
- Eligible to get job opportunities in R&D Laboratories, Biopharmaceutical Companies and Clinical Laboratories.

#### UNIT I

Mendelian principles: Dominance, segregation, independent assortment, deviation from Mendelian inheritance. Concept of gene: Allele, multiple alleles, pseudoallele, complementation tests. Extensions of Mendelian principles: Codominance, incomplete dominance, pleiotropy, linkage and crossing over, X linkage, X limited, and X influenced characters. 1933 Nobel Prize "for Morgan's discoveries concerning the role played by the chromosome in heredity." Gene mapping methods: Linkage maps, lod score for linkage testing, tetrad analysis in *Neurospora*.

(15 Hours)

#### UNIT II

Extra chromosomal inheritance: Inheritance of mitochondrial genes, maternal inheritance. Microbial genetics: Methods of genetic transfers – transformation, conjugation, transduction and sex-duction, Human genetics: Chromosome banding, karyotypes, Barr bodies and chromosomal abnormalities, Pedigree analysis, Polygenic inheritance, genetic disorders.

(14 Hours)

#### UNIT III

Molecular genetics: Prokaryotic and eukaryotic gene expression, Gene mutation and DNA repair; Types of gene mutations – Methods for detection of induced mutations – P-element insertional mutagenesis in *Drosophila* – C-value paradox; Genetic regulation of development and differentiation in *Drosophila*, *C. elegans*, and Zebra fish.

(14 Hours)

#### UNIT IV

Structural and numerical alterations of chromosomes: Deletion, duplication, inversion, translocation, ploidy and their genetic implications. 1983 Nobel Prize for the discovery of Mobile Genetic Element. Transposons and transposition mechanisms; Oncogenes- tumor inducing retroviruses and viral oncogenes; chromosome rearrangement and cancer; cellular roles of tumor suppressor genes, p<sup>RB</sup>, p<sup>53</sup>, genetic pathways in cancer.

(14 Hours)

#### UNIT V

Population Genetics: Gene pool, gene frequency; Hardy-Weinberg law, random genetic drift, founder's principle. Chromosomal micro-dissection, DNA Finger Printing and Fluorescent *in situ* Hybridization (FISH), Types of DNA sequencing: Sanger-Gullison Method, Maxam and Gilbert Method, Next Generation Sequencing, Single Nucleotide Polymorphism (SNP). Types of PCR and their applications, DNA and Protein Microarray technology. Human Genome Project: An Overview and merits and demerits. 2020 Nobel Prize in Chemistry for discovery of Genome editing- CRISPR/CAS9 Model.

(15 Hours)

#### Correlation of Programme objectives with course outcomes

COURSE OUTCOME	PO1	PO2	PO3	PO4	PO5
• Promote to get jobs in R&D laboratories of various sectors	✓	✓	✓	✓	
• Gain knowledge about the genes and their functions	✓	✓	✓	✓	
• Genetic disorders and diseases can be predicted by the students using pedigree analysis	✓	✓	✓	✓	
• Develop skills to modify the genetic system of an organism	✓	✓	✓	✓	

#### Unit wise programme specific qualification attributes

Unit	Unit Title	Intended Learning Chapters (K1, K2)	Hours of Instruction
I	Mendelian principles	K1, K2, K3	14.4
II	Extra chromosomal inheritance & Human Genetics	K1, K2, K3, K4, K5	14.4
III	Molecular genetics & Mutation	K1, K2, K3, K4, K5	14.4
IV	Structural and numerical alterations of chromosomes	K1, K2, K3, K4, K5	14.4
V	Population Genetics Principles and Techniques in Genetics	K1, K2, K3, K4, K5, K6	14.4

#### REFERENCE BOOKS:

- 1) Strachan, T. and Read, A. (2018). Human Molecular Genetics. CRC Press, US
- 2) Camarin, R.H. (2017). Principles of Genetics. 7<sup>th</sup> Edition, McGraw Hill Education, India.

- 3) Watson, J.D. and Tania, A.B. (2017). *Molecular Biology of the Gene*. 7<sup>th</sup> Edition, Pearson Education, UK.
- 4) Krebs, J.E., Goldstein, E.S. and Kilpatrick, S.T. (2017). *Lewin's Genes XII*. 12<sup>th</sup> Revised Edition, Jones and Bartlett Publishers, US
- 5) Snustad, D.P. and Simmons, M.J. (2015). *Principles of Genetics*. 7<sup>th</sup> Edition, John Wiley and Sons, US.
- 6) Strickberger M.W. (2015). *Genetics*. 3<sup>rd</sup> Edition, Prentice India.
- 7) Primrose, S.B. and Twyman, R. (2006). *Principles of Gene Manipulation and Genomics*. 7<sup>th</sup> Edition, Blackwell Publishing Company, US.



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TAMIL NADU



**M.Sc. Zoology Course - SEMESTER-I**

(This syllabus is applicable to the students who are admitted on or after 2022-2023 academic year onwards)

**Core Practical Paper-01**  
**Total Contact Hours: 108**

**Credits: 3**

**Paper Code: 22ZOO01**  
**Weekly Contact Hours: 6**

**LAB COURSE-I**  
**(Core Papers: I-V)**

**Course objectives:**

- To understand the working principles and applications
- To learn how to quantify the biochemical substances and heritable traits.
- To know the role of fauna in and around our ecosystem.

**Course outcome:**

On successful completion of this skill-based course, the student will be eligible to get job opportunities in R&D Laboratories, Biopharmaceutical Companies and Clinical Laboratories and also be selected as fauna conservators

**Core I & II Invertebrates and Chordates**

1. Spotters and Slides (For *Plasmodium* sp., Sponges, *Hydra*, Liver fluke, Tape worm, *Peripatus*.)
2. Plankton Survey in Periyar University Pond
3. Survey of Insects and Millipedes in Periyar University Campus (Field Study)
4. Survey of Fishes and Reptiles in Periyar University Campus (Field Study)
5. Identification of Migratory Birds
6. Structure and function of Major Mammalian Organs (Rat-heart, pancreas, liver, kidney and gonads) – Voucher Specimen
7. Skeleton of Human - Voucher Specimen

**Core III Cell and Molecular Biology**

1. Culture and characterization of Insect Gut Bacterial species
2. Micrometry for cell measurement
3. Identification of different types of cells in blood
4. Counting of Various Stages of Mitosis (onion root tip)
5. Observation of Meiosis in Grasshopper
6. Cells of vital organs (Slides: Kidney, Liver, Spleen, Stomach, muscles, lung and colon)
7. Drug resistant genes in *Caenorhabditis elegans*

**Core IV Biochemistry**

1. Determination of Protein concentration in Animal Tissue
2. Determination of glucose level in Student Volunteer Blood

- Effect of Temperature on salivary amylase activity
- Separation and Identification of amino acids by paper chromatography
- Spotters: Diabetes, Lesch-Nyhan syndrome and GOUT Disease
- Protein Molecular Weight Determination using SDS-PAGE

#### Core V Molecular Genetics

- Observation of Mendelian traits Among Student Volunteers
- Identification of Human Syndromes – Voucher Specimen
- Study on polygenic inheritance – Voucher Specimen
- Pedigree Analysis of Genetic Disorder (Hemophilia and Night Blindness)
- Genetic Counseling methods (Among Student Volunteers)
- DNA Isolation and Agarose Gel Electrophoresis
- PCR Analysis

#### Correlation of Programme objectives with course outcomes

COURSE OUTCOME	PO1	PO2	PO3	PO4	PO5
• Exclusively develop skills in cell biology, biochemistry, genetics and molecular taxonomy	✓	✓	✓	✓	
• Gain knowledge to work with biochemical and microbiological laboratories to predict diseases	✓	✓	✓	✓	✓
• Understand the histology of vital organs and their functions	✓	✓	✓	✓	

#### Unit wise programme specific qualification attributes

Unit	Unit Title	Intended Learning Chapters (K1, K2)	Hours of Instruction
I	Invertebrates	K1, K2, K3, K6	21.6
II	Chordates	K1, K2, K3, K6	21.6
III	Cell and Molecular Biology	K1, K2, K3, K4, K5, K6	21.6
IV	Biochemistry	K1, K2, K3, K4, K5, K6	21.6
V	Genetics	K1, K2, K3, K4, K5, K6	21.6

#### REFERENCE BOOKS:

- Plumer HT (2012). Practical : Biochemistry , Wiley Publication, India
- Borah D (2012). Biotechnology Lab Practices, Global Academic Publisher, India.
- Kannan S, Krishnan M, Thirumurugan R and Achiraman S (2012). Methods in Molecular Biology, UVN Publishers, India.
- Lal SS (2009). Practical Zoology, Rastogi Publications, New Delhi.
- Kannan S and N. Kayalvishi, (2022). Cell and Molecular Biology- A Practical Approach, MJP Press, India.



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**M.Sc. Zoology Course - SEMESTER-I**

(This syllabus is applicable to the students who are admitted on or after 2022-2023 academic year onwards)

**Elective Paper-01**

**Total Contact Hours: 72**

**Credits: 4**

**Paper Code: 22ZOOE01**

**Weekly Contact Hours: 4**

### MICROBIOLOGY

#### **Course objectives:**

- 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 outcome:**

On successful completion of this course, the student will be:

- Able to recall the relationship of infections to symptoms, relapse and the accompanying pathology.
- To develop a heightened sense of understanding in students about the microscopic world around them.
- To understand and apply the physical and chemical control measure, explains mode of action of antibiotics and lists the microbial diseases in farm animals.

#### **UNIT I:**

History and Scope of Microbiology- Wittaker's Five Kingdom concept- Difference between prokaryotic and eukaryotic microorganisms. Structure and Significance of Viruses, Viroids, and Prions. Cellular microorganisms - Bacteria, Algae, Fungi and Protozoa with emphasis on distribution and occurrence, morphology, mode of reproduction and economic importance.

(15 Hours)

#### **UNIT II:**

Culture and Characterization: Isolation and identification of bacteria. Bacterial Culture methods – Streak plate, pour plate, spread plate and rolling tube Methods. Preservation of Cultures using glycerol and cryopreservation Techniques. Phases of bacterial growth Sigmoid and J shape curve. Microbial control – Physical and chemical agents. Types of sterilization and disinfection. Staining: Simple and differential staining; Gram staining; acid fast staining; endospore staining; capsule staining and flagella staining.

(15 Hours)

#### **UNIT III:**

Microbial genetics: Methods of genetic transfers – transformation, conjugation, transduction. Mutations and mutagenesis: Definition and types of Mutations; Physical and chemical

mutagens; Uses of mutations, DNA repair mechanisms. Site Directed mutagenesis. Microbial Genomics: Genome project of *Escherichia coli* and *Yeast*. Metagenomics concepts and Significance,

(14 Hours)

**UNIT IV:**

Host pathogen interaction: Infection, Invasion, Pathogen, Pathogenicity, Virulence, Toxicogenicity, Carriers and their types, Opportunistic infections, Nosocomial infections. Transmission of infection. Bacterial diseases - Tuberculosis, Plague, Anthrax. Pandemics of Viral disease causing agents: Polio, Hepatitis, Rabies, Dengue, Influenza, Corona swine flu, Ebola, Chikungunya, Japanese Encephalitis. Protozoan diseases - Amoebiasis and Malaria.

(15 Hours)

**UNIT V:**

History and developments in industrial microbiology. Microbial fermentation Microbial production of Antibiotics: penicillin, streptomycin, Vitamin B12 Vaccines - genetic recombinant vaccines. Significance of Corona viral vaccines. Bioremediation- Principles and applications.

(13 Hours)

**Correlation of Programme objectives with course outcomes**

<b>COURSE OUTCOME</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>
• Develop skills in microbiology		✓	✓	✓	
• To gain knowledge and practical skill related to clinical laboratories		✓	✓	✓	
• To establish knowledge on pathogenic microbes		✓	✓	✓	

**Unit wise programme specific qualification attributes**

<b>Unit</b>	<b>Unit Title</b>	<b>Intended Learning Chapters (K1, K2)</b>	<b>Hours of Instruction</b>
I	History and Scope & Mycology	K1, K2, K3	14.4
II	Culture and Characterization	K1, K2, K3, K4, K5, K6	14.4
III	Microbial genetics	K1, K2	14.4
IV	Host parasite interaction	K1, K2, K3, K4, K5, K6	14.4
V	Industrial Microbiology	K1, K2, K3, K4, K5, K6	14.4

**REFERENCE BOOKS:**

1. Atlas RM (2001). Principles of Microbiology. 2<sup>nd</sup> edition, McGraw-Hill.
2. Dubey RC and Maheswari DK (2014). Textbook of Microbiology. S. Chand and Co.
3. Pelczar M J, Chan ECS and Kreig NR (2015). Microbiology. Tata-McGraw Hill.
4. Prescott LM (2016). Microbiology. 6<sup>th</sup> Edition. McGraw-Hill.
5. Stanier R, Ingraham J, Wheelis M and Painter P (2014). General Microbiology. 5<sup>th</sup> Edition, Macmillan Press.
6. Kathleen Park Talaro and Barry Chess (2018). Foundations in Microbiology 10<sup>th</sup> 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





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SUTHANTHRA THIRUNALAI AMUDHA PERUVIZHA  
TAMIL NADU



**M.Sc. Zoology Course - SEMESTER-I**

(This syllabus is applicable to the students who are admitted on or after 2022-2023 academic year onwards)

**Elective Paper-02**

**Total Contact Hours: 72**

**Credits: 4**

**Paper Code: 22ZOOE02**

**Weekly Contact Hours: 4**

### **BIOETHICS AND BIOSAFETY**

#### **Course Objectives:**

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

#### **Course outcomes:**

1. Students will gain awareness about Intellectual Property Rights (IPRs) to take measure for the protecting their ideas
2. They will able to devise business strategies by taking account of IPRs
3. They will be able to assists in technology upgradation and enhancing competitiveness.
4. They will acquire adequate knowledge in the use of genetically modified organisms and its effect on human health
5. They will gain more insights into the regulatory affairs.

#### **UNIT-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.

(14 Hours)

#### **UNIT-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.

(14 Hours)

#### **UNIT-III**

**Intellectual Property Right:** Introduction, intellectual property: trade secret, patent, copyright, patent law, Choice and management of IPRs, advantage and limitations of IPRs.

(14 Hours)

#### **UNIT-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).

(15 Hours)

## UNIT-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.

(15 Hours)

### Correlation of Programme objectives with course outcomes

COURSE OUTCOME	PO1	PO2	PO3	PO4	PO5
• Develop skills in Biosafety	✓	✓	✓	✓	✓
• To gain knowledge and practical skill related to clinical laboratories		✓	✓	✓	
• To establish knowledge on handling of animals		✓	✓	✓	

### Unit wise programme specific qualification attributes

Unit	Unit Title	Intended Learning Chapters (K1, K2)	Hours of Instruction
I	Biosafety	K1, K2, K3	14.4
II	Bioethics	K1, K2, K3, K4, K5	14.4
III	Intellectual Property Rights	K1, K2	14.4
IV	Patents and patent processing	K1, K2, K4, K5	14.4
V	Regulatory framework in Biotechnology	K1, K2, K3, K4, K5, K6	14.4

### Reference Books

1. David H. Holt. (1992). Entrepreneurship: New Venture Creation, Prentice Hall Publication, UK.
2. Anthony C. Warren and Jack M. Kaplan, (2009). Patterns of Entrepreneurship Management, John Wiley and Sons Publications, US.
3. Gupta, C.B. and S.S. Khanka, (2017). Entrepreneurship and Small Business Management: Sultan Chand & Sons Publication, India.
4. Sateesh M K. (2010). Bioethics and Biosafety, I. K. International Pvt Ltd.
5. Sree Krishna V. (2007). Bioethics and Biosafety in Biotechnology, New Age International Publishers, India.
6. Sibley KD (2013). The law and strategy of Biotechnological patents. Butter Worth Publications, UK.
7. Ganguli P (2006). Intellectual Property Rights, Tata McGraw-Hill, India.
8. Singh BD (2020). Biotechnology- - Kalyani Publications, India.



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**M.Sc. Zoology Course - SEMESTER-II**

(This syllabus is applicable to the students who are admitted on or after 2022-2023 academic year onwards)

**Core Paper-06**

**Total Contact Hours: 72**

**Credits: 4**

**Paper Code: 22ZOOC06**

**Weekly Contact Hours: 4**

### ANIMAL PHYSIOLOGY

#### **Course Objectives:**

- To impart the functional aspects of human physiological systems.
- To learn on the physiology of sensory organs.
- To understand circulatory and myocardial functions.

#### **Course Outcome:**

- Students will get opportunity to serve as Lab Technician in Paramedical Institutes.
- Students will get a chance to enter higher education like Ph.D. Programme.

#### **UNIT I**

**Homeostasis in animals-** Thermoregulation: Temperature compensation in poikilotherms, and homeotherms, Physical, chemical and neural regulation. **Osmotic and ionic regulation in fishes. Stress and adaptations:** Adaptations to pressure - High altitude and deep diving. Functional anatomy of digestive system. Digestion and absorption. Neuroendocrine regulation of gastro – intestinal movements and secretions. 2005 Nobel Prize for the discovery of the role of *Helicobacter pylori* in gastritis and peptic ulcer.

(13 Hours)

#### **UNIT II**

Respiration-Breathing movements and exchange of respiratory gases at the pulmonary surface. Respiratory quotient Respiratory Pigments. **Circulation and Excretion:** Comparative anatomy of heart structure, myogenic heart, cardiac cycle, heart as a pump, blood pressure, blood volume regulation, neural regulation, ECG - its principle and significance. 1998 Nobel Prize for the discovery of nitric oxide as a signaling molecule in the cardiovascular system.

(14 Hours)

#### **UNIT III**

Cascade of biochemical reactions (factors) involving in blood coagulation. Functional anatomy of mammalian kidney and its renal units. Physiology of urine formation. The significance of Henley's loop. Role of hormones in renal physiology. Formation of nitrogenous excretory products NH<sub>3</sub>, Urea & Uric acid. **Muscle:** Types of Muscles- Striated and non-striated, voluntary and involuntary, Ultra structure of muscle fiber, Chemistry and Molecular mechanism of muscular contraction. Neuromuscular coordination, Muscle fatigue and muscle twitch. Biochemistry of actomyosin, ATPase reaction.

(15 Hours)

#### UNIT IV

**Nervous system and sensory physiology:** Gross anatomy of brain and spinal cord, Structure of neuron and types of neurons. Synapse between neurons and between neurons and muscle. Importance of Neuro endocrine regulation in Insects and Human. Structure and functions of Neurotransmitters. **Receptors:** Chemical senses: Pheromones and Behaviours in Mammals, Phonoreception –Physiology of hearing, Photoreception - Photochemistry of vision.1977 Nobel Prize for discoveries concerning the peptide hormone production of the brain. 1981 Nobel Prize for the discovery of functional specialization of the cerebral hemisphere. 2000 Nobel Prize for the discovery concerning signal transduction in the nervous system. 2004 Nobel prize for the discovery of odorant receptors and the organization of the olfactory system. 2014 Nobel Prize for the discovery of cells that constitute a positioning system in the brain.

(17 Hours)

#### UNIT V

Anatomy : Structure and functions of Male and Female Reproductive organs. Reproductive cycle and their endocrine regulation in human. 2010 Nobel Prize for the development of *in vitro* fertilization. Structure and functions of Secondary Sexual Organs: Prostaglandin – Impact in male reproduction and why prone to Cancer. 1992 Nobel Prize for discoveries concerning prostaglandins and related biologically active substances.

(13 Hours)

#### Correlation of Programme objectives with course outcomes

COURSE OUTCOME	PO1	PO2	PO3	PO4	PO5
• Able to draw and illustrate human organ systems	✓	✓	✓	✓	
• Understand the functions of endocrine glands and hormones	✓	✓	✓	✓	
• Explain the human circulatory system	✓	✓	✓	✓	✓

#### Unit wise programme specific qualification attributes

Unit	Unit Title	Intended Learning Chapters (K1, K2)	Hours of Instruction
I	Homeostasis, Osmotic and regulation	K1, K2	14.4
II	Respiration	K1, K2	14.4
III	Circulation and Excretion	K1, K2	14.4
IV	Muscle Physiology	K1, K2	14.4
V	Nervous system and sensory physiology	K1, K2, K5	14.4

#### REFERENCE BOOKS

- 1 Eckert, Roger, Randall, D.J., Burggren, Warren, French, Kathleen. (2019). Eckert's Animal Physiology, Fifth Edition. W.H. Freeman & Co Ltd. USA
- 2 Gordon, M. S., Bartholomew, G. A., Grinnel, A. D., Jorgensen, C. B. White, F.N., (1971). Animal Function - Principles and Adaptations. Macmillan Co. London.
- 3 Hall, J. E (2020). Guyton and Hall Text Book of Medical Physiology. Thirteenth Edition, Elsevier Sander Publications, USA.
- 4 Ian Kay (2020). Introduction to Animal Physiology Pear Tree Press Ltd., Singapore.

- 5 Knut Schmidt-Nielsen (2020). *Animal Physiology: Adaptation and Environment*, Sixth Edition, Cambridge University Press, UK.
- 6 Moyes, C. D., and P. M. Sculte. (2016). *Principles of Animal Physiology*, 2<sup>nd</sup> Edition, Pierson Education, India.
- 7 Prosser, C. and L. Brown (1999). *Comparative Animal Physiology III* Ed. W.B. Saunders Company, Philadelphia
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PERIYAR UNIVERSITY

DEPARTMENT OF ZOOLOGY

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

SUTHANTHRA THIRUNALAI AMUDHA PERUVIZHA  
TAMIL NADU



**M.Sc. Zoology Course - SEMESTER-II**

(This syllabus is applicable to the students who are admitted on or after 2022-2023 academic year onwards)

**Core Paper-07**

**Total Contact Hours: 72**

**Credits: 4**

**Paper Code: 22ZOOC07**

**Weekly Contact Hours: 4**

### **DEVELOPMENTAL BIOLOGY**

#### **Course objectives:**

- To motivate the students to learn the basic concepts of Developmental Biology.
- To facilitate students to learn the molecular perspective of fertilization.

#### **Course outcome:**

On successful completion of this course, the student will be Able to get an opportunity to work as a Lab Technician in fertility clinics and gaining knowledge to fit them to do research in the topic of interest.

#### **UNIT - I**

Basic concepts of development: Types of eggs and their Polarity, biological symmetry and chemo-differentiation of eggs. Gametogenesis: Spermatogenesis, Oogenesis and vitellogenesis. Potency, commitment, specification, induction, competence, determination and differentiation; morphogenetic gradients; cell fate and cell lineages; Genes contributing to gonad development – Role of SF1, WT1, SRY, SOX 9 and other genes.

(14 Hours)

#### **UNIT-II**

Role of maternal contribution in early embryogenesis – masked RNA. Molecular perspectives of fertilization: Recognition of egg and sperm, Egg and sperm interaction, fertilization, species – specific recognition, cortical reaction, activation of egg metabolism, fusion of genetic material. Artificial insemination: IUI, 2010 Nobel Prize for Development of in vitro Fertilization – Test tube baby.

(14 Hours)

#### **UNIT-III**

Cleavage and its patters, biochemical changes during cleavage, influence of male and female pronuclei during early development, blastula and gastrula and morphogenetic movements. Nuclear transplantation experiments in amphibians – Embryonic stem cell and its application. Genes that pattern *Drosophila* body plan: morphogenetic gradients, cascades and signaling pathways in *Drosophila* development – Homeo box concept and its role.

(14 Hours)

#### UNIT-IV

Cell-cell interaction, adhesion and communication – Organizer and induction: Spemann’s classical experiment, molecules of Nieukoop center – activin, noggin, BMP4, Wnt, FGF and retinoic acid – chemistry and mechanism. Limb and tail development in Amphibians and reptiles. Post embryonic development – larval formation, metamorphosis, Environmental regulation of development.

(15 Hours)

#### UNIT-V

Nuclear determination of developmental events, Molecular basis of early embryonic development, Differentiation at tissue level - Epithelio-mesenchymal interaction, differentiation at organ level – cyclopia and acephaly, role of Hox D gene, Hox A gene. Concept of gene knock out, abnormal differentiation – teratoma and teratogens. Mechanism of Programmed cell death (Apoptosis).

(15 Hours)

#### Correlation of Programme objectives with course outcomes

COURSE OUTCOME	PO1	PO2	PO3	PO4	PO5
• Understand the mechanism of fertilization	✓	✓	✓	✓	
• Draw the structure of sperm	✓	✓	✓	✓	
• Compare the reproductive system of vertebrates	✓	✓	✓	✓	
• Knowledge about the gastrulation of amphibian	✓	✓	✓	✓	

#### Unit wise programme specific qualification attributes

Unit	Unit Title	Intended Learning Chapters (K1, K2)	Hours of Instruction
I	Basic concepts of development	K1, K2	14.4
II	Fertilization	K1, K2	14.4
III	Totipotency and pluripotency & Stem cells	K1, K2, K3, K4, K5, K6	14.4
IV	Cell-cell interactions	K1, K2, K3, K4, K5	14.4
V	Differentiation & gene knock out	K1, K2, K3, K4, K5, K6	14.4

#### References:

1. Frederick R Bailey (2018). Text-Book of Embryology, Forgotten Books, London.
2. Datta A. K. (2017). Essentials of Human Embryology (7<sup>th</sup> Ed.), Current Books International Publications, India.
3. Subhadra Devi V (2017). Inderbir Singh’s Human Embryology (11<sup>th</sup> Revised Ed.), Jaypee Brothers Medical Publishers, India.
4. Vishram Singh (2017). Textbook of Clinical Embryology, Elsevier Publications, Netherland.
5. Scott F. Gilbert (2019). Developmental Biology (11<sup>th</sup> edition), Sinauer Publications, US.
6. Sadler (2016). Langman’s Medical Embryology (13<sup>th</sup> Ed.), Wolters Kluwer Publications, US.

7. Tickle, Martinez Arias Wolpert (2015). Principles of Development 5<sup>th</sup> Ed) Oxford University Press, London.
8. Carlson (2013), Human Embryology and Developmental Biology (5<sup>th</sup> Ed), Elsevier Health – US
9. Balinsky B.I. (2012), An Introduction to Embryology (5 Ed.), Cengage Learning India
10. Das N (2012), Fundamental Concepts of Developmental Biology, Affiliated East-West Press Pvt. Ltd. New Delhi, India.
11. Gerald P. Schatten (2006) Current Topics in Developmental Biology (1<sup>st</sup> Ed.), Academic Press, US.
12. Jonathan M. W. Slack (2005), Essential Developmental Biology, (2<sup>nd</sup> Ed), Wiley-Blackwell, US.
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**M.Sc. Zoology Course - SEMESTER-II**

(This syllabus is applicable to the students who are admitted on or after 2022-2023 academic year onwards)

**Core Paper-08**

**Total Contact Hours: 72**

**Credits: 4**

**Paper Code: 22ZOOC08**

**Weekly Contact Hours: 4**

### EVOLUTION

#### **Course Objectives:**

- To enable the students to understand how living systems evolved.
- To understand the mechanism of evolutionary changes through adaptation, natural selection, speciation and the history of life.

#### **Course Outcome:**

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

- Get jobs in Zoological Museum, Zoological Survey of India (ZSI), and Paleontological Institutes.
- Apply knowledge of evolution to the solution of problems facing the human population and in animal conservation.

UNIT I: Introduction: Origin of evolutionary thoughts. Origin of Life. Biological evolution and Creationism. Lamarckism, Neo-Lamarckism – Charles Darwin: The voyage on the Beagle – Neo-Darwinism – The Modern Synthesis - Macroevolution and Speciation: Modes of Speciation - Allopatric, Peripatric, Parapatric, and Sympatric. Species concepts – Morphological, Ecological and Biological.

(14 Hours)

UNIT II: Evidence for Evolution: Evidences from Comparative Anatomy and Morphology, Vestigial organs and Fossil records Causes of evolution – Mutation, Gene flow, Genetic drift, Non-random mating and Natural Selection – Hardy-Weinberg equilibrium – Reproductive isolation: Pre-zygotic and Post-zygotic.

(14 Hours)

UNIT III: Natural Selection: Components of Natural Selection, Models of Natural Selection: Stabilizing, directional, and disruptive selection. Group selection, kin selection, and sociobiology- Ecogeographic rules: Subspecies concepts- Clines and hybrid zones.

(14 Hours)

UNIT IV: Patterns of Evolution: Anagenesis and Cladogenesis, Phyletic Gradualism and Punctuated Equilibrium, Monophyletic, Polyphyletic and Paraphyletic Evolution, Convergent and Divergent Evolution – Adaptive radiation. Phenetics and cladistics- Tracing ancestor-descendant relationships- The molecular clock.

(15 Hours)

UNIT V: Evolutionary innovations and the origin of higher taxa- Evolution of Homo sapiens and molecular biological and immunological evidences for evolution. Impact of DNA bar coding in modern Evolutionary studies. Extinctions - An Overview.

(15 Hours)

**Correlation of Programme objectives with course outcomes**

COURSE OUTCOME	PO1	PO2	PO3	PO4	PO5
• Compare the different types of evolutionary theories	✓	✓	✓	✓	
• Gain knowledge about the human evolution	✓	✓	✓	✓	
• Able to differentiate sympatric and allopatric species	✓	✓	✓	✓	
• Knowledge about the fossilization	✓	✓	✓	✓	

**Unit wise programme specific qualification attributes**

Unit	Unit Title	Intended Learning Chapters (K1, K2)	Hours of Instruction
I	Introduction & Species concepts	K1, K2	14.4
II	Hardy-Weinberg equilibrium	K1, K2	14.4
III	Natural selection	K1, K2	14.4
IV	Phenetics and cladistics	K1, K2	14.4
V	Ontogeny and phylogeny	K1, K2	14.4

**REFERENCE BOOKS:**

1. Cain, A. (2018). Animal Species and Their Evolution. Princeton University Press, US.
2. Parker, S. and Roberts, A. (2015). Evolution: The Whole Story. Thames and Hudson Publishers, UK.
3. Hall, B.K. and Hallgrímsson, B. (2014). Strickberger's Evolution. Jones and Bartlett Publishers, US.
4. Futuyma, D.J. (2013). Evolution, Sinauer Associates, USA.
5. Herron, J.C. and Freeman, S. (2013). Evolutionary Analysis. 5<sup>th</sup> Edition. Pearson Publication, India.
6. Scott, E.C. (2005). Evolution vs. Creation: An Introduction. University of California Press, Berkeley, CA.
7. Dobzhansky, T. (1970). Genetics of the evolutionary process, Columbia University Press, US.
8. Darwin, C. (1958). The Autobiography of Charles Darwin 1809-882., The Norton Library, New York, US.
9. Darwin, C. (1845). The Voyage of the Beagle. John Murray, London.



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(This syllabus is applicable to the students who are admitted on or after 2022-2023 academic year onwards)

**Core Paper-09**

**Total Contact Hours: 72**

**Credits: 4**

**Paper Code: 22ZOOC09**

**Weekly Contact Hours: 4**

### **BEHAVIOURAL ECOLOGY**

#### **Course Objectives:**

- To enable the students to impart knowledge about the different types of behaviour.
- To gain basic understanding about molecular genetics approaches
- To gain knowledge about animal communications.

#### **Course Outcome:**

- Students will get knowledge about the different types of animal behaviour.
- They apply their knowledge to know the behavioural patterns of animals while doing research.
- Students gain knowledge about the endocrine glands and the diseases

**Unit I** Introduction–Background to Behavioral ecology- Founding fathers- Karl Von Fritz, Tinbergen and Lorenz contribution-Methods for studying animal behaviour- proximate and ultimate causation of behaviour Different types of observation methods- Focal animal sampling- *Ad libitum* sampling- Scan sampling- One Zero sampling- Ethograms-Videography and Videography and Camera traps- Radio-telemetry- Molecular analysis of animal scats.

(14 Hours)

**Unit II** Animal movements-Taxis, Kinesis, Orientation, animal navigation and migration- Animal Learning- Instinct, Habituation, imprinting-Associative learning-Classical conditioning – Trial and error learning-Operant conditioning and positive and negative reinforcement-- Observational or social learning.

(14 Hours)

**Unit III** Social system- Selfish herd- Kin selection- Altruism- Honey bee, Reciprocal altruism- Vampire bats- Hamilton's rule-Group foraging and its advantages- Dispersion-migration- territoriality-Communication –Vocal and signal communication- Warning colouration, mimicry and deception. Mating system-Sexual dimorphism-Male- Male competition-Female choice-Leks-Alternative mating tactics –satellite males-monogamy-Polyandry-Polygyny-Sperm competition- Parental care.

(14 Hours)

**Unit IV** Behavioural Genetics- Effective population size- Hardy-Weinberg Equilibrium-Molecular markers- RAPD- RFLP-Mitochondrial DNA markers and DNA barcoding and

Barcode of life- DNA fingerprinting- QTL mapping- Genomics and Next generation sequencing- Phylogeography.

(15 Hours)

**Unit V** Chronobiology –Biological rhythm-Types and characteristics of biological rhythm - Zeitgebers: photic and non-photoc zeitgebers-Entrainment and free running rhythm- short term and long-term rhythm- Circadian rhythm, Pace maker, Melatonin and clock genes.

(15 Hours)

**Correlation of Programme objectives with course outcomes**

COURSE OUTCOME	PO1	PO2	PO3	PO4	PO5
• Background to Behavioral ecology	✓	✓	✓	✓	
• gain knowledge about Animal movements	✓	✓	✓	✓	
• Understand Social system in animals	✓	✓	✓	✓	
• Gain Knowledge about Behavioural Genetics	✓	✓	✓	✓	

**Unit wise programme specific qualification attributes**

Unit	Unit Title	Intended Learning Chapters (K1, K2)	Hours of Instruction
I	Background to Behavioral ecology	K1, K2	14.4
II	Animal movements	K1, K3	14.4
III	Social system in animals	K1, K2,K4	14.4
IV	Behavioural Genetics	K1, K2	14.4
V	Chronobiology	K1, K2,K3	14.4

**References:**

1. Alcock, J (2017). Animal Behavior: An Evolutionary Approach, Sinauer Associates, USA
2. Breed,M.D., and J. Moore (2015). Animal Behavior, 2<sup>nd</sup> Edition, Academic Press, USA
3. Davies, N.B., Krebs, J. R and West (2012). An Introduction to Behavioural Ecology, Wiley-Blackwel Publication, US.
4. Hadley,M., and J.Levine (2006). Endocrinology, Pearson 6<sup>th</sup> Edition, USA.
5. Joanna R. Freel and, Heather Kirk, & Stephen D (2020) Molecular Ecology, Wiley
6. Manning, A, and M. Dawkins (2012). An Introduction to Animal Behaviour, Cambridge University Press, London.
7. Nelson, R.J., Krigsfeld, L.J (2016). An Introduction to Behavioral Endocrinology, 5<sup>th</sup> Edition, OUP, USA.
8. Turner, C.D. (2012). General Endocrinology, East-West Press Pvt. Ltd, NewDelhi.
9. Wyatt, T.D. (2014). Pheromones and Animal Behaviour. Cambridge University Press, USA.
10. Bruce, A. Schutle, Thomas, E. and M.H.Ferkin, (2016). Chemical Signals in Vertebrates. Springer International Publishing. Switzerland.
11. Ring T. Clarde and A.K.Minks (2018). Insect Pheromones. A New Direction. Springer Publications, NY.



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**M.Sc. Zoology Course - SEMESTER-II**

(This syllabus is applicable to the students who are admitted on or after 2022-2023 academic year onwards)

**Core Paper-10**

**Total Contact Hours: 72**

**Credits: 4**

**Paper Code: 22ZOOC10**

**Weekly Contact Hours: 4**

**STEM CELL BIOLOGY**

**Course Objectives**

- To enable the students to impart knowledge about stem cell biology.
- To gain basic understanding culture and applications of stem cells
- To gain knowledge about stem cell signaling and its impact on disease treatment

**Course Outcome**

- Develop skills in stem cell biology
- To gain knowledge and practical skill related to clinical laboratories
- To establish knowledge on stem cell biology

**UNIT-I**

Introduction to Stem Cell Biology. Definition and properties of Stem Cell – Types of Stem Cells - Stem Cell Plasticity and Regeneration. Methods of Stem Cell differentiation into Heart, Kidney, Pancreatic tissues. Significance of pluripotent Stem Cells of Vertebrates embryos. Present perspective and future challenges of Stem Cells.

(14 Hours)

**UNIT-II**

Pluripotent Stem Cells- Molecular basis, Characteristics, and Characterization of human pluripotent Stem Cells. Multipotent adult Progenitor Cells, Cellular models of Pluripotency - EC, ES and EG Cells. Human ES and EG Cells. Role of Cytokines in Embryogenic Stem Cells. Importance of cytokine receptors.

(14 Hours)

**UNIT-III**

Stem Cell signaling- Signal transduction cascades in Stem Cell nucleus - Role of STAT signaling- STAT family – Structure and regulation of SHP/ERK signaling-WNT signaling-TGF $\beta$  signaling pathways and their functions in Stem Cells. Proteomics of Stem Cells pluripotency- Oct-4 as a key transcription factor-Oct-4 expression and activity assays, Regulation of Oct-4 expression. SOX2, Nano structure and function in Stem Cells.

(14 Hours)

**UNIT-IV**

Biomedical significance of Stem Cells technology – Significance of Stem Cells in Tissue engineering – Culture, Delivery and activation of local and distinct endogenous Stem Cells of Bone, Embryo and Hematopoietic Stem Cells. Applications of Cancer Stem Cells, Neural Stem Cells, Cell based repair for Cardio Vascular Regeneration and Neovascularization, Pancreatic Stem Cells and Cell based therapies for Musculo-Skeletal repair. Ethical and regulatory consideration about Stem Cells research and product development.

(15 Hours)

#### UNIT- V

Laboratory Facility for Human embryonic Stem cell research: General laboratory considerations, cell culture area, molecular biology area, Additional considerations. Record Keeping – General procedure, Reagent and consumable tracking, stock and Reagent inventory systems. Equipment maintenance, safety, Management of biological hazards. Quality control, Cell Banking system. Incoming cells, Initial Expansion (Mother stock), Secondary (Master Bank) Quality control standards – Routine monitoring of cell stays, Basic set of Tests for monitoring pass aged cells, Additional Tests for frozen cell Banks. Microbial contaminating Testing for mycoplasma, Fungal and bacterial contamination.

(15 Hours)

#### Correlation of Programme objectives with course outcomes

COURSE OUTCOME	PO1	PO2	PO3	PO4	PO5
• Develop skills in stem cell biology		✓	✓	✓	✓
• To gain knowledge and practical skill related to clinical laboratories		✓	✓	✓	
• To establish knowledge on stem cell biology		✓	✓	✓	

#### Unit wise programme specific qualification attributes

Unit	Unit Title	Intended Learning Chapters (K1, K2)	Hours of Instruction
I	Introduction to Stem Cell Biology	K1, K2, K3, K5, K6	14.4
II	Pluripotent Stem Cells	K1, K2, K3, K5	14.4
III	Stem Cell signalling	K1, K2, K3, K5	14.4
IV	Biomedical significance of Stem Cells	K1, K2, K3, K6	14.4
V	Laboratory Facility	K1, K2, K3, K6	14.4

#### REFERENCE BOOKS:

1. Lanza R. (2014). Handbook of Stem Cells. Elsevier Publication, USA.
2. Mary Clarke, Jonathan Frampton (2020). Stem Cells Biology and Application, Taylor and Francis, USA.
3. Robert Lanza and Robert Lanza, Anthony Atala (2013). Essentials of Stem Cell Biology. Academic Press, US.
4. Alain A. Vertès, Nasib Qureshi, Arnold I. Caplan, Lee E. Babiss (2015). Stem Cells in Regenerative Medicine: Science, regulation and business strategies, John Wiley & Sons, Ltd, US.



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**M.Sc. Zoology Course - SEMESTER-II**

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**Core Practical Paper-02**  
**Total Contact Hours: 108**

**Credits: 3**

**Paper Code: 22ZOOP02**  
**Weekly Contact Hours: 6**

**LAB COURSE-II**  
**(Core Papers: VI-X)**

**Course objectives:**

- To have hands on experience in handling of hormone related disorders.
- To support to do experiments on animal physiology
- To learn how do we enhance the productivity in Fishery and Silk industries

**Course outcome:**

- This course work paves the way for bringing research outcome for the betterment of our society and promotes entrepreneurship.

1. Pregnancy testing for hcG in urine samples (from Volunteers)
2. Identification of thyroidism among the students (from Volunteers)
3. Effect of pH on opercular movement in fish
4. Effect of temperature on opercular movement in fish
5. Online Observations of impact of climate change on Biodiversity in India
6. Cultivation of Silkworm to assess the Larval and Pupal stages of silkworm
7. Identification of Endocrine glands in mammals (Voucher Specimen)
8. Identification of Endocrine glands in insect (Voucher Specimen)
9. Identification of Scent glands in mammals
10. Identification of Pheromone glands in insects
11. Identification of Secondary sexual characters in Peacock
12. Identification of Homology among Fauna of Periyar University
13. Identification of Vestigial organs of human by Student Volunteers (own)
14. Ants and plant interaction (Convergent Evolution)

**SPOTTERS:**

1. Typical structure of Neuron
2. Ultra-structure of Skeletal Muscles
3. Observation of 24, 48 and 72 Hour stages of Chick embryo
4. Blastula and Gastrula stages in Embryo
5. Photographs for tsunami effects in Tamil Nadu
6. Adaptive Radiation in Darwin Finches
7. Marine and freshwater prawns
8. Phylogenetic Tree
9. Pheromone trap
10. Pheromones and Animal behaviours

### Correlation of Programme objectives with course outcomes

COURSE OUTCOME	PO1	PO2	PO3	PO4	PO5
• Develop skills for dissecting animals	✓	✓	✓	✓	
• Draw the neuro-endocrine system in insects	✓	✓	✓	✓	
• Identify and explain about the stages of chick embryo	✓	✓	✓	✓	✓
• Able to identify blood groups and developing lab technician skills	✓	✓	✓	✓	

### Unit wise programme specific qualification attributes

Unit	Unit Title	Intended Learning Chapters (K1, K2)	Hours of Instruction
I	Animal Physiology	K1, K2, K6	21.6
II	Developmental Biology	K1, K2, K6	21.6
III	Evolution	K1, K2, K6	21.6
IV	Animal Behaviour	K1, K2, K6	21.6
V	Endocrinology	K1, K2, K6	21.6

### REFERENCE BOOKS

1. Laura R. Keller, John H. Evans, Thomas C. S. Keller (1999). Experimental Developmental Biology: A Laboratory Manual, Academic Press, US.
2. Yolanda P. Cruz (1993). Laboratory Exercises in Developmental Biology, Academic Press, US.
3. Nigam SC, Nigam SC and Omkar (2006). Experimental Animal Physiology and Biochemistry, New Age International, India.
4. Seidman and Moore (2009). Basic Laboratory Methods for Biotechnology: Textbook and Laboratory Reference, 2<sup>nd</sup> edition. Prentice Hall, UK.





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(This syllabus is applicable to the students who are admitted on or after 2022-2023 academic year onwards)

Elective Paper-03

Total Contact Hours: 72

Credits: 4

Paper Code: 22ZOOE03

Weekly Contact Hours: 4

### VERMITECHNOLOGY

#### Course Objectives:

- To understand the concepts of vermiculture and vermicomposting.
- To understand the characteristics of earthworm species suitable for vermiculture and vermicomposting.
- To understand various applications of earthworms in organic solid waste management, soil fertility, and bioremediation.

#### Course Outcomes:

On successful completion of this course, the student will be able to understand the core concepts of vermiculture and vermicomposting and then involved in the entrepreneurship to promote agriculture. Successful students will apply vermitechnology in vermicomposting, soil fertility, and bioremediation processes and become an entrepreneur.

**UNIT- I:** Introduction to Vermitechnology – Earthworms – morphology and anatomy – Biology of *Perionyx excavatus*. – Ecological grouping – Epigeic, Anecic and Endogeic species; Role of earthworms in nutrient cycling and sustainable agriculture.

(14 Hours)

**UNIT- II:** Vermiculture – definition, scope and importance; Endemic and Exotic earthworm species for culture – Environmental requirements; Culture methods – indoor and outdoor cultures – monoculture and polyculture. Vermibed preparation.

(14 Hours)

**UNIT- III:** Applications of vermiculture – Vermicomposting – different methods of vermicomposting; use of vermicastings in organic farming/horticulture, earthworms for management of municipal organic solid wastes. Nutrient value of worm cast/vermicompost – Vermiremediation of hazardous materials. Vermiwash preparation and application.

(14 Hours)

**UNIT- IV:** Advantages of Vermicomposting Technology – Earthworm and microbial influence during vermicomposting – Physical, chemical and biological influence of earthworms in drilospheres and vermicasts. Marketing the products of vermiculture – creating the demand by awareness and demonstration, advertisements, packaging and transport, direct marketing.

(15 Hours)

**UNIT- V:** Predators, Parasites, and Pathogens of Earthworms and their control. Earthworms in food and medicine – Prospects of vermiculture as a self-employment venture – Potentials and constraints for vermiculture in India.

(15 Hours)

**Correlation of Programme objectives with course outcomes**

COURSE OUTCOME	PO1	PO2	PO3	PO4	PO5
• To understand various applications of Vermitechnology	✓	✓	✓	✓	
• To identify earthworm species used in organic waste management	✓	✓	✓	✓	
• To use earthworms in bioremediation of industrial wastes	✓	✓	✓	✓	
• To become an entrepreneur by culturing earthworms	✓	✓	✓	✓	

**Unit wise programme specific qualification attributes**

Unit	Unit Title	Intended Learning Chapters (K1, K2)	Hours of Instruction
I	Morphology and Anatomy	K1, K2	14.4
II	Vermiculture & Culture methods	K1, K2	14.4
III	Applications of vermiculture	K1, K2, K3, K6	14.4
IV	Advantages of Vermitechnology	K1, K2, K3, K4, K5, K6	14.4
V	Diseases and control	K1, K2, K3, K4, K5, K6	14.4

**REFERENCES**

- 1 Edwards, C.A. Arancon, N.Q. and Sherman, R. (2011). Vermiculture Technology: Earthworms, Organic Wastes, and Environmental Management. CRC Press, Boca Raton, FL.
- 2 Karaca, A. (2011). Biology of Earthworms (Soil Biology Book-24). Springer Publishers.
- 3 Ranganathan, L.S. (2006). Vermibiotechnology – From Soil Health to Human Health. Agrobios, India.
- 4 Ismail, S.A. (2005). The Earthworm Book. Second Edition, Other India Press, Apusa, Goa, India.
- 5 Edwards, C.A. (2004). Earthworm Ecology. CRC Press, Boca Raton, FL.
- 6 Ismail, S.A. (1997). Vermicology: The Biology of Earthworms. 1st Edition, Orient Longman, India.



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PERIYAR UNIVERSITY  
DEPARTMENT OF ZOOLOGY

Salem-636011, Tamil Nadu

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

SUTHANTHIRA THIRUNAL AMUDHA PERUVIYHA  
TAMIL NADU



**M.Sc. Zoology Course - SEMESTER-II**

(This syllabus is applicable to the students who are admitted on or after 2022-2023 academic year onwards)

**Elective Paper-04**

**Total Contact Hours: 72**

**Credits: 4**

**Paper Code: 22ZOOE04**

**Weekly Contact Hours: 4**

**BAT ECOLOGY**

**Course Objectives:**

- To enable the students to impart knowledge about the different types of bats
- To gain basic understanding about chronobiology.
- To gain knowledge about bats behaviour.

**Course Outcome:**

- Students will get knowledge about the different types of bats.
- They apply their knowledge to know the behavioral patterns of bats.
- Students gain knowledge about the chronobiology and molecular techniques.

**UNIT I**

Fundamentals of ethology: Introduction- Founding fathers of animal behaviour - Innate and acquired behaviour - Proximate and ultimate causation of behaviour - Animal learning – Trial and error learning - Classical and operant conditioning.

(14 Hours)

**UNIT II**

Breeding and foraging behavior: Breeding behaviour – Monogamy - Polygamy - Polyandry – Resource defence polygyny - Female defence polygyny - Advantages of roosting together - Parental Care-Foraging behaviour – Types of foraging – Group and solitary foraging – Factors affecting foraging - Resource sharing - Partitioning of resources – Eavesdropping.

(14 Hours)

**UNIT III**

Chronobiology: Introduction- Different types of biological rhythm- Ultradian, Circadian and Infradian rhythms- Zeitgebers, Free running and entrainment of rhythms- Animals with varying circadian rhythms- Role of Pineal gland and Melatonin in Circadian rhythm- Body temperature rhythm. Neural basis of biological clock and role of suprachiasmatic nuclei. Sleep wakefulness cycle. Time keeping genes. problems and treatments for Jet-lag and shift work.

(14 Hours)

**UNIT IV**

Collection and identification of bats: Classification of bats and their identification – Collection methods of bats - Mist netting - hoop netting - Tuttle traps – Methods of marking bats – Non-invasive methods of identification of bats - Methods to study the abundance of bats. Echolocation and its uses- Classification based on echolocation-Classification based on

food types - Bat roosting areas - Beneficial role of bats – Pollination - seed dispersal - insect control - guano analysis - Diseases spread by bats.

(15 Hours)

#### UNIT V

Molecular ecology: Molecular ecology and phylogeography – DNA markers – DNA fingerprinting - Minisatellites - Microsatellite - Mitochondrial DNA - PCR – RAPD – RFLP- DNA Structure and Inheritance, Molecular Markers, Genomics and Next-Generation Sequencing- Population Genetic Diversity and Effective Population Size- Phylogenetics and Barcoding- QTL Mapping.

(15 Hours)

#### Correlation of Programme objectives with course outcomes

COURSE OUTCOME	PO1	PO2	PO3	PO4	PO5
• Background to Bat ecology	✓	✓	✓	✓	
• Gain knowledge about Bat movements	✓	✓	✓	✓	
• Understand Social system in Bats	✓	✓	✓	✓	
• Gain Knowledge about molecular ecology of bats	✓	✓	✓	✓	

#### Unit wise programme specific qualification attributes

Unit	Unit Title	Intended Learning Chapters (K1, K2)	Hours of Instruction
I	Fundamentals of ethology	K1, K4	14.4
II	Breeding and foraging behavior	K1, K3	14.4
III	Chronobiology	K1, K2, K3	14.4
IV	Collection and identification of bats	K1, K2	14.4
V	Molecular ecology	K1, K2, K5	14.4

#### REFERENCE BOOKS

1. Alcock, J. (2013). Animal Behavior: An evolutionary approach. Sinauer Associates, Inc
2. Chandrashekar, M.K. (2006). Time in the living world. University Press (India) Ltd.
3. Dytham, C. (1999). Choosing and Using Statistics: A Biologist's Guide. Oxford: Blackwell Scientific.
4. Kunz, T.H. & B. Fenton. (2000). Bat ecology. Pp.798, University of Chicago Press.
5. Martin, P. & Bateson, P. (1999). Measuring Behaviour: An Introductory Guide. 2nd edn. Cambridge: Cambridge University Press.
6. Rowe, G., Beebe, T. (2008). An introduction to Molecular Ecology. Oxford University Press.



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**M.Sc. Zoology Course - SEMESTER-III**

(This syllabus is applicable to the students who are admitted on or after 2022-2023 academic year onwards)

**Core Paper-11**

**Total Contact Hours: 72**

**Credits: 4**

**Paper Code: 22ZOOC11**

**Weekly Contact Hours: 4**

**IMMUNOLOGY**

**Course Objectives:**

- To motivate students to learn the lymphoid organs of our body
- To make them understand the different types of immunoglobulins
- To get knowledge about different types of techniques used in immunology

**Course Outcome:**

- The students will get more knowledge about lymphoid organs
- The students could differentiate the immunoglobulin based on their structures
- Students get overview knowledge about immunology
- All the students get vaccinated against Covid 19

**UNIT I**

History of Immunology-Jenner, Pasteur, Metchnikoff, Kitasato – Types of immunity – Innate immunity- organs involved- Acquired Immunity – Cells involved- Hematopoietic stem cells – Cells of immune system, T and B cell activation and maturation, Antigen- The molecular basis of antigen and antibody interactions. Organs of Immunity- Primary- Bone marrow, Bursa- Thymus- Secondary lymphoid Organs- Lymph nodes, MALT- Spleen.

(14 Hours)

**UNIT II**

Immunoglobulins- General Structure- Types- IgG, IgA, IgM, IgE, IgD- Class switching- Hybridoma technology- Monoclonal antibody production and designer monoclonal antibodies. Immunologic messenger molecules- Cytokines, Chemokines, interferons interleukins- Complement system: Classical, Alternate, MBL pathway.

(14 Hours)

**UNIT III**

Transplantation Immunology- Tissue typing and organ transplantation –MHC gene in human and mouse, MHC class I and class II molecules –Autoimmune diseases: Type-1 Diabetes- Addison's disease and Graves, disease. Immunostimulation and Immunosuppression and their clinical significance.

(14 Hours)

#### UNIT IV

Immunity against diseases- HIV- Structure- spread and control- Covid-19- Stages of infection- spread and control measures- quarantine. Molecular interaction between T cell and Corona virus-2 - Covid19 Vaccines and their effectiveness - booster dose. Cancer and Tumour immunology – Nobel Prize 2020 for discovery of Immunotherapy for Cancer – 2019 Nobel Prize for discovery concerns the impact of Hepatitis C virus and Cancer.

(15 Hours)

#### UNIT V

Techniques in Immunology: Radio Immuno Assay, ELISA, Western Blotting, Immunofluorescence technique, immunohistochemistry. Vaccines– whole organism vaccine, synthetic peptide vaccine, multivalent subunit-anti idotype vaccine, designer vaccine, edible vaccine, DNA vaccine, recombinant vector vaccine; Abzymes, Current scenario of vaccines and vaccination.

(15 Hours)

COURSEOUTCOME	PO1	PO2	PO3	PO4	PO5
• To become an immune therapist in hospitals	✓	✓	✓	✓	
• Medical consultant in hospitals	✓	✓	✓	✓	✓
• To develop clinical laboratories	✓	✓	✓	✓	

#### Unit wise programme specific qualification attributes

Unit	Unit Title	Intended Learning Chapters (K1,K2)	Hours of Instruction
I	Historical perspectives, lymphoid organs	K1,K2	14.4
II	Immunoglobulins Structure & Function	K1,K2	14.4
III	MHC gene	K1,K2	14.4
IV	Vaccines	K1,K2,K3,K6	14.4
V	Principles and applications of immune techniques	K1,K2,K3,K6	14.4

#### REFERENCE BOOKS:

1. Abbas,A.K., and A.H.Lichtman (2017). Cellular and molecular immunology, First-South Asia Edition, Elsevier.
2. Delves,P.,S. Martin,D. Burtonand I.M.Roitt, (2017). Roitt's Essential Immunology, 13<sup>th</sup>Edition, Wiley–Blackwell publications, USA
3. Murphy,K.M., and Weaver,C (2017). Janeway's Immunology, 9<sup>th</sup>edition, W.W.Norton & Company, USA
4. Paul,W.E. (2012). Fundamental Immunology, 7<sup>th</sup>Edition, Lippincott Williams and Wilkins, USA
5. Punt.J., Stranford,S., Jones,P., W.A. Owen (2018). Kuby Immunology 8<sup>th</sup>Edition,W.H. Freeman & Company, NewYork.
6. Tizard,I.R.(1995). Immunology- An introduction IV Ed. Saunders College Publications, Philadelphia, USA.



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**M.Sc. Zoology Course - SEMESTER-III**

(This syllabus is applicable to the students who are admitted on or after 2022-2023 academic year onwards)

**Core Paper-12**

**Total Contact Hours: 72**

**Credits: 4**

**Paper Code: 22ZOOC12**

**Weekly Contact Hours: 4**

**ANIMAL CELL CULTURE AND NANOBIOTECHNOLOGY**

**Course Objectives:**

- Students are motivated to impart knowledge and practical skills on isolation, culture and preservation of animal cells.
- This course is intended to provide solid understanding of concepts and applications of animal cell culture. This course also teaches the students to learn the different techniques of culturing the specific type of cells.
- This subject also aims to provide knowledge practical skills on the synthesis, characterization and application of different nanoparticles.

**Course Outcome:**

- You will be an expertise in cell culture theory and practices.
- On completion of the course you can fit yourselves in the international nanotechnology laboratories reproducing your experience the study period.
- You will have basic and novel ideas for future research on monotherapy for various diseases.

**UNIT – I**

Introduction to animal cell and tissue culture, its advantages and limitations Stages of culturing - cell culture media, cell lines, characterization and maintenance of cell lines large scale culture, bioreactor models for animal cell culture. Applications of cell line in understanding the basic cell biology. Telomerase and cellular aging. Cryopreservation and cell bank.

(14 Hours)

**UNIT – II**

Transgenic techniques: use of viral vectors –adenovirus, adeno associated virus, retroviral vectors. Stem cells – Definition, functions and origin, types, stem cell therapy, stem cell culture. Cloned genes and production of recombinant proteins and vaccines. Insulin, somatotrophin, Human interferons. Hepatitis B virus vaccine; DNA vaccine. Ethical and biosafety considerations.

(14 Hours)

### UNIT – III

Scope of Nanobiotechnology– Landmarks in Nanobiotechnology – Current Scenario of Nano Science and Technology. Synthesis of Nano materials – Biological Methods and Chemical Methods – Chemical Vapor condensation and Sol gel methods. Monodispersion of Nanoparticles. Nanobiomaterials.

(14 Hours)

### UNIT – IV

Optical (UV-Vis/Fluorescence), X-ray diffraction, Imaging and size (Electron microscopy), Light scattering technique, Zeta potential, Surface and composition (ECSA, EDAX, AFM/STM), Vibrational (FT-IR and RAMAN), SERS - Magnetic, Electrical and Electrochemical

(15 Hours)

### UNIT – V

Development of Drug delivery system: Use of polymers and co-polymers in drug delivery. Methods of drug loading. Evaluation of cytotoxicity, drug ability for the drug loaded nano materials. Nanomaterials as gene delivering agent; Uses of Nanomaterials in controlling microbial diseases, biochemical and genetic disorders. Development of Nanomedicine for diabetes and cancer.

(15 Hours)

### Correlation of Programme objectives with course outcomes

COURSE OUTCOME	PO1	PO2	PO3	PO4	PO5
• To become a researcher in nanotechnology	✓	✓	✓	✓	
• To become an entrepreneur in producing animal model for research	✓	✓	✓	✓	
• To develop mass culture in industries	✓	✓	✓	✓	✓

### Unit wise programme specific qualification attributes

Unit	Unit Title	Intended Learning Chapters (K1, K2)	Hours of Instruction
I	Animal cell culture	K1, K2, K3, K6	14.4
II	Transgenic techniques	K1, K2, K3, K6	14.4
III	Introduction and Synthesis	K1, K2, K3, K6	14.4
IV	Characterization of Nano materials	K1, K2, K3, K6	14.4
V	Development of Drug delivery system	K1, K2, K3, K6	14.4

### REFERENCE BOOKS:

1. John Masters (2000). Animal Cell Culture: A Practical Approach. OUP Oxford
2. Al-Rubeai M (2015). Animal Cell Culture, Springer.
3. Davis JM (2011). Animal Cell Culture: Essential Methods, Wiley-Blackwell, USA.
4. Mather JP and Barnes D (2003). Methods in Cell Biology, Vol 57 Animal Cell Culture Methods, Academic Press, New York.



5. David J Lockwood (2004). FRSC: Introduction to Nanoscale Science and Technology, National Research Council of Canada Ottawa, Ontario, Canada.
6. Shuchi Kaushik, Anurag Jyoti, Rajesh Singh Tomar (2020). Nanobiotechnology: Concepts and Applications in Health, Agriculture, and Environment. CRC Press.
7. Arunava Goswami, Samrat Roy Choudhury (2017). Nanobiotechnology Basic and Applied Aspects. Anthem Press.



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TAMIL NADU



**M.Sc. Zoology Course - SEMESTER-III**

(This syllabus is applicable to the students who are admitted on or after 2022-2023 academic year onwards)

**Core Paper-13**

**Total Contact Hours: 72**

**Credits: 4**

**Paper Code: 22ZOOC13**

**Weekly Contact Hours: 4**

### PRINCIPLES OF ECOLOGY

#### **Course Objectives:**

- To understand how interactions between organisms and their physical environment drive the dynamics of individuals, populations, communities, and ecosystems.
- To understand the importance of ecology to issues regarding human welfare.
- To learn about the significance of endemic biodiversity and the need for its conservation.
- To understand the idea, methodology and basic tools of environmental modeling and their applications.

#### **Course Outcomes:**

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

- Understand core concepts and methods from ecological science and its application in environmental problem-solving.
- Understand the importance of ecology to issues regarding human well-being.
- See the connectivity and relevance of ecology to other fields of study.

#### **UNIT I**

**The Environment:** Physical environment; biotic environment; biotic and abiotic interactions. Concept of habitat and niche; fundamental and realized niche; resource partitioning; character displacement. Ecological complexity and stability in food webs, Food chain and their significance, Ecological pyramids. **Ecosystem:** Structure and function; energy flow and mineral cycling (CNP); Concepts of Limiting factors – Liebig's law of minimum – Shelford's law of tolerance.

(14 Hours)

#### **UNIT II**

**Environmental Pollution and Management: Air pollution:** Source, pollutants and effects of CFC, ozone, acid rain - global warming, emission standards, monitoring and control of pollution. **Water pollution:** Sources, effects - sewage and industrial wastes - Waste water treatment - eutrophication. - biomagnifications. **Oil pollution:** Coastal pollution - Oil Slicks and Spills, Post-gulf war effects. **Land pollution:** Solid waste and hospital waste management. Microplastics Pollution and Remediation. Organizations involved in environmental protection. Global Environmental Policies.

(14 Hours)

### UNIT III

**Population and Community Ecology:** Characteristics of a population; population growth curves; population regulation; life history strategies (*r* and *K* selection). **Species interactions:** Types of interactions, interspecific competition, herbivory, carnivory, pollination, symbiosis. **Communities:** Nature of communities; community structure and attributes; levels of species diversity and its measurement; edges and ecotones. **Ecological succession:** Types; mechanisms; changes involved in succession; concept of climax.

(14 Hours)

### UNIT IV

**Biogeography:** Major terrestrial biomes; theory of island biogeography; biogeographical zones of India. **Biodiversity and Conservation biology:** Importance of biodiversity, Global biodiversity hotspots - endemic, endangered and Keystone species - Diversity measurements - Principles of conservation, major approaches to management, Indian case studies on conservation/management strategy (Project Tiger, Biosphere reserves).

(15 Hours)

### UNIT V

**Environmental Stress and Management:** Global climatic pattern, global warming, atmospheric ozone, acid and nitrogen deposition, Impact of climate change on biodiversity. Major classes of contaminants. Uptake, biotransformation, detoxification, elimination and accumulation of toxicants. Bioindicators and biomarkers of environmental health. **Environmental modelling:** Scope and problem definition, goals and objectives, definition; modelling approaches– deterministic, stochastic and the physical approach; applications of environmental models.

(15 Hours)

### Correlation of Programme objectives with course outcomes

COURSE OUTCOME	PO1	PO2	PO3	PO4	PO5
• To become an ecologist and an environmentalist	✓	✓	✓	✓	
• To become forest conservator	✓	✓	✓	✓	
• To work in pollution control board	✓	✓	✓	✓	

### Unit wise programme specific qualification attributes

Unit	Unit Title	Intended Learning Chapters (K1, K2)	Hours of Instruction
I	The Environment	K1, K2	14.4
II	Environmental Pollution and Management	K1, K2, K6	14.4
III	Population and Community Ecology	K1, K2, K3, K4, K5	14.4
IV	Biogeography; Biodiversity and Conservation Biology	K1, K2, K3, K4, K5	14.4
V	Environmental Stress and Management; Environmental Modelling	K1, K2, K3, K4, K5	14.4

### REFERENCE BOOKS:

- 1) Copsey, J.A. and Black, S.A. (2018). Species Conservation: Lessons from Islands (Ecology, Biodiversity and Conservation). Cambridge University Press.
- 2) Sharma, B.K. (2015). Environmental chemistry. 11<sup>th</sup> edition, Goel Publishing House, Meerut.

- 3) Dhawan, N.G. and Khan, A.S. (2014). Disaster Management and Preparedness. (Based on the syllabus prescribed by UGC for Disaster Management Education). CBS Publishers. New Delhi.
- 4) Morin, P.J. (2011). Community Ecology. 2<sup>nd</sup> edition, Wiley-Blackwell Publishers.
- 5) Odum, E. and Barrett, G.W. (2005). Fundamentals of Ecology. 5<sup>th</sup> Edition, Cengage Publishers.
- 6) Asthana, D.K. and Meera, A. (2001). Environment – Problems and Solution. S. Chand and Company, New Delhi.
- 7) Sharma, B.K. and Kaur, H. (1997). An Introduction to Environmental Pollution. Goel Publishing House, Meerut.
- 8) Edward, I.N. (1996). Applied Ecology and Environmental Management. Wiley-Blackwell Publishers.
- 9) Sinha, R.K. (1996). Biodiversity - Global Concerns. Common Wealth Publishers.



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**M.Sc. Zoology Course - SEMESTER-III**

(This syllabus is applicable to the students who are admitted on or after 2022-2023 academic year onwards)

**Core Paper-14**

**Total Contact Hours: 72**

**Credits: 4**

**Paper Code: 22ZOOC14**

**Weekly Contact Hours: 4**

**BIOLOGY OF CANCER**

**Course Objectives:**

- To motivate students to learn the fundamentals of cancer
- To enable the students to know how the cancer treatment strategy
- To get knowledge about different types of cancer diagnosis and treatment.

**Course Outcome:**

- This course work provides chance to work in stem cells and cancer stem cells. There is a chance for the students to enter into the modern cancer and stem cell laboratories as scientist.

**UNIT I**

Regulation of the Eukaryotic cell cycle, Cancer biomarkers, Primary and established cell lines, Kinetics of Cancer cell growth, Genetics of cancer biology. Cancer proteomics at a glance. 1975 Nobel Prize for the discovery concerning the infection between tumour viruses and the genetic material of the cell. 1989 Nobel Prize for discovery of the cellular origin of retroviral oncogenes.

(14 Hours)

**UNIT II**

Cell Signaling in Cancer Cells and Signaling Types of signaling pathways that control gene activity in normal and cancer cells, endocytotic and exocytotic proteins in membranes and organelles. 1992 Nobel Prize for discoveries concerning reversible protein phosphorylation as a biological regulatory mechanism. 2001 Nobel Prize for the discoveries of key regulators of the Cell Cycle

(14 Hours)

**UNIT III**

Etiology, epidemiology, diagnosis and treatment of Breast, Lung, cervical and colo-rectal, cancers. Current scenario of micro-RNA technology in cancer medicine. Role of DNA vaccination in cancer treatment. 2008 Nobel Prize for discovery of human papilloma viruses causing cervical cancer. 2020 Nobel prize for the discovery of Hepatitis C virus causes Cancer.

(14 Hours)

**UNIT IV**

2002 Nobel Prize for the discoveries concerning genetic regulation of organ development and programmed Cell Death. Diagnosis of Cancer : At cytological Level, at biochemical level and at genetic level. MRI Scan : 2003 Nobel Prize for discoveries concerning Magnetic Resonance Imaging. Principle and applications of RNAi technology: 2006 Nobel Prize for

discovery of RNA interference- gene silencing by double standard RNA, Cancer Stem cell technology.

(15 Hours)

#### UNIT V

Cancer Therapy: Principle and Applications of Surgery, Radiotherapy, Chemotherapy, Immunotherapy, hormone therapy, Monoclonal antibody therapy, combinatorial therapy. Merits and Demerits of Cancer therapy. Mechanism of development of drug resistance in cancer cells, Development of Multidrug resistance. Significance of Triple negative cancers and its challenge in cancer treatment. Nano-based smart drug delivery and treatment of cancer. Cancer gene therapy, Therapeutic Cloning and small molecule therapy for cancer.

(15 Hours)

#### Correlation of Programme objectives with course outcomes

COURSE OUTCOME	PO1	PO2	PO3	PO4	PO5
• To become researcher in oncology	✓	✓	✓	✓	✓
• To gain knowledge in etiology and epidemiology of various cancers	✓	✓	✓	✓	
• To acquire knowledge about molecular biology of cancer	✓	✓	✓	✓	✓
• To develop practical skills in diagnosis of various cancers	✓	✓	✓	✓	

#### Unit wise programme specific qualification attributes

Unit	Unit Title	Intended Learning Chapters (K1, K2)	Hours of Instruction
I	Regulation of the Eukaryotic cell cycle	K1, K2, K3, K4, K5	14.4
II	Cell Signaling	K1, K2, K3, K4, K5	14.4
III	Etiology, Epidemiology and Tehranostics	K1, K2, K3, K4, K5, K6	14.4
IV	Introduction to Stem cells	K1, K2, K3, K4, K5, K6	14.4
V	Applications of cancer stem cells	K1, K2, K3, K4, K5, K6	14.4

#### REFERENCE BOOKS:

1. Turksen K (2002). Embryonic Stem Cells Method and Protocols. Humana press.
2. Korobkin R and Munzer SR (2007). Stem Cell Century, Law and Policy for a Breakthrough Technology, Yale University Press.
3. Lanza R (2004). Hand Book of Stem Cells Volume 1and2, Elsevier press.
4. Committee R (2004). Stem Cells and the Future of Regenerative Medicine by on the Biological and Biomedical Application of Stem Cell Research.
5. Robertis EDP and De Robertis EMF (2005). Cell and Molecular Biology, (8th edn), De, B.I.Waverly Pvt. Ltd., New Delhi.
6. Lodish H, Kaiser CA, Brasher A, Amon A, Berk A, Kreger M, Ploegh H and Scott MP (2012). Molecular Cell Biology, 7<sup>th</sup> edition, Garland Publishing, Inc. New York.
7. Kiessling, A.A. (2006). Human Embryonic Stem Cells (Second Ed.) Jones & Barlett Publishers.
8. Lanza, R. (2005). Essentials of Stem Cell Biology. Academic Press.



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### M.Sc. Zoology Course - SEMESTER-III

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**Core Practical Paper-03**  
**Total Contact Hours: 108**

**Credits: 3**

**Paper Code: 22ZOOP03**  
**Weekly Contact Hours: 6**

#### **LAB COURSE-III** **(Core Paper XI-XIV)**

#### **Course Objectives:**

- To motivate students to learn immuno-techniques
- To understand how do separate proteins and DNA
- To get knowledge about different types of nanobio-techniques

#### **Course Outcome:**

- These hands on training course would support the students to get into research with throughput ideas. Chance for them to work in molecular biology laboratories.

1. Radial immunodiffusion
2. Double immunodiffusion
3. Blood Group Testing
4. Immuno electrophoresis
5. Widal Test – Quantitative and Qualitative Method
6. Isolation of plasmid DNA and Agarose Gel Electrophoresis
7. Isolation of chromosomal DNA from human blood
8. SDS PAGE to determine protein Molecular Weight
9. Placoid and Tenoid scale
10. Synthesis of Silver Nanoparticle
11. Biosynthesis of Gold Nanoparticle
12. Characterization of Synthesized Nanoparticle using UV-Visible Spectrophotometer
13. Population Estimation of Soil organisms
14. Determination of Dissolved oxygen by Wrinkler's Method
15. Fauna of Pond and Grassland Ecosystems in Periyar University Campus.

#### **SPOTTERS**

1. MCF-7 cells
2. A549 Cells
3. ZR751 Cells
4. HepG2 Cells
5. Electrophoresis unit
6. Autoimmune diseases
7. ELISA Reader

8. DAPI Staining Picture
9. AO/EtBr Staining Picture
10. Apoptotic Cells
11. Zeta analyzer
12. Scanning electron Microscope
13. X-Ray Diffraction
14. Rocket Gel Immuno Electrophoresis

#### Correlation of Programme objectives with course outcomes

COURSE OUTCOME	PO1	PO2	PO3	PO4	PO5
• Develop skills on blood group testing	✓	✓	✓	✓	
• Develop skills AGE & PAGE	✓	✓	✓	✓	
• Skills on synthesis of nanoparticles	✓	✓	✓	✓	✓
• Develop knowledge on various cell lines	✓	✓	✓	✓	

#### Unit wise programme specific qualification attributes

Unit	Unit Title	Intended Learning Chapters (K1, K2)	Hours of Instruction
I	Immunology	K1, K2, K3, K4, K5	27
II	Animal cell culture and nanobiotechnology	K1, K2, K3, K4, K5	27
III	Principles of Ecology	K1, K2, K3, K4, K5	27
IV	Biology of Cancer	K1, K2, K3, K4, K5	27

#### REFERENCE BOOKS

1. Hay FC and Westwood OMR (2008). Practical Immunology, John Wiley and Sons.
2. Wilson K and Walker JM (2010). Principles and Techniques of Biochemistry and Molecular Biology, Cambridge University Press.
3. Yadav B (2012). Bioinformatics: A practical guide for Molecular Biologists LAP Lambert Academic Publishing.
4. Green MR and Sambrook J (2012). Molecular cloning: a laboratory manual, 2nd ed. Cold Spring Harbor, N.Y.: Cold Spring Harbor Laboratory Press.
5. Kannan S, Krishnan M, Thirumurugan R and Achiraman S (2012). Methods in Molecular Biology, UVN Publishers, India.





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**Elective Paper-05**

**Total Contact Hours: 72**

**Credits: 4**

**Paper Code: 22ZOOE05**

**Weekly Contact Hours: 4**

**AQUACULTURE AND FISHERY BIOLOGY**

**Objectives:**

- ❖ Main objective is to provide basic knowledge on cultivation of aquatic animals
- ❖ to provide advanced knowledge about establishment of aquaculture industry.

**Outcome:**

- ❖ Our stake holders will become the best entrepreneur in the field of aquaculture and fishery industry. Further our students will become a fisher biologist to cultivate genetically engineered fishes in the form of food and ornamental organisms.

**UNIT - I**

Historical background and present status of aquaculture: purpose and importance of aquaculture. Types of culture systems: Traditional, extensive, semi-intensive, intensive, super-intensive. Characteristic features of cultivable species (Indian major carps, murels, catfish and tilapia), oyster, crustaceans (Crabs, lobsters and copepods) and Prawns.

(14 Hours)

**UNIT - II**

Types of aquaculture: Freshwater and brackish water aquaculture and mariculture, merits and demerits. Site selection and for ponds, design, construction and management of ponds, types of ponds. Control of aquatic weeds, pests and predators.

(14 Hours)

**UNIT - III**

Composite fish culture: Mono sex culture, culture of air-breathing fishes, sewage fed fish culture, Fish-cum duck culture: induced breeding of carps: Broodstock management. Prawn Culture: Introduction to prawns, Types of species, Fresh water prawn farming and Marine Prawn farming, Methods of Prawn farming. Spoilage and its prevention.

(14 Hours)

**UNIT - IV**

Fish and prawn diseases: Parasitic, protozoan, bacterial, fungal and viral diseases and their control measures. Processing and preservation of prawns and Fishes, fishery by-products.

(15 Hours)

## UNIT - V

Present status of Freshwater, riverine, reservoir, pond and cold-water fisheries. Estuarine and brackish water fisheries and their economics. Fish gears and crafts used in South Indian Fisheries. Marine Fisheries: Sardine, Mackerel, Bombay duck, Sciaenids, Ribbonfish, Silver bellies, Pomfrets, Carangids, Sharks, Shrimps, Molluscs (Mussels, clams and scallops) and their economic importance. CMFRI, CIBA, MPEDA, CIFT, FSI, CIFT

(15 Hours)

### Correlation of Programme objectives with course outcomes

COURSE OUTCOME	PO1	PO2	PO3	PO4	PO5
• To develop aquaculture industry	✓	✓	✓	✓	
• To become researcher in fishery biology	✓	✓	✓	✓	
• Entrepreneur in pearl culture	✓	✓	✓	✓	

### Unit wise programme specific qualification attributes

Unit	Unit Title	Intended Learning Chapters (K1, K2)	Hours of Instruction
I	Historical background and present status	K1, K2, K3	14.4
II	Types of aquaculture	K1, K2, K3	14.4
III	Composite fish culture Technique	K1, K2, K3	14.4
IV	Fish diseases & Control	K1, K2, K3, K4, K5	14.4
V	Inland fisheries	K1, K2, K3, K4, K5	14.4

### REFERENCE BOOKS:

1. Mikkola H (2017). Fisheries and Aquaculture In The Modern World. Intech publisher
2. Sandra E. Shumway and G. Jay Parsons (2016). Scallops: Biology, Ecology, Aquaculture, and Fisheries (Developments in Aquaculture and Fisheries Science) (3 Ed) Elsevier Science
3. Khanna SS and Singh HR (2014). A Text Book of Fish Biology & Fisheries, 2<sup>nd</sup> Edition, Publisher: Narendra Publishing House, New Delhi.
4. John E. Bardach, John H. Ryther, William O. Mclarney (2013). Aquaculture: The Farming and Husbandry of Freshwater and Marine Organisms (1<sup>st</sup> Ed), Wiley India Pvt Ltd.
5. Swain SK (2012), Fisheries and Aquaculture Technology, Swastik Publishers and distributors
6. Moyle PB and Joseph J (2011). Fishes: An Introduction to Ichthyology (5<sup>th</sup> Ed), Prentice Hall India Learning P. Ltd.
7. Pillay TVR and Kutty MN (2011). Aquaculture: Principles and Practices (2<sup>nd</sup> Ed), Wiley India Pvt Ltd.
8. Rath RK (2011). Freshwater Aquaculture (3<sup>rd</sup> Ed), Scientific Publishers Journals Dept.
9. Srivastava C B L and Sushma (2006). A Text Book of Fishery Science and Indian Fisheries, KitabMahal, New Delhi.



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TAMIL NADU



சுதந்திரத்திற்குள்ளே  
அமுதம் பெருவழி

**M.Sc. Zoology Course - SEMESTER-III**

(This syllabus is applicable to the students who are admitted on or after 2022-2023 academic year onwards)

**Elective Paper-06**

**Total Contact Hours: 72**

**Credits: 4**

**Paper Code: 22ZOOE06**

**Weekly Contact Hours: 4**

**MEDICAL PARASITOLOGY**

**Course Objectives:**

- To enable the students to impart knowledge about the different types of Parasites.
- To gain basic understanding about Zoonotic diseases
- To gain knowledge about Parasitic Vectors

**Course Outcome:**

- Students will get knowledge about the different types of Pathogens.
- They apply their knowledge to know the control measures of parasitic diseases

**UNIT I:**

Introduction to parasitism- Parasitic evasion of host defenses- Pathology of parasitic infection- Types of parasites- Obligatory and facultative parasites- diversity of parasites- Mode of transmission of parasites

(14 Hours)

**UNIT II:**

Protozoan parasites- Leishmaniasis- Amoebiasis- Morphology, biology, life cycle and control measures- - Malaria-types of malarial parasites-Sporogonic cycle- Exo-erythrocytic cycle – Endo-erythrocytic cycle- Vectors of malaria- control measures

(14 Hours)

**UNIT III:**

Helminth parasites- Taeniasis- Life cycle and pathogenicity, transmission, preventive and control measures- morphology, biology, life-cycles, modes of entry of *Schistosoma*, *Wuchereria*- *Fasciola hepatica*, *Ascaris lumbricoides* - Life cycle - mode of transmission and control measures.

(14 Hours)

**UNIT IV:**

Vectors and Vector borne diseases- Mosquitoes and flies- Culex. Anopheles and Aedes- Life cycle- diseases spread and control measures- Diseases spread by Sand flies, fleas, ticks, mites, Crustaceans and their control.

(15 Hours)

**UNIT V:**

Microbial zoonosis- Bacterial diseases- Plague, Salmonellosis, Anthrax, Tuberculosis- Viral diseases- AIDS, Rabies- SARS- Influenza - transmission-epidemiology and prevention – Emerging infectious diseases- Covid-19- Ebola- Nipah – preventive measures and treatment.

(15 Hours)

**Correlation of Programme objectives with course outcomes**

<b>COURSE OUTCOME</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>
<ul style="list-style-type: none"> <li>Students will get knowledge about the different types of Pathogens.</li> </ul>	✓	✓	✓		
<ul style="list-style-type: none"> <li>They apply their knowledge to know the control measures of parasitic diseases</li> </ul>	✓		✓	✓	✓

**Unit wise programme specific qualification attributes**

<b>Unit</b>	<b>Unit Title</b>	<b>Intended Learning Chapters (K1, K2)</b>	<b>Hours of Instruction</b>
I	Historical background and Parasitic evasion of host defenses	K1, K2, K3	14.4
II	Protozoan parasites	K1, K2, K3	14.4
III	Helminth parasites	K1, K2, K3	14.4
IV	Vectors and Vector borne diseases	K1, K2, K3, K4, K5	14.4
V	Microbial zoonosis	K1, K2, K3, K4, K5	14.4

**References:**

- Bhattacharya, D (2018). Text book of Parasitology, Wave books, New Delhi, India
- Bose, M. (2017). Parasitosis and Zoonosis, New central book agency, Kolkata, India
- Chatterjee, K. D., (2019). Parasitology Protozoology and Helminthology, CBS publishers, India
- Coleman, M. (2022). Human Parasitology, KAUFMAN PRESS, USA
- Ghosh, S. (2019). Paniker's Textbook of Medical Parasitology, Jaypee Brothers Medical Publishers, India
- Loker, E.S. & Hofkin, B. V (2015). Parasitology: A conceptual approach, Garland Science, USA
- Riedel, S., Morse, S. A., Mietzner T. A., & S. Miller (2019). Jawetz Melnick & Adelbergs Medical Microbiology, McGraw Hill Publisher, India
- Shymasundary, K & Rao, K. H. (2012). Medical parasitology, MJP publishers, Chennai, India



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**M.Sc. Zoology Course - SEMESTER-III**

(This syllabus is applicable to the students who are admitted on or after 2022-2023 academic year onwards)

**Supportive Paper-01**

**Total Contact Hours: 72**

**Credits: 4**

**Paper Code: 22ZOOS01**

**Weekly Contact Hours: 4**

### CANCER THERAPEUTICS

#### **.Course Objectives:**

- Students will gain knowledge of tumorigenesis, learn techniques commonly used in cancer biology
- The fundamental principles behind cancer prevention, and therapeutic management.

#### **Course Outcome:**

- This course work provides chance to work in stem cells and cancer stem cells. There is a chance for the students to enter into the modern cancer and stem cell laboratories as scientist.

**UNIT I: Surgery-**Developing and evaluation a cancer screening programme; Surgery and its types; Principles of Cancer management surgical oncology; Diagnose, score and treat side-effects and complications of surgical treatment.

(14 Hours)

**UNIT II: Chemotherapy-**Chemical carcinogenesis; Clinical examination; Applications of new technologies in prevention, assessing risk, diagnostics, and treatment. Concepts of combined modality treatment and the significance of radiation and chemotherapy in comprehensive management of cancer. 2019 Nobel Prize winners William G. Kaelin Jr., Sir Peter J. Ratcliffe, and Gregg L. Semenza, for their discoveries of how cells sense and adapt to oxygen availability was the top story in oncology.

(14 Hours)

**UNIT III: Radiation therapy-** Radiological Examination; Primary radiological image formation, use of contrast media, Historical developments in Radiotherapy, Various types of sources used in Radiotherapy and their properties; Importance of Immobilization in radiotherapy, Physical and biologic basis of Radiation Oncology; Principles of Hyperthermia, Photodynamic Therapy for cancer Rationale, radiobiological factors, current clinical outcomes.

(14 Hours)

**UNIT IV: Cancer immunotherapy-** Exploitation of acquired immune response; Monoclonal antibody therapy; Harnessing innate immunity; lymphokinatic activated killer cells, Interferon, Cytokines: biology and applications in cancer medicine; Active specific immunotherapy with vaccines; immunology for cancer prevention.2018 Nobel Prize to James

P. Allison and Tasuku Honjo for their discovery of cancer therapy by inhibition of negative immune regulation."

(15 Hours)

**UNIT V: Nanotherapeutics-** Principles of drug delivery systems, Nanodrugs for diagnosis and treatment of cancer; concept of nano drug encapsulation, self-assembly, controlled release (targeted, triggered release and Cellular uptake mechanisms), *in vitro* methods to study anticancer properties of nanomaterials, Nanoparticles for Photodynamic Therapy of cancer; Antisense and siRNA therapy; nanoparticle assisted vaccine development; nano shells for surgery. Nano-toxicology. Single molecule therapy.

(15 Hours)

### Correlation of Programme objectives with course outcomes

COURSE OUTCOME	PO1	PO2	PO3	PO4	PO5
• To become researcher in oncology	✓	✓	✓	✓	✓
• To gain knowledge in etiology and epidemiology of various cancers	✓	✓	✓	✓	
• To acquire knowledge about molecular biology of cancer	✓	✓	✓	✓	✓
• To develop practical skills in diagnosis of various cancers	✓	✓	✓	✓	

### Unit wise programme specific qualification attributes

Unit	Unit Title	Intended Learning Chapters (K1, K2)	Hours of Instruction
I	Surgery	K1, K2, K3, K4, K5	14.4
II	Chemotherapy	K1, K2, K3, K4, K5	14.4
III	Radiation therapy	K1, K2, K3, K4, K5, K6	14.4
IV	Cancer immunotherapy	K1, K2, K3, K4, K5, K6	14.4
V	Nanotherapeutics	K1, K2, K3, K4, K5, K6	14.4

### REFERENCE BOOKS:

1. Turksen K (2002). Embryonic Stem Cells Method and Protocols. Humana press.
2. Korobkin R and Munzer SR (2007). Stem Cell Century, Law and Policy for a Breakthrough Technology, Yale University Press.
3. Lanza R (2004). Hand Book of Stem Cells Volume 1and2, Elsevier press.
4. Committee R (2004). Stem Cells and the Future of Regenerative Medicine by on the Biological and Biomedical Application of Stem Cell Research.
5. Robertis EDP and De Robertis EMF (2005). Cell and Molecular Biology, (8th edn), De, B.I.Waverly Pvt. Ltd., New Delhi.
6. Lodish H, Kaiser CA, Brasher A, Amon A, Berk A, Kreger M, Ploegh H and Scott MP (2012). Molecular Cell Biology, 7<sup>th</sup> edition, Garland Publishing, Inc. New York.
7. Kiessling, A.A. (2006). Human Embryonic Stem Cells (Second Ed.) Jones & Barlett Publishers.
8. Lanza, R. (2005). Essentials of Stem Cell Biology. Academic Press.



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**M.Sc. Zoology Course - SEMESTER-III**

(This syllabus is applicable to the students who are admitted on or after 2022-2023 academic year onwards)

**Supportive Paper-02**

**Total Contact Hours: 72**

**Credits: 4**

**Paper Code: 22ZOOS02**

**Weekly Contact Hours: 4**

### VERMICULTURE AND VERMICOMPOSTING

#### **Course Objectives:**

- To introduce the term Vermitechnology to the students.
- To understand the concepts of vermiculture and vermicomposting.
- To understand the characteristics of earthworm species suitable for vermiculture and vermicomposting.
- To understand various applications of earthworms in organic solid waste management, soil fertility, and bioremediation.

#### **Course Outcomes:**

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

- Understand the core concepts of vermiculture and vermicomposting.
- Identify the earthworm species suitable for vermiculture and vermicomposting.
- Apply vermitechnology in vermicomposting, soil fertility, and bioremediation processes and become an entrepreneur.

**UNIT- I:** Earthworm – morphology and anatomy – Biology of *Perionyx excavatus* – Ecological grouping – Epigeic, Anecic and Endogeic species; Role of earthworms in nutrient cycling and sustainable agriculture.

(14 Hours)

**UNIT- II:** Vermiculture – definition, scope and importance; Endemic and Exotic earthworm species for culture – Environmental requirements; Culture methods – indoor and outdoor cultures – monoculture and polyculture. Vermibed preparation.

(14 Hours)

**UNIT- III:** Applications of vermiculture – Vermicomposting – different methods of vermicomposting; use of vermicastings in organic farming/horticulture, earthworms for management of municipal organic solid wastes. Nutrient value of worm cast/vermicompost – Vermiwash preparation and application.

(14 Hours)

**UNIT- IV:** Advantages of Vermicomposting technology – Earthworm and microbial influence during vermicomposting – Physical, chemical and biological influence of earthworms in drilospheres and vermicasts. Marketing the products of vermiculture –

creating the demand by awareness and demonstration, advertisements, packaging and transport, direct marketing.

(15 Hours)

**UNIT- V:** Predators, Parasites, and Pathogens of Earthworms and their control. Earthworms in food and medicine – Prospects of vermiculture as a self-employment venture – Potentials and constraints for vermiculture in India.

(15 Hours)

**Correlation of Programme objectives with course outcomes**

<b>COURSE OUTCOME</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>
• To understand various applications	✓	✓	✓	✓	
• To identify earthworm species used in organic waste management	✓	✓	✓	✓	
• To use earthworms in bioremediation of industrial wastes	✓	✓	✓	✓	
• To become an entrepreneur	✓	✓	✓	✓	

**Unit wise programme specific qualification attributes**

<b>Unit</b>	<b>Unit Title</b>	<b>Intended Learning Chapters (K1, K2)</b>	<b>Hours of Instruction</b>
I	Morphology and anatomy	K1, K2	10.8
II	Vermiculture & Culture methods	K1, K2	10.8
III	Applications of vermiculture	K1, K2, K3, K6	10.8
IV	Marketing	K1, K2, K6	10.8
V	Future perspectives	K1, K2, K6	10.8

**REFERENCE BOOKS:**

- 1 Edwards, C.A. Arancon, N.Q. and Sherman, R. (2011). Vermiculture Technology: Earthworms, Organic Wastes, and Environmental Management. CRC Press, Boca Raton, FL.
- 2 Karaca, A. (2011). Biology of Earthworms (Soil Biology Book-24). Springer Publishers.
- 3 Ranganathan, L.S. (2006). Vermibiotechnology – From Soil Health to Human Health. Agrobios, India.
- 4 Ismail, S.A. (2005). The Earthworm Book. Second Edition, Other India Press, Apusa, Goa, India.
- 5 Edwards, C.A. (2004). Earthworm Ecology. CRC Press, Boca Raton, FL.
- 6 Ismail, S.A. (1997). Vermiculture: The Biology of Earthworms. 1<sup>st</sup> Edition, Orient Longman, India.





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**M.Sc. Zoology Course - SEMESTER-IV**

(This syllabus is applicable to the students who are admitted on or after 2022-2023 academic year onwards)

**Core Paper-15**

**Total Contact Hours: 72**

**Credits: 4**

**Paper Code: 22ZOOC15**

**Weekly Contact Hours: 4**

### RESEARCH METHODOLOGY

#### **Course objectives:**

- To promote research atmosphere among student's community.
- To support to do independent research.

#### **Course outcome:**

- This course work paves the way for bringing research outcome for the betterment of our society. Students will get an opportunity to enter into Industry or research institute as technician or statistician.

#### **UNIT I:**

Microbiological Techniques - Media Preparation and sterilization - Inoculation and growth monitoring, Microbial identification. Microscopy: Principle & applications - Light microscope and phase contrast microscope - Fluorescence microscope - Electron microscope (SEM & TEM) - Confocal microscopy. Principle and applications of - Spectrophotometer Measurement of pH and biological Buffers.

(14 Hours)

#### **UNIT II**

Chromatography, principle type and application. Electrophoresis, Principles, types and applications -PAGE and agarose gel electrophoresis. Principle and Applications of Flow cytometry, Polymerase chain reaction (PCR), RT-PCR Blotting DNA Sequencing types and applications. Immunological techniques - Immunodiffusion (Single & Double) - Immuno electrophoresis Techniques Principle and applications of Immune-biotechnology.

(14 Hours)

#### **UNIT III**

Cell culture techniques. - Design and functioning of tissue culture laboratory - Culture media, essential components and Preparation - Cell viability testing and cell harvesting methods Cryopreservation of cells and tissues, freeze drying.

(14 Hours)

#### UNIT IV

Definition - scope of biostatistics Measures of central tendency – arithmetic mean, median and mode. Measures of dispersion - range, mean deviation, standard deviation, Standard error. Co-efficient of variation, types of correlation, linear regression analysis. Basics of Probability and Probability distribution.

(15 Hours)

#### UNIT V

Statistical hypothesis – types, testing (hypothesis, null hypothesis, alternate hypothesis Parametric tests – Student’s t-Test; Analysis of Variance (ANOVA or F-Ratio: One way and Two-way analysis); Chi-square test (Test of Independence and Test of Goodness of Fit) Correlation and regression analysis concepts and their application. Scope, importance and status of Bioinformatics. Biological databases (Gene bank and Protein sequence database) Big Data Analysis

(15 Hours)

#### Correlation of Programme objectives with course outcomes

COURSE OUTCOME	PO1	PO2	PO3	PO4	PO5
• To gain knowledge in microbial technology	✓	✓	✓	✓	✓
• To gain knowledge in cryotechniques	✓	✓	✓	✓	✓
• Become an biostatistician	✓	✓	✓	✓	
• Statistical advisor in publication division	✓	✓	✓	✓	

#### Unit wise programme specific qualification attributes

Unit	Unit Title	Intended Learning Chapters (K1, K2)	Hours of Instruction
I	Microbiological Techniques	K1, K2, K3, K4, K5, K6	14.4
II	Cryotechniques	K1, K2, K3, K4, K5, K6	14.4
III	Cell culture techniques	K1, K2, K3, K4, K5, K6	14.4
IV	Mean, Median and Mode	K1, K2, K3, K4, K5	14.4
V	Statistical hypothesis	K1, K2, K3, K4, K5, K6	14.4

#### References

1. John M. Davis (2011). Animal Cell Culture: Essential Methods. John Wiley & Sons, Ltd.
2. Ian Freshney R. (2016). Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications. 7th Edition Wiley-Blackwell Publishers New York.
3. Michael Butler (2003). Animal Cell Culture and Technology (THE BASICS). Garland Science Taylor and Francis
4. Mahajan B. K., Arun Bhadra Khanal (2008). Methods in Biostatistics: For Medical Students. 7 th Edition. JPB Publishers.
5. Nageswara Rao G (2018). Biostatistics & Research Methodology. BSP Books Pvt. Ltd.
6. Wilson K & K.W. Goulding (2017). A Biologists Guide to Principles and Techniques of Practical Biochemistry. ELBS publications.



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**M.Sc. Zoology Course - SEMESTER-IV**

(This syllabus is applicable to the students who are admitted on or after 2022-2023 academic year onwards)

**Elective Paper-07**

**Total Contact Hours: 72**

**Credits: 4**

**Paper Code: 22ZOOE07**

**Weekly Contact Hours: 4**

### MOLECULAR ONCOLOGY

#### Objectives:

- ❖ Strive the students to understand the basic knowledge on biology of cancer
- ❖ to provide basic practical skills on the beneficiary treatment modalities.
- ❖ The subject is also designed to learn and how do we overcome the problems faced during cancer progression.

#### Outcome:

The students opt this subject as supportive that could develop his/her to be a professional oncologist to characterize the cancer at molecular level and have a chance to work as histo-pathologists in molecular oncology laboratories.

#### UNIT - I

History, scope and current scenario of cancer research. Cancer – Types and their prevalence –  
- Classification based on origin/organ: breast, colon, lung, prostate, cervical and oral cancers.

#### UNIT II

Molecular mechanism of oncogenesis – Proto oncogenes, oncogene, oncoproteins, tumour suppressor genes and gene products like p53 proteins and receptors proteins involved in cancer targeting.

#### UNIT III

Apoptosis and cancer: Mechanism of apoptosis - proteins involved in apoptosis-Signaling pathways: Significance of –RB, Cyclins, CDKs, related pathways – Relationship between cancer and anti-apoptotic proteins.

#### UNIT - IV

Principle and methods of cancer diagnosis: – Biochemical, Genetic, Cytotoxic and cell growth and viability tests. Current status of cancer proteomics. Cancer Gene Therapy – concepts and applications.

#### UNIT - V

Cancer therapy – at cellular level- at gene level- at protein level. Principles of cancer biomarker and their applications – chemotherapeutics for cancer, Phytotherapy for cancer.

### Correlation of Programme objectives with course outcomes

COURSE OUTCOME	PO1	PO2	PO3	PO4	PO5
• To become researcher in oncology	✓	✓	✓	✓	✓
• To gain knowledge in etiology and epidemiology of various cancers	✓	✓	✓	✓	
• To acquire knowledge about molecular biology of cancer	✓	✓	✓	✓	✓
• To develop practical skills in diagnosis of various cancers	✓	✓	✓	✓	

### Unit wise programme specific qualification attributes

Unit	Unit Title	Intended Learning Chapters (K1, K2)	Hours of Instruction
I	History & scope	K1, K2	10.8
II	Molecular mechanism of oncogenesis	K1, K2	10.8
III	Apoptosis and cancer	K1, K2, K6	10.8
IV	Principle and methods of cancer diagnosis	K1, K2, K3, K6	10.8
V	Cancer therapy	K1, K2, K3, K6	10.8

### REFERENCE BOOKS:

1. Tannock IF and Hill RP (1998) The Basic Science of Oncology, Third edition, McGraw- Hill, New York.
2. Bronchud MH, Foote M, Giaccone G, olopade O and Workman P(2017) Principles of Molecular Oncology, Fifth edition, Humana Press, New Jersey.
3. Depatin KM and Fulda S (2015) Apoptosis and Cancer Therapy, WILEY-VCHVerlag GmbH and Co., New York.
4. Hayatt MA (2016) Methods of Cancer Diagnosis, Therapy, and Prognosis, Vol-7; Springer, Netherlands.
5. Missailidis S (2012) Anticancer Therapeutics, John Wiley and Sons, Ltd., USA.

- 1 Soo-Ho Lim, Young-Taek Kim, Sang-Poong Lee (1990). Sericulture Training Manual - Published by FAO - USA. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
- 2 Veda, K., Nagai, I. and Horikomi, M. (1997). Silkworm Rearing (Translated from Japanese). Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
- 3 Wu Pang-Chuan and Chen Da-Chuang (1994). Silkworm Rearing - Published by FAO - USA.



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**M.Sc. Zoology Course - SEMESTER-IV**

(This syllabus is applicable to the students who are admitted on or after 2022-2023 academic year onwards)

**Elective Paper-08**

**Total Contact Hours: 72**

**Credits: 4**

**Paper Code: 22ZOOE08**

**Weekly Contact Hours: 4**

**STATISTICAL TOOLS FOR LIFE SCIENCES**

**Course Objectives:**

- This course is intended for students with limited or no experience with SPSS.
- This course will give students a brief overview of creating data files, running statistical analysis, and reading output.

**Course Outcome:**

At the completion of this course, students will be able to:

- Prepare and manipulate datasets for analysis in SPSS.
- Conduct simple descriptive and graphic analyses of data in SPSS.
- Prepare a report with a summary of analyses conducted in SPSS.

**UNIT I**

Definition; Scope of Biostatistics, Variables in biology; Population and sampling, sampling distribution; Difference between parametric and non – parametric statistics; Data Collection, Classification, Tabulation. Introduction to Statistical Package for Social Sciences (SPSS) for windows. Variable naming on SPSS –data entry, Analysis of data – Formulation of frequency tables.

(14 Hours)

**UNIT II**

Measures of central tendency – Mean, Median, and Mode; Measures of dispersion – Range, standard deviation and Standard Error; Skewness and kurtosis; Diagrammatic representation – Bar and pie chart , histogram, frequency polygon, Frequency Curve , Logarithmic curves, Scatter plot and line graphs.

(14 Hours)

**UNIT III**

Correlation – Types, methods – Graphic, mathematical- Pearson's correlation co-efficient, Regression – Simple linear regression, regression equation and regression line.

(14 Hours)

**UNIT IV**

Elements of probability – Probability distribution – Binomial, Poisson, Normal, Tests of significance – Hypothesis testing- Type I and Type II error, level of significance. Student 't' test - One sample 't' test, Independent sample and Paired 't' test.

(15 Hours)

## UNIT V

Chi – square; Chi – square test for Goodness fit; Test for Independence of Attributes. F-test – Analysis of Variance (ANOVA) – One way ANOVA – Two way analysis of variance - Introduction to Multivariate statistics.

(15 Hours)

**Note: Students will work out problems using SPSS package at the time of examination.**

### Correlation of Programme objectives with course outcomes

COURSE OUTCOME	PO1	PO2	PO3	PO4	PO5
• To become a biostatistician	✓	✓	✓	✓	
• To become a consultant in corporate companies	✓	✓	✓	✓	
• Statistical advisor in publication division	✓	✓	✓	✓	

### Unit wise programme specific qualification attributes

Unit	Unit Title	Intended Learning Chapters	Hours of Instruction
I	Scope of Biostatistics	K1, K2, K3, K4, K5	7.2
II	Measures of central tendency	K1, K2, K3, K4, K5	7.2
III	Correlation & Regression	K1, K2, K3, K4, K5	7.2
IV	Elements of probability	K1, K2, K3, K4, K5	7.2
V	Chi – square & ANOVA	K1, K2, K3, K4, K5	7.2

### REFERENCE BOOKS

1. Einspruch, E. L. (2004). Next steps with SPSS. Sage Publications, International educational and Professional Publisher, Thousand Oaks, London, New Delhi.
2. Mille, R. L., Ciaran, A., Fullerton, D. A. and Maltby, J. (2002). SPSS for social scientists (Version 9, 10, 11). Consultant editor- Jo. Campling publishers Palgrave MacMillon (UK,USA) Printed in China.
3. George, D. and Mallery, P. (2021). IBM SPSS Statistics 27 Step by Step: A Simple Guide and Reference. 17th Edition, Routledge, New York. 418pp.

### WEB LINKS

1. <http://www.spss-tutorials.com/>
2. <https://www.ibm.com/docs/en/spss-statistics/25.0.0?topic=tutorial>
3. <https://www.javatpoint.com/spss>
4. <https://www.lse.ac.uk/Methodology/Software-tutorials/SPSS-tutorials>



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SUTHANTHRA THIRUNAL AMUDHA PERUVIZHA  
TAMIL NADU



சுதந்திரத்திற்குள்ளே  
அமுதம் பெருவழி

**M.Sc. Zoology Course - SEMESTER-IV**

(This syllabus is applicable to the students who are admitted on or after 2022-2023 academic year onwards)

**Industry oriented Paper-01**

**Total Contact Hours: 36**

**Credits: 1**

**Paper Code: 22ZOOIO01**

**Weekly Contact Hours: 2**

### INDUSTRY ORIENTED PAPER: SERICULTURE

#### Objectives:

- Gain in-depth knowledge on the sericulture and moriculture.
- Provide chance to learn the economical, medical and social interest of sericulture.
- Learn novel techniques in Seribiotechnology.

#### Outcome:

- Students will get placement in Sericulture industries
- Explore the knowledge about silkworm diseases and undertake research.
- Make the students to start-up sericulture unit under self-employment programme.

**UNIT -I:ECONOMIC IMPORTANCE AND SILKWORM BIOLOGY:**Prospects and status –Identification methods of Silkproducing species - their distribution – Bombyx mori - life cycle – Methods to estimate life cycle and factors affecting life cycle, organization of larvae, pupae and moth - structure of the silk gland.

**UNIT-II:MORICULTURE :**Mulberry - distribution - varieties and methods to develop hybrid varieties - methods of cultivation andpreparation –Classical and Modern techniques in harvesting,transportation and preservation of leaves. Estimation of feeding and nutrition - specificity of diet –Analysis of factors affecting nutrition value. Identification of Pest and diseases.

**UNIT-III:SILKWORM REPRODUCTION AND GENETICS:** Reproduction - Growth andDevelopment of silkworms – Determination of mating behavior in Tasar, Eri, Muga and Mulberysilkworms –Methods to estimate physiology of molting in different varieties (Uni, bi and multivoltine) - Endocrinology of reproduction and development. Genetics - mutation breeding techniques and Methods to develop new strains.

**UNIT-IV:PATHOGENIC DISEASES AND PEST:** Pathology - Viral, bacterial, fungi and protozoandiseases – Techniques to isolate bacterial and fungal pathogens of silkworm. Laboratory culture techniques of microbial pathogens. Control methods. Uzifly menace.

**UNIT-V: SILKWORM REARING AND SILK REELING:** Rearing operations - Selection andconstruction of rearing house Incubation - Hatching - brooding, Harvesting methods. Reeling techniques – lacing, skinning and Re-reeling processes.



### Correlation of Programme objectives with course outcomes

COURSE OUTCOME	PO1	PO2	PO3	PO4	PO5
❖ Students will get placement in Sericulture industries	✓	✓		✓	✓
❖ Explore the knowledge about silkworm diseases and undertake research.	✓	✓	✓	✓	
❖ Make the students to start-up sericulture unit under self-employment programme	✓	✓	✓	✓	✓

### Unit wise programme specific qualification attributes

Unit	Unit Title	Intended Learning Chapters	Hours of Instruction
<b>SERICULTURE</b>			
I	<b>ECONOMIC IMPORTANCE AND SILKWORM BIOLOGY</b>	K1, K3, K4, K6	15
II	<b>MORICULTURE</b>	K1, K2, , K4	15
III	<b>SILKWORM REPRODUCTION AND GENETICS</b>	K1, K2, K3, K6	15
IV	<b>PATHOGENIC DISEASES AND PEST</b>	K1, K2, K3, K5	15
V	<b>SILKWORM REARING AND SILK REELING</b>	K1, K4, K5, K6	15

### REFERENCE BOOKS

Eikichi, H. (1999). Silkworm Breeding (Translated from Japanese). Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.

Ganga, G. (2003). Comprehensive Sericulture Vol-II: Silkworm Rearing and Silk Reeling. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.



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**M.Sc. Zoology Course - SEMESTER-IV**

(This syllabus is applicable to the students who are admitted on or after 2022-2023 academic year onwards)

**Project Work**

**Total Contact Hours: 342**

**Paper Code: 22ZOOPR01**

**Credits: 4**

**Weekly Contact Hours: 19**

**PROJECT WORK AND VIVA VOCE**

**Course Objectives:**

To enable the students

- To gain research knowledge.
- To know how to execute independent research.

**Course Outcome:**

At the completion of this course, students will be able to do independent research at national and international standard.

Aim: (a) Application of knowledge to real life situation (b) to introduce research methodology. Topic of dissertation may be chosen from any area of Zoology and may be laboratory based, field based or both or computational, with emphasis on originality of approach. It may be started during 2nd / 3rd semester and shall be completed by the end of the 4<sup>th</sup> semester. The Dissertation to be submitted should include (a) background information in the form of introduction (b) objectives of the study (c) materials and methods employed for the study (d) results and discussion thereon (e) summary and conclusions and (f) bibliography. Apart from these sections, importance of the results, originality and general presentation also may be taken into consideration for evaluation.

**Correlation of Programme objectives with course outcomes**

COURSE OUTCOME	PO1	PO2	PO3	PO4	PO5
• To develop research skills		✓	✓		✓
• Develop novel thinking ability		✓	✓		✓
• Knowledge on publications, patents, product developments etc.		✓	✓		✓

**Unit wise programme specific qualification attributes**

Unit	Unit Title	Intended Learning Chapters	Hours of Instruction
I	Specialization topic of research supervisor	K3, K4, K5, K6	342



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**M.Sc. Zoology Course - SEMESTER-IV**

(This syllabus is applicable to the students who are admitted on or after 2022-2023 academic year onwards)

**Seminar Paper:01**

**Total Contact Hours: 18**

**Paper Code: 22ZOOSP01**

**Credits: 01**

**Weekly Contact Hours: 01**

### SEMINAR PAPER

#### Course Objective

- To enrich the subject knowledge of students in research
- Update information related to the field of interest of our students

#### Course Outcome

- Students can choose their field of research while doing master programme
- Enable students to learn about better journals in their field of interest

#### Details about this course work

- There is no specific course content.
- 
- The students can select the topic of interest and present by preparing power point slides for 15 minutes followed by discussion for another 5 minutes
- Per Class 3 students should present
- The topic should be selected from high standard and peer reviewed journals or about the research of the World Class Zoologists or Newly developed techniques or technologies – The journal paper should be in the current academic year
- Only external examination will be conducted at the end of semester. The examiner will be from our sister departments from the Periyar University.

## VALUE ADDED COURSES



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## M.Sc. Zoology Course

(This syllabus is applicable to the students who are admitted on or after 2022-2023 academic year onwards)

**Value Added Course-01**  
**Total Contact Hours: 36**

**Paper Code: 22ZOOVA01**  
**Credits: 2**

### **3D CELL CULTURE AND TISSUE ENGINEERING** **(Extra Credit Paper: Online Mode Certificate Course)**

#### **Course objectives:**

- To enable the Advance learners to gain comprehensive knowledge in the multidisciplinary science of 3D cell biology.
- To develop in-depth knowledge on molecular basis of 3D Cell Culture.

#### **Course outcome:**

At the end of the certificate course, students will be able to

- To equip themselves to culture the animal cells in hydrogel and skills in 3D cells and its molecular functions and become aware of tissue engineering and its applications in biomedical sciences.
- Understand how to use the 3D Cell culture techniques in future studies related to cell biology in biomedical advance research.

#### **UNIT 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.

#### **UNIT II**

Laboratory setup of 3 D cell culture – Principle and applications of Microfluidic System, CO<sub>2</sub> incubator, Live Cell Imaging Microscope and Confocal Microscope. Significance of 3D Bioprinting and types of Bio-inks

#### **UNIT III**

3D Cell culture methods: Hanging drop, Non-adhesive wells, Rotating wall vessel, Microfluidics, Magnetic levitation, Aqueous two-phase system. Advantage and disadvantage of 3D cell culture methods.

#### **UNIT IV**

Hydrogel preparation and utilization for Scaffold culture, scaffold-free culture, culturing on natural polymers and synthetic polymers. Tissue Engineering: Types and Applications. High-throughput technologies in tissue engineering.

#### **UNIT V**

Applications of 3D Cell Culture: Drug Designing, Organoids, 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.

#### **Reference Books**

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

**Correlation of Programme objectives with course outcomes**

<b>COURSE OUTCOME</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>
<ul style="list-style-type: none"> <li>• To equip themselves to culture the animal cells in hydrogel and skills in 3D cells and its molecular functions and become aware of tissue engineering and its applications in biomedical sciences.</li> </ul>	✓	✓	✓	✓	✓
<ul style="list-style-type: none"> <li>• Understand how to use the 3D Cell culture techniques in future studies related to cell biology in biomedical advance research.</li> </ul>		✓	✓	✓	✓

**Unit wise programme specific qualification attributes**

<b>Unit</b>	<b>Unit Title</b>	<b>Intended Learning Chapters (K1, K2)</b>	<b>Hours of Instruction</b>
I	Evolution of 3D cell culture	K1, K2, K3	Total 36 Hours, Online mode teaching and Evaluation
II	Laboratory setup of 3 D cell culture	K1, K2, K4, K5	
III	3D Cell culture methods	K2, K4, K5	
IV	High-throughput technologies in tissue engineering.	K3, K5	
V	Applications of 3D Cell Culture	K4, K5,	



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### M.Sc. Zoology Course

(This syllabus is applicable to the students who are admitted on or after 2022-2023 academic year onwards)

Value Added Course-02  
Total Contact Hours: 36

Paper Code: 22ZOOVA02  
Credits: 2

### POULTRY SCIENCE

(Extra Credit Paper: Online Mode Certificate Course)

#### Course Objectives:

- To understand design of poultry house and rearing norms of poultry
- To make the student understand about the basic principles of nutrition and different kinds of feeds
- To make the student aware about the various pathogenic microorganisms affecting the poultry species, their route of entry, symptoms, diagnosis and various prevention and control measures
- To make the student study about the various types of incubation methods, conditions and equipment required at the poultry form

#### Course Outcome:

- Students will get knowledge about the poultry house and rearing norms of poultry
- They apply their knowledge to know the poultry nutrition and pathogenic microorganisms affecting the poultry species
- Students gain knowledge about the various types of incubation methods, conditions and equipments required at the poultry form

#### UNIT I

**Introduction:** History of Poultry Science - Definition of poultry-classification of poultry-variety and strains of chickens. Poultry products (Egg and Poultry meat). Development of poultry industry in India. Ducks, Turkeys, Japanese quails, Emu and Guinea fowl culture.

#### UNIT II

**Poultry Nutrition:** Feed ingredients, processing of feed –forms of feed– mash, pellet & crumble feed preparation and feeding methods. Feeding chicks, growers, layers, broiler and breeders. production of drug, pesticide & toxin free feeds

#### UNIT III

**Housing of poultry:** Selection of site and location of poultry farm – importance of poultry housing- basic principles of construction.

#### UNIT IV

**Hatching and rearing norms for poultry:** Breeding in Fowls -Rearing of chickens- Design and location of hatchery; Methods of incubation.

#### UNIT V

**Healthcare of poultry:** Classification of poultry diseases – diagnosis, treatment, prevention and control.

#### Correlation of Programme objectives with course outcomes

COURSE OUTCOME	PO1	PO2	PO3	PO4	PO5
• Genetic toxicology		✓	✓	✓	✓
• Genotoxic agents		✓	✓	✓	✓
• Chromosomal aberration		✓	✓	✓	✓
• Gene mutation		✓	✓	✓	✓
• Plant based assays		✓	✓	✓	✓

#### Unit wise programme specific qualification attributes

Unit	Unit Title	Intended Learning Chapters (K1, K2)	Hours of Instruction
I	History of Poultry Science	K1, K2	Total 36 Hours, Online mode teaching and Evaluation
II	Poultry Nutrition	K1, K2	
III	Housing of poultry	K2, K3, K5	
IV	Hatching and rearing norms for poultry	K3, K5	
V	Healthcare of poultry	K4, K5,	

#### REFERENCE BOOKS

1. Singh, R. A. (2011). Poultry Production. 3rd Edition. Kalyani Publishers, New Delhi.
2. Jull A. Morley, (2007). Successful Poultry Management. 2nd Edition. Biotech Books, New Delhi.
3. Hurd M. Louis, (2003). Modern Poultry Farming. 1st Edition. International Book Distributing Company, Lucknow. B.Sc. poultry Production and Business Management under CCII Programme – 2016-17 onwards Page 7 of 53
4. Bell D. Donald and Weaver D. William Jr., (2007). Commercial Chicken Meat and Egg Production. 5th Edition. Springer India Pvt. Ltd., Noida.
5. Sreenivasaiah., P. V., (2015). Textbook of Poultry Science. 1st Edition. Write & Print Publications, New Delhi
6. Jull A. Morley, (2007). Successful Poultry Management. 2nd Edition. Biotech Books, New Delhi.
7. Jadhav N. V., and Siddique M. F., (2007). Handbook of Poultry Production and Management. 2nd Edition. Jaypee Brothers Medical Publishers Pvt. Ltd., New Delhi.
8. Leeson S., & Summers J. D., (2001). Scott's Nutrition of the Chicken. 4th Edition. University Books, Canada



9. Reddy Ramasubba V., and Bhosale T. Dinesh, (2004). Handbook of Poultry Nutrition. 1st Edition. International Book Distribution Co., Lucknow, India.
10. Mahajan Naresh, (2015). Poultry Nutrition and Management. 1st Edition. Anmol Publications Pvt. Ltd., New Delhi. B.Sc. poultry Production and Business Management under CCII Programme – 2016-17 onwards Page 17 of 53
11. Thyagarajan. D., (2011). Diseases of Poultry. 1st Edition. Satish Serial Publishing House, New Delhi, India.



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### M.Sc. Zoology Course

(This syllabus is applicable to the students who are admitted on or after 2022-2023 academic year onwards)

Value Added Course-03  
Total Contact Hours: 36

Paper Code: 22ZOOVA03  
Credits: 2

### GENOTOXICOLOGY

(Extra Credit Paper: Online Mode Certificate Course)

#### Course Objectives:

- To understand genetic toxicology, genetic damages, genotoxic agents and their biological effects.
- To know the methods used in genotoxicology.
- To analyse biological samples from test animals for genotoxic effects.

#### Course Outcomes:

On successful completion of this course, the student will be able to understand various genotoxic agents and the analysis methods in the field of genotoxicology.

**UNIT- I:** Role of genetic toxicology in health effect testing – DNA damage and repair – Mutagenesis and carcinogenesis – Consequence of genotoxicity in humans.

**UNIT- II:** Classification of genotoxic agents – Genotoxic carcinogens. *In vitro* clastogenicity – mammalian chromosomal aberration assay; micronucleus assay (human lymphocytes); *In vivo* clastogenicity – rodent dominant lethal test and mouse heritable translocation assay.

**UNIT- 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.

**UNIT- IV:** Gene mutation in *Saccharomyces cerevisiae*; *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.

**UNIT- V:** Genotoxic agents in agro-ecosystem – mutagenicity and carcinogenicity of pesticides. Plant dependent mutation assays – *Allium cepa* assay, *Vicia faba* assay.

### Correlation of Programme objectives with course outcomes

COURSE OUTCOME	PO1	PO2	PO3	PO4	PO5
• Genetic toxicology	✓	✓	✓	✓	
• Genotoxic agents	✓	✓	✓	✓	
• Chromosomal aberration	✓	✓	✓	✓	
• Gene mutation	✓	✓	✓	✓	
• Plant based assays	✓	✓	✓	✓	

### Unit wise programme specific qualification attributes

Unit	Unit Title	Intended Learning Chapters (K1, K2)	Hours of Instruction
I	Genetic toxicology	K1, K2	Total 36 Hours, Online mode teaching and Evaluation
II	Genotoxic agents	K1, K2	
III	Chromosomal aberration	K1, K2, K3, K4	
IV	Gene mutation	K1, K2, K3, K4	
V	Plant based assays	K1, K2, K3, K4	

### REFERENCES

- 1 Brusick, D. (2013). Principles of Genetic Toxicology. Springer Publications.
- 2 Proudlock, R. (2016). Genetic Toxicology Testing – A Laboratory Manual. Elsevier-Academic Press.
- 3 Fleck, R.F. (2012). Genetic Toxicology: An Agricultural Perspective. Springer Verlag.
- 4 EHC 240 (2009): 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.. 752pp.



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### M.Sc. Zoology Course

(This syllabus is applicable to the students who are admitted on or after 2022-2023 academic year onwards)

Value Added Course-04

Total Contact Hours: 36

Paper Code: 22ZOOVA04

Credits: 2

### REGENERATIVE MEDICINE

(Extra Credit Paper: Online Mode Certificate Course)

#### Course Objectives:

In the times of constant buzz revolving around discovering meta-modern therapeutic approaches to human life, is where the scope, as well as the impact of regenerative medicine, comes into play. This also helps in combating the problem of organ transplant and organ damage.

#### Course outcomes:

- To identify and isolate basic scientific, translational, clinical, (and where relevant) epidemiological, demographic and social elements of their research problem
- Students will gain in depth practical knowledge of the biology of stem cells and their differentiation potentials.
- To describe methods of applications to replace damaged or destroyed cells including tissue engineering
- To account for regenerative medicine applications to human diseases
- To account for and evaluate current theories, methods and techniques within the research field, their practical execution and application

#### UNIT-I

Stem cell evolution, Historical perspective - with model systems, Stemness basic, Type of stem cells, Stem cell markers, Stem cell niches, Trans-differentiation, properties and characterization stem cells, Stem Cell Therapy .

#### UNIT-II

Isolation of Pluripotent stem cell and molecular mechanism of Self renewal and differentiation Current status of induced pluripotent stem cells (iPSCs); iPSCs clinical applications)

#### UNIT-III

Hematopoietic and non-hematopoietic stem cells and their differentiation MSCs Stem cell bioengineering

#### UNIT-IV

Applications of Regenerative Medicine in the nervous system, eye, heart, lung, liver, kidney, pancreas and kidney; large scale manufacturing of cells, tissues and organs; artificial organs

#### UNIT-V

Gene therapy applications; Engineered Tissues and Regenerative Medicine; Molecular therapy for regeneration; Personalized therapies in Regenerative Medicine

#### Correlation of Programme objectives with course outcomes

COURSE OUTCOME	PO1	PO2	PO3	PO4	PO5
• Stem cell evolution	✓	✓	✓	✓	
• Isolation of Pluripotent	✓	✓	✓	✓	
• Hematopoietic and non-hematopoietic	✓	✓	✓	✓	
• Applications of Regenerative Medicine	✓	✓	✓	✓	
• Gene therapy	✓	✓	✓	✓	

#### Unit wise programme specific qualification attributes

Unit	Unit Title	Intended Learning Chapters (K1, K2)	Hours of Instruction
I	Stem cell evolution	K1, K2	Total 36 Hours, Online mode teaching and Evaluation
II	Isolation of Pluripotent	K1, K2	
III	Hematopoietic and non-hematopoietic	K1, K2, K3, K4	
IV	Applications of Regenerative Medicine	K1, K2, K3, K4	
V	Gene therapy	K1, K2, K3, K4	

#### Reference

1. Anthony Atala, James A. Thomson (2007). Principles of Regenerative Medicine. Academic Press.
2. Atala A (2009). Foundations of Regenerative Medicine: Clinical and Therapeutic Applications. Academic Press.
3. Hossein Baharvand, Nasser Aghdami (2013). Regenerative Medicine and Cell Therapy (Stem Cell Biology and Regenerative Medicine). Humana Press.
4. Gustav Steinhoff (2011). Regenerative Medicine. Springer.
5. David L. Stocum (2012). Regenerative Biology and Medicine, Second Edition. Academic Press.
6. Philip H. Schwartz, Robin L. Wesselschmidt (2011). Human Pluripotent Stem Cells: Methods and Protocols (Methods in Molecular Biology). Springer.
7. Michal Amit and Joseph Itskovitz-Eldor (2011). Atlas of Human Pluripotent Stem Cells: Derivation and Culturing (Stem Cell Biology and Regenerative Medicine). Springer



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**M.Sc. Zoology Course**

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**Value Added Course-05**  
**Total Contact Hours: 36**

**Paper Code: 22ZOOVA05**  
**Credits: 2**

**INSECT HOST INTERACTIONS**

**(Extra Credit Paper: Online Mode Certificate Course)**

**Course objectives:**

- To gain knowledge about the insect plant interaction communication
- To motivate the students to integrated pest management

**Course outcome:**

- At the end of the semester, students will be able to understand pest insects
- Gain knowledge about monitoring insect pests and control measures

**UNIT I**

Classification of Insects. External morphology of Insects- Life cycle of insects – Types of metamorphosis.

**UNIT II**

Insects as vectors of plantpathogens.Important insect vectors and their characteristics; mouth partsand feeding processes of important insect vectors.Efficiency oftransmission.

**UNIT III**

Transmission of plant viruses and fungal pathogens.Relation between viruses and their vectors.

**UNIT IV**

Transmission of bacterial pathogensby insects.Epidemiology and management of insect transmitted diseases through vector management.

**UNIT V**

Cultural, Chemical, Mechanical, biological pest management.

### Correlation of Programme objectives with course outcomes

COURSE OUTCOME	PO1	PO2	PO3	PO4	PO5
• Gain knowledge about insects	✓	✓	✓	✓	
• Develop skills to manage the insect pests	✓	✓	✓		✓
• Gain knowledge about monitoring pest infestation	✓	✓	✓	✓	
• Develop skills to manage plant diseases	✓	✓	✓		✓

### Unit wise programme specific qualification attributes

Unit	Unit Title	Intended Learning Chapters	Hours of Instruction
I	Classification insects	K1, K2	Total 36
II	Insects as vectors	K1, K2, K4, K5	Hours, Online
III	Transmission of fungal and viral diseases	K1, K2, K3, K5	mode teaching
IV	Transmission of bacterial diseases	K1, K2, K3	and
V	Control measures of insect pests	K2, K4, K5, K6	Evaluation

### Reference

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, 5<sup>th</sup> Edition, Wiley publications
3. Snodgras (2004). Principles of Insect Morphology, Cbs Publishers, India.
4. Chapman, R.F., Simpson, S.J., Douglas, A.E., (2013). The Insects: Structure And Function, 5<sup>th</sup> Edition, Cambridge University Press.
5. Imms, A.D., Richards, O.W., Davies, R.G., (1977). IMMS' General Textbook of Entomology, Structure, Physiology and Development. Springer publications
6. Oakeshott, J., Whitten, M.J., (1993). Molecular Approaches to Fundamental and Applied Entomology. Springer publications
7. Ananthkrishnan, T.N., (2007). Dimensions of Molecular Entomology, Universities Press, Hyderabad, India
8. Basu AN. (1995). *Bemisia tabaci* (Gennadius) - Crop Pest and Principal Whitefly Vector of Plant Viruses. Oxford & IBH, New Delhi.
9. Harris KF & Maramarosh K (1980). Vectors of Plant Pathogens. Academic Press, London.
10. Maramorosch K & Harris KF. (1979). Leafhopper Vectors and Plant Disease Agents. Academic Press, London.
11. Youdeovei A & Service MW. (1983). Pest and Vector Management in the Tropics. English Language Books Series, Longman, London.



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PERIYAR UNIVERSITY  
DEPARTMENT OF ZOOLOGY

Salem-636011, Tamil Nadu

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

SUTHANTHRA THIRUNAL AMUDHA PERUVIZHA  
TAMIL NADU



சுதந்திரத்திற்குள்ளே  
அமுதம் பெருவழி

### M.Sc. Zoology Course

(This syllabus is applicable to the students who are admitted on or after 2022-2023 academic year onwards)

Value Added Course-06  
Total Contact Hours: 36

Paper Code: 22ZOOVA06  
Credits: 2

### MEDICAL ENTOMOLOGY

(Extra Credit Paper: Online Mode Certificate Course)

#### Objectives:

- ❖ Main objective is to provide in-depth knowledge on the vector insects that cause various diseases to human and animals
- ❖ The units are framed to provide basic knowledge on mosquitoes and other disease transmitting insects
- ❖ This topic is designed to provide knowledge on classical and novel techniques in pest management programme.

#### Outcome:

- ❖ Strong foundation on the disease transmitting insects will be laid.
- ❖ You will be an expert and public advisor in insect transmitted diseases.
- ❖ Study on this topic fits you for leading pesticide companies and advisor for insect pest management.

**UNIT 1: Introduction to Disease Transmitting Insects:** Classification of Vectors - Human vectors and Animal vectors. Vector born diseases and control. Forensic application of insects

**UNIT 2: Insect morphology and metamorphosis:** Structure of egg, larvae, pupa and adult insects. Types of mouthparts, Antennae, wings and legs. Types of metamorphosis in insects.

**UNIT 3: Mosquitoes and mosquito born diseases -** Mosquito life cycle. Mosquito feeding behavior. Anopheles, Aedes and Culex.

**UNIT 4: Other Vectors and vector borne diseases:** Sand flies, Bugs – Human bugs, lice & fleas. Life cycle of Housefly and Cockroach

**UNIT 5: Vector Control** –Integrated vector control program. Chemical, Physical and Botanical control. Synthesis of Metal Nanoparticles for insect vector control.



### Correlation of Programme objectives with course outcomes

COURSE OUTCOME	PO1	PO2	PO3	PO4	PO5
❖ Strong foundation on the disease transmitting insects will be laid.	✓	✓	✓	✓	✓
❖ You will be an expert and public advisor in insect transmitted diseases.	✓	✓	✓		✓
❖ Study on this topic fits you for leading pesticide companies and advisor for insect pest management.		✓	✓	✓	✓

### Unit wise programme specific qualification attributes

Unit	Unit Title	Intended Learning Chapters (K1, K2)	Hours of Instruction
I	Introduction to Disease Transmitting Insects	K1, K2, K3	Total 36 Hours, Online mode teaching
II	Insect morphology and metamorphosis	K1, K2, K4,	
III	Mosquitoes and mosquito born diseases	K1, K2, K4	
IV	Other Vectors and vector borne diseases	K3, K4	
V	Vector Control	K5,	

### REFERENCE BOOKS

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

## **ADD ON COURSES**



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TAMIL NADU



### M.Sc. Zoology Course

(This syllabus is applicable to the students who are admitted on or after 2022-2023 academic year onwards)

Add On Course-01  
Total Contact Hours: 36

Paper Code: 22ZOOA001  
Credits: 2

### VERMICULTURE

(Extra Credit Paper: Online Mode Certificate Course)

#### Course Objectives:

- ❖ To understand the concepts of vermiculture and vermicomposting.
- ❖ To understand the characteristics of earthworm species suitable for vermiculture and vermicomposting.
- ❖ To understand various applications of earthworms in organic solid waste management, soil fertility, and bioremediation.

#### Course Outcomes:

On successful completion of this course, the student will be able to understand the core concepts of vermiculture and vermicomposting and then involved in the entrepreneurship to promote agriculture. Successful students will apply vermitechnology in vermicomposting, soil fertility, and bioremediation processes and become an entrepreneur.

**UNIT-I:** Vermiculture – definition, scope and importance – Earthworm morphology and anatomy – Biology of *Perionyx excavatus* & *Eisenia fetida* – Ecological Classification of Earthworms.

**UNIT-II:** Common earthworm species used for culture – Environmental requirements – Culture methods – indoor and outdoor cultures – monoculture and polyculture.

**UNIT-III:** Vermicomposting materials and methods – Small scale and large Scale Vermicomposting. Factors affecting vermicomposting. Maintenance of Vermicomposting beds.

**UNIT-IV:** Applications of vermiculture – use of vermicastings in organic farming/horticulture, earthworms for management of municipal organic solid wastes. Nutrient value of worm cast/vermicompost – Effect of vermicompost on plants.

**UNIT-V:** Advantages of Vermitechnology – Marketing the products of vermiculture – creating the demand by awareness and demonstration, advertisements, packaging and transport, direct marketing – Potentials and constraints for vermiculture in India.

**REFERENCES:**

1. Edwards, C.A. Arancon, N.Q. and Sherman, R. (2011). Vermiculture Technology: Earthworms, Organic Wastes, and Environmental Management. CRC Press, Boca Raton, FL.
2. Karaca, A. (2011). Biology of Earthworms (Soil Biology Book-24). Springer Publishers.
3. Ranganathan, L.S. (2006). Vermibiotechnology – From Soil Health to Human Health. Agrobios, India.
4. Ismail, S.A. (2005). The Earthworm Book. Second Edition, Other India Press, Apusa, Goa, India.

**Correlation of Programme objectives with course outcomes**

<b>COURSE OUTCOME</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>
<ul style="list-style-type: none"> <li>• To understand core concepts of vermiculture and vermicomposting</li> <li>• To become an entrepreneurship to promote agriculture</li> </ul>	✓	✓	✓	✓	
		✓	✓	✓	✓

**Unit wise programme specific qualification attributes**

<b>Unit</b>	<b>Unit Title</b>	<b>Intended Learning Chapters</b>	<b>Hours of Instruction</b>
I	Vermiculture Introduction	K1, K2, K3	Total 36 Hours, Online mode teaching and Evaluation
II	Common earthworm species	K1, K2, K3	
III	Vermicomposting materials and methods	K1, K2, K3, K4, K5, K6	
IV	Applications of vermiculture	K1, K2, K3, K4, K5, K6	
V	Advantages of Vermitechnology	K1, K2, K3	



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### M.Sc. Zoology Course

(This syllabus is applicable to the students who are admitted on or after 2022-2023 academic year onwards)

Add On Course-02

Total Contact Hours: 36

Paper Code: 22ZOOA002

Credits: 2

### PCR TECHNOLOGY

(Extra Credit Paper: Online Mode Certificate Course)

#### Course objectives:

- ❖ To provide knowledge on the concept of PCR and its uses.
- ❖ To provide knowledge on working with PCR
- ❖ To identify various diseases using PCR technology

#### Course outcome:

- CO1:** Understand the basic principle of PCR reaction and Types and uses of PCR Machine.
- CO2:** Diagnose various diseases causing culprits at gene level
- CO3:** Understand various applications of PCR techniques in industries & Clinical Laboratories
- CO4:** Become an entrepreneur by developing PCR kit.

#### UNIT-I

History, scope and future prospects of polymerase chain reaction- Invention of PCR Machine and advances in PCR Instrumentation, Working principle of PCR

#### UNIT-II

Types and Evolution of PCR: qPCR, RT-PCR, Ong PCR, Nested PCR, Inverse PCR, Hot Start PCR, Multiplex PCR, and Solid State PCR

#### UNIT-III

Sample preparation and handling of chemicals and reagents in PCR laboratory- Bio-safety measures, Good Laboratory Practices

#### UNIT-IV

Processing of biopsy samples-DNA/RNA isolation and identification of DNA/RNA fragments-Agarose and Polyacrylamide Gel Electrophoresis

### UNIT-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)

#### Reference books:

1. Kannan S, Krishnan M, ThirumuruganR, 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
3. Mark A. Behlke, Kornelia Berghof-Jäger, Tom Brown (2019). Polymerase Chain Reaction: Theory and Technology Publisher: Caister Academic Press.
4. Thomas Weissensteiner Tania Nolan Stephen A. Bustin , Hugh G. Griffin Annette Griffin (2003). PCR Technology: Current Innovations, Second Edition (Weissensteiner, PCR Technology) CRC Press
5. Henry A. Erlich (2009). PCR Technology: Principles and Applications for DNA Amplification Palgrave Macmillan, London

#### Correlation of Programme objectives with course outcomes

COURSE OUTCOME	PO1	PO2	PO3	PO4	PO5
• Understand the basic principle of PCR reaction and Types and uses of PCR Machine.	✓	✓	✓	✓	
• Diagnose various diseases causing culprits at gene level.		✓	✓	✓	✓
• Understand various applications of PCR techniques in industries & Clinical Laboratories		✓	✓	✓	
• Become an entrepreneur by developing PCR kit.					✓

#### Unit wise programme specific qualification attributes

Unit	Unit Title	Intended Learning Chapters	Hours of Instruction
I	History, scope and future prospects	K1, K2, K3	Total 36 Hours, Online mode teaching and Evaluation
II	Types and Evolution of PCR	K1, K2, K3	
III	Sample preparation and handling	K1, K2, K3, K4, K5, K6	
IV	Processing of biopsy samples	K1, K2, K3, K4	
V	Applications of PCR	K1, K2, K3, K4, K5, K6	



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### M.Sc. Zoology Course

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Add On Course-03  
Total Contact Hours: 36

Paper Code: 22ZOOAO03  
Credits: 2

### ORNITHOLOGY

(Extra Credit Paper: Online Mode Certificate Course)

#### Course Objectives:

- To know about the diversity of birds in and around Periyar University
- To learn the different types of calls produced by the birds
- To understand the conservation status of birds in India
- To study the mechanism of bird flight

#### Course Outcomes:

On successful completion of the course, the student will be able to  
CO 1- Identify the birds present in and around Periyar University  
CO 2- Recognize the birds through the calls emitted by them  
CO 3- To get placement in conservation agencies

#### Unit: 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

#### Unit: II

Bird Habitats Bird Counting/ Census-Bird Watching: Identification of Birds in flight, Identification through Calls and songs. Equipments used for Bird Watching.

#### Unit: 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

#### Unit: 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

**Unit 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.

**REFERENCES**

1. Ali, S., Ripley, B.S (1990). A hand book of Birds of Indian sub continent, Oxford University Press.
2. Grimmet, R., Inskipp, T and Nameer, P.O. (2007). Birds of southern India, BNHS, Bombay
3. Kazmierczak, K and van Perlo, B. (2000). A field guide to the birds of Indian subcontinent, Yale University Press, USA

**Correlation of Programme objectives with course outcomes**

<b>COURSE OUTCOME</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>
The student will be able to					
CO 1- Identify the birds present in and around Periyar University	✓	✓	✓	✓	
CO 2- Recognize the birds through the calls emitted by them	✓	✓	✓	✓	
CO 3- To get placement in conservation agencies	✓	✓	✓	✓	

**Unit wise programme specific qualification attributes**

<b>Unit</b>	<b>Unit Title</b>	<b>Intended Learning Chapters</b>	<b>Hours of Instruction</b>
I	Ornithology Introduction	K1, K2	Total 36 Hours, Online mode teaching and Evaluation
II	Bird Habitats Bird Counting	K1, K2, K3, K4	
III	Breeding behaviour of birds	K1, K2, K3, K4	
IV	Activity recording and Ethogram	K1, K2, K3, K4, K5	
V	Bird Migration	K1, K2, K3, K4, K5	