

DEPARTMENT OF ZOOLOGY  
PERIYAR UNIVERSITY  
PERIYAR PALKALAI NAGAR  
SALEM - 636 011



SYLLABUS FOR

**M.Sc., Zoology Programme under  
Choice Based Credit System (CBCS)  
With effect from the academic year 2018-2019 onwards**

**PERIYAR UNIVERSITY, SALEM – 636 011**  
**(Reaccredited with “A” Grade by the NAAC)**  
**DEPARTMENT OF ZOOLOGY**  
**M.Sc. Zoology Course Scheme**  
*(with effect from the Academic Year 2018-2019 onwards)*

Subject Code	Title of the Paper	Weekly Contact Hours	Credits	Internal marks	External Marks	Total Marks
<b>SEMESTER-I</b>						
18ZOOC01	Invertebrates	4	4	25	75	100
18ZOOC02	Chordates	4	4	25	75	100
18ZOOC03	The Cell	4	4	25	75	100
18ZOOC04	Biochemistry	4	4	25	75	100
18ZOOC05	Principles of Genetics	4	4	25	75	100
18ZOOP01	Lab Course-I (Covering core papers I-V)	6	3	40	60	100
18ZOOE01	Electives	4	4	25	75	100
18ZOOE02	1. Microbiology 2. Soft Skill Development					
	<b>Total</b>	<b>30</b>	<b>27</b>	<b>190</b>	<b>510</b>	<b>700</b>
<b>SEMESTER-II</b>						
18ZOOC06	Animal Physiology	4	4	25	75	100
18ZOOC07	Developmental Biology	4	4	25	75	100
18ZOOC08	Evolution	4	4	25	75	100
18ZOOC09	Animal Behaviour and Endocrinology	4	4	25	75	100
18ZOOP02	Lab Course-II (Covering core papers VI-IX)	6	3	40	60	100
18ZOOE03	Electives	4	4	25	75	100
18ZOOE04	1. Vermitechnology 2. Economic Entomology					
18ZOOS01	Supportive	4	4	25	75	100
18ZOOS02	1. Molecular Oncology 2. Vermiculture & Vermicomposting					
	<b>Total</b>	<b>30</b>	<b>27</b>	<b>190</b>	<b>510</b>	<b>700</b>
<b>SEMESTER-III</b>						
18ZOOC10	Immunology	4	4	25	75	100
18ZOOC11	Animal Cell Culture and Nanobiotechnology	4	4	25	75	100
18ZOOC12	Environmental Biology	4	4	25	75	100
18ZOOC13	Aquaculture and Fishery Biology	4	4	25	75	100
18ZOOP03	Lab Course-III (Covering core papers X-XIII)	6	3	40	60	100
18ZOOE05	Electives	4	4	25	75	100
18ZOOE06	1. Cancer and Stem Cell Biology 2. Research Methodology					
18ZOOS03	Supportive	4	4	25	75	100
18ZOOS04	1. Entrepreneurial Zoology 2. Advances in Zoology					
	<b>Total</b>	<b>30</b>	<b>27</b>	<b>190</b>	<b>510</b>	<b>700</b>
<b>SEMESTER-IV</b>						
18ZOOPR01	Project work and <i>viva voce</i>	26	12	100	100 (50+50) Int + Ext	200
18ZOOFV01	Field Visit/Industrial Visit Report*	--	2	50	--	50
18ZOOEC01	Soft Skill Development: Statistical package for the social sciences (SPSS) (Extra Credit Paper)	4	4	40	60	100
	<b>Total</b>	<b>30</b>	<b>14+4</b>	<b>190</b>	<b>160</b>	<b>350</b>
<b>CUMULATIVE TOTAL</b>		<b>120</b>	<b>95+4</b>	<b>760</b>	<b>1690</b>	<b>2450</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.

## **SWAYAM COURSES**

Students must select the subject related online SWAYAM COURSES offered by other institutions across the country. At least two courses must be successfully completed within two years of M.Sc. Programme to get the Degree. Registration for the Swayam Course will be guided by the Mentor available in our Department.

## **ELIGIBILITY**

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

## **DURATION**

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.

## **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.

**The following procedure will be followed for Internal Marks:**

Theory Papers Internal

Best two tests out of 3: 10 marks

Attendance : 5 marks

Seminar : 5 marks

Assignment : 5 marks

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25 marks  
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Practical : 40 Internal Marks

Attendance : 5 Marks

Practical Test : 30 Marks

(Best of 2 out of 3)

Record : 5 Marks

Project : 20 Marks

Internal Marks : 20 Marks

Presentations Viva : 20 Marks

Project Report : 60 Marks

**Break-up Details for Attendance**

Below 60% : No Marks

60% to 75% : 3 Marks

76% to 90% : 4 Marks

91% to 100% : 5 Marks

## **REQUIREMENTS FOR PROCEEDING TO SUBSEQUENT SEMESTERS:**

- (i) Candidates shall register their names for the First semester examination after the admission in the PG courses.
- (ii) Candidates shall be permitted to proceed from the First Semester upto the Final Semester irrespective of their failure in any of the Semester Examination subject to the condition that the candidates should register for all the arrear subjects of earlier semesters along with current (subject) Semester subjects.
- (iii) Candidates shall be eligible to proceed to the subsequent semester, only if they earn sufficient attendance as prescribed therefore by the Syndicate from time to time.

Provided in case of candidate earning less than 50% of attendance in any one of the semester due to any extraordinary circumstance such as medical grounds, such candidates who shall produce Medical Certificate issued by the Authorized Medical Attendant (AMA), duly certified by the Principal of the College, shall be permitted to proceed to the next semester and to complete the course of study. Such candidate shall have to repeat the missed semester by rejoining after completion of final semester of the course, after paying the fee for the break of study as prescribed by the University from time to time.

## **PASSING MINIMUM**

- a) There shall be no Passing Minimum for Internal.
- b) For External Examination, Passing Minimum shall be of 50% (Fifty Percentage) of the maximum marks prescribed for the paper.
- c) In the aggregate (External + Internal) the passing minimum shall be of 50% for each Paper/Practical/Project and Viva-voce.
- d) Grading shall be based on overall marks obtained (internal + external).

## **CLASSIFICATION OF SUCCESSFUL CANDIDATES**

Candidates who secured not less than 60% of aggregate marks (Internal + External) in the whole examination shall be declared to have passed the examination in the First Class. All other successful candidates shall be declared to have passed in Second Class. Candidates who obtain 75% of the marks in the aggregate (Internal + External) shall be deemed to have passed the examination in First Class with Distinction, provided they pass all the examinations (theory papers, practicals, project and viva-voce) prescribed for the course in the First appearance.

## GRADING SYSTEM

The term grading system indicates a Seven (7) Point Scale of evaluation of the performances of students in terms of marks obtained in the Internal and External Examination, grade points and letter grade.

### SEVEN POINT SCALE (As per UGC notification 1998)

GRADE	GRADE POINT	PERCENTAGE EQUIVALENT
`O' = Outstanding	5.50 – 6.00	75 – 100
`A' = Very Good	4.50 – 5.49	65 – 74
`B' = Good	3.50 – 4.49	55 – 64
`C' = Average	3.00 – 3.49	50 – 54
`D' = Below Average	1.50 – 2.99	35 – 49
`E' = Poor	0.50 – 1.49	25 – 34
`F' = Fail	0.00 – 0.49	0 - 24

## RANKING

Candidates who pass all the examinations prescribed for the course in the first appearance itself alone are eligible for Ranking / Distinction.

Provided in the case of candidates who pass all the examinations prescribed for the course with a break in the First Appearance due to the reasons as furnished in the Regulations under “Requirements for Proceeding to subsequent Semester” are only eligible for Classification.

### PATTERN OF QUESTION PAPER:

PART – A (200 words): Answer All 5 Questions either or type 5 x 5 = 25 marks

PART – B (500 words): Answer All 5 Questions either or type 5 x 10 = 50 marks

### APPEARANCE FOR IMPROVEMENT:

Candidates who have passed in a theory paper / papers are allowed to appear again for theory paper / papers only once in order to improve his / her marks, by paying the fee prescribed from time to time. Such candidates are allowed to improve within a maximum period of 10 semesters counting from his / her first semester of his / her admission. If candidate improve his marks, then his improved marks will be taken into consideration for the award of Classification only. Such improved marks will not be counted for the award of Prizes / Medals, Rank and Distinction. If the candidate does not show improvement in the marks, his previous marks will be taken into consideration. Candidate will be allowed to improve marks in the Practicals, Project, Viva-voce, Field work.

**TRANSITORY PROVISION:**

Candidates who have undergone the course of study prior to the academic year 2018 -2019 will be permitted to appear for the examinations under those Regulations for a period of three years i.e., up to and inclusive of April / May 2019 Examinations. Thereafter, they will be permitted to appear for the examination only under the Regulations then in force.

PERIYARUNIVERSITY, SALEM

Department of Zoology

M.Sc. Zoology Course - SEMESTER-I

(This syllabus is applicable to the students who are admitted on or after 2018-2019 academic year onwards)

INVERTEBRATES

Course objectives:

- The students will classify the invertebrates 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. Locomotion: Amoeboid, Flagella and Ciliary movement in protozoa. Locomotion in Annelida and Echinodermata.

**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.

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

**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.

**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.

**REFERENCE BOOKS**

1. Veer Bala Rastogi (2017) Invertebrate Zoology, Kedar Nath Ram Nath,
2. Kotpal R.L (2014), Modern Text Book of Zoology – Invertebrates, (2016 Ed) Rastogi Publications - Meerut



3. Robert D. Barnes (2006) Invertebrate Zoology, 7<sup>th</sup> Edition
4. Barrington E J W (2012) Invertebrate Structure and Function, (2<sup>nd</sup> Ed) Affiliated East-West Press Pvt. Ltd. New Delhi
5. Pechenik J.A. (2005) Biology of The Invertebrates Mc Graw Hill, India

PERIYARUNIVERSITY, SALEM

Department of Zoology

M.Sc. Zoology Course - SEMESTER-I

(This syllabus is applicable to the students who are admitted on or after 2018-2019 academic year onwards)

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 Chordates and classification of Prochordates:** Geological time scale, Origin of chordates, Vertebrate relationships and basic structure.

UNIT II

Type study: *Amphioxus*. **Pisces:** General characters and outline classification upto orders with suitable examples. Type study: Shark. **Amphibia:** Characters and 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.

UNIT III

**Reptilia:** General characters and outline classification up to orders with suitable examples of biological interest. Skull in Reptilia. Morphology of *Calotes*. Origin and adaptive radiation in Reptilia – Extinct Reptiles. Identification and study of Poisonous and non-poisonous snakes of India.

UNIT IV

**Aves:** General characters and outline classification up to orders with suitable examples of biological interest. Type study: Pigeon. *Archaeopteryx*, Significance of *Archaeopteryx*, Migratory Birds.

UNIT V

**Mammalia:** General characters and outline classification up to orders with suitable examples of biological interest. Prototheria, Metatheria and Eutheria- Type study: Rabbit. Importance of Marsupial Mammals. Exoskeleton structures of birds and mammals, Dentition in Mammals, Ruminant stomach in mammals and Echolocation in bats. Vertebrate Fossils: *Archaeopteryx* and Mesozoic mammals.

**Reference books:**

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

**PERIYAR UNIVERSITY, SALEM**

**Department of Zoology**

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

(This syllabus is applicable to the students who are admitted on or after 2018-2019 academic year onwards)

**THE CELL**

**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 - Importance of Meiosis in evolution of sexual reproduction in animals and Nondisjunction.

**UNIT - II**

Ultra-structure, types and functions of Plasma membrane – Fluid Mosaic model theory; Ribosome and Golgi bodies, Lysosome, Endoplasmic reticulum. Mitochondria: ultrastructure and functions. Micro bodies peroxisomes and glyoxisomes.

**UNIT – III**

Nucleus: ultrastructure of nuclear membrane, Nucleolus, Nucleoplasm and Chromatin fibres, Microtubules, microfilaments – Cilia and Flagella. Signal Transduction Pathways: organization of cell signals and their receptors. Ion channel coupled receptors – secondary messengers. Amplifiers, Integrators and signal hypothesis.

**UNIT – IV**

Nucleic Acid: DNA as genetic material (direct and indirect evidences) – Structure and types of DNA and RNA. Eukaryotic Chromosome: Chromosome structure based classification. Mutations: Mutagens-physical, chemical and biological agents – mutation types –molecular basis of spontaneous and induced mutation. Mutagenesis testing: AMES test.

## **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 – RNA processing, capping, polyadenylation, splicing mechanism. Protein Synthesis: Translation and post translational modifications and their biological importance. Mechanism of cell aging and senescence. Comparison of Cell death: Necrotic and apoptotic cells.

## **REFERENCE BOOKS:**

1. Cooper, G.M.2016. The Cell – A Molecular Biological Approaches. ASM Press, Washington.
2. Alberts B, Johnson A, Lewis J, Raff M, Roberts K and Walter P (2015) Essential Cell Biology. Garland Science, New York
3. De Robertis EDP and De Robertis EMF (2011) Cell and Molecular Biology. Lippincott Williams and Wilkins, USA.
4. Gupta PK (2014) Cell and Molecular Biology. Rastogi Publications, Meerut.
5. Karp G (2017) Cell and Molecular Biology: Concepts and Experiments. 6<sup>th</sup> edition, John Wiley and Sons Ltd. New York.
6. Lewin B (2016) Genes XIII Oxford University Press, Oxford.
7. Walker JM and Gingold EB (2013) Molecular Biology and Biotechnology. Panima University Press, Oxford Publishing Co., New Delhi.
8. Thorpe NO (2000) Cell Biology, John Wiley and Sons, New York.
9. Turner PC McLennan AG Bates AD and White MRH (2007) Instant Notes Molecular Biology. Viva Books Pvt. Ltd., New Delhi.
10. Thomas Pollard, William Earnshaw, Jennifer Lippincott Schwartz, Graham Johnson, (2017) Cell Biology, 3<sup>rd</sup> Edition, Elsevier Publishing, USA,

**Core Paper: 04**

**Paper Code: 18ZOOC04**

**PERIYAR UNIVERSITY, SALEM**

**Department of Zoology**

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

(This syllabus is applicable to the students who are admitted on or after 2018-2019 academic year onwards)

**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 and pKa value determination. Classification, structure and function of carbohydrates. Carbohydrate metabolism and metabolic disorder: Diabetes and their biomedical significance.

**UNIT II**

**Amino acids:** Structure, classification and physicochemical properties of amino acids, Essential amino acids, glycogenic and ketogenic amino acids. **Proteins:** Classification and properties of proteins. Levels of structure in protein architecture. **Enzymes:** Types of Enzymes. Structure of Lysozyme, mechanism of enzyme action, enzyme kinetics, enzyme inhibitors, coenzymes. Inborn errors of metabolism.

**UNIT III**

**Lipids:** Structure and Classification, Oxidation of fatty acids, ketosis, biosynthesis of fatty acids, triglycerides, Cholesterol physiology & function, Cholesterol biosynthesis and Beta oxidation of fatty acids. Biomedical importance of very-low-density lipoproteins (VLDL),

intermediate-density lipoproteins (IDL), low-density lipoproteins (LDL), and high-density lipoproteins (HDL). Obesity: Causes and Preventive measures.

#### **UNIT IV**

**Porphyrins:** Hemoglobin synthesis and Sickle cell anemia. Nucleoside and nucleotide.  
**Nucleic acids:** Free nucleotides – structure, properties 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.

#### **UNIT V**

**Signal transduction:** Hormones and their receptors, steroid hormone receptor and gene action. Peptide hormone receptor (cell surface receptors), signaling through G-protein coupled receptors, signal transduction pathways, cAMP, cGMP, phosphatidyl inositol and calcium as second messengers, regulation of signaling pathways.

#### **REFERENCE BOOKS**

Murray, R. K., Granner, D. K., Mayes, P. A., Rodwell, V. W. (2017) Harper's Biochemistry. Prentice Hall International Inc.

Lehninger, A. L., Nelson, D. K., and Cox, M. M. (2015) Principles of Biochemistry. CBS Publishers and distributors, New Delhi.

Stryer, L. (2016) Biochemistry. W. H. Freeman and Company, New York.

Voet.D. Judith, G. Voet, Charlotte W. Pratt. (2014) Fundamentals of Biochemistry, John Wiley& Sons Inc. New York.

Satyanarayanan, U (2015). Essentials of Biochemistry, Uppala Author – Publisher Interlinks, Vijayawada.

**Core Paper: 05**

**Paper Code: 18ZOOC05**

**PERIYAR UNIVERSITY, SALEM**

**Department of Zoology**

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

(This syllabus is applicable to the students who are admitted on or after 2018-2019 academic year onwards)

**PRINCIPLES OF GENETICS**

**Course objectives:**

- To understand the concepts and applications of genetics.
- To learn on the quantification of heritable traits.
- To know the role of genes in human health and development.

**Course outcome:**

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

- 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, gene interactions, pleiotropy, genomic imprinting, penetrance and expressivity, linkage and crossing over, X linkage, X limited, and X influenced characters. Gene mapping methods: Linkage maps, tetrad analysis, mapping with molecular markers.

**UNIT II**

Extra chromosomal inheritance: Inheritance of mitochondrial genes, maternal inheritance. Microbial genetics: Methods of genetic transfers – transformation, conjugation, transduction and sex-duction, mapping genes by interrupted mating, fine structure analysis of genes. Human genetics: Pedigree analysis, lod score for linkage testing, karyotypes, genetic disorders.

**UNIT III**

Quantitative genetics: Polygenic inheritance, heritability and its measurements, QTL mapping. Mutation: Types, causes and detection, mutant types – lethal, conditional, biochemical, loss of function, gain of function, germinal verses somatic mutants, insertional mutagenesis.



## **UNIT IV**

Structural and numerical alterations of chromosomes: Deletion, duplication, inversion, translocation, ploidy and their genetic implications. Recombination: Holiday Model, Homologous and non-homologous recombination, including transposition, site-specific recombination.

## **UNIT V**

Principles and applications of prenatal diagnosis – Chorionic villus sampling and Amniocentesis. Karyotyping – Detection of Syndromes – Chromosomal micro-dissection, DNA Finger Printing and Fluorescent *in situ* Hybridization (FISH). DNA sequencing, HGP – merits and demerits, RFLP and AFLP.

## **REFERENCE BOOKS:**

- 1) Tamarin, R.H. 2017. Principles of Genetics. 7<sup>th</sup> Edition, McGraw Hill Education.
- 2) Watson, J.D. and Tania, A.B. 2017. Molecular Biology of the Gene. 7<sup>th</sup> Edition, Pearson Education.
- 3) 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.
- 4) Snustad, D.P. and Simmons, M.J. 2015. Principles of Genetics. 7<sup>th</sup> Edition, John Wiley and Sons.
- 5) Strickberger M.W. 2015. Genetics. 3<sup>rd</sup> Edition, Prentice India.
- 6) Primrose, S.B. and Twyman, R. 2006. Principles of Gene Manipulation and Genomics. 7<sup>th</sup> Edition, Blackwell Publishing Company.

**Core Practical Paper: 01**

**Paper Code: 18ZOOP01**

**PERIYAR UNIVERSITY, SALEM**

**Department of Zoology**

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

(This syllabus is applicable to the students who are admitted on or after 2018-2019 academic year onwards)

**LAB COURSE-I**

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

**Core III Cell and Molecular Biology**

1. Micrometry for cell measurement
2. Identification of different types of cells in blood
3. Observation of Mitosis (onion root tip)
4. Observation of Meiosis (Grasshopper – Voucher Specimen)
5. Cells of vital organs (Slides: Kidney, Liver, Spleen, Stomach, muscles, lung and colon)

**Core IV Biochemistry**

1. Estimation of Protein
2. Determination of glucose level in Blood
3. Effect of Temperature on salivary amylase activity
4. Identification of amino acids by paper chromatography
5. Spotters: Diabetes, Lesch-Nyhan syndrome and GOUT Disease

### **Core V Genetics**

1. Observation of Mendelian traits Among Student Volunteers
2. Identification of Human Syndromes – Voucher Specimen
3. Study on polygenic inheritance – Voucher Specimen
4. Pedigree Analysis of Genetic Disorder (Hemophilia and Diabetes)
5. Genetic Counseling methods (Among Student Volunteers)

### **REFERENCE BOOKS:**

1. Plumer HT (2012) Practical : Biochemistry , Wiley Publication, India
2. Borah D (2012) Biotechnology Lab Practices, Global Academic Publisher, India.
3. Kannan S, Krishnan M, Thirumurugan R and Achiraman S (2012) Methods in Molecular Biology, UVN Publishers, India.
4. Lal SS (2009) Practical Zoology, Rastogi Publications, New Delhi.

**Elective Paper: 01**

**Paper Code: 18ZOOE01**

**PERIYAR UNIVERSITY, SALEM**

**Department of Zoology**

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

(This syllabus is applicable to the students who are admitted on or after 2018-2019 academic year onwards)

**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.

**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.

**UNIT I:**

History and Scope of Microbiology- Wittaker's Five Kingdom concept- General features of prokaryotes. Morphology and ultra-structure of viruses. Mycology: Classification of biomedically important fungal species.

**UNIT II:**

Culture and Characterization: Isolation and identification of bacteria. Techniques of pure culture methods. Phases of growth. Methods of sterilization and disinfection –. Staining: Simple and differential staining; Gram staining; acid fast staining; endospore staining; capsule staining and flagella staining.

**UNIT III:**

Microbial genetics: Methods of genetic transfers – transformation, conjugation, transduction. Microbial Genomics: Genome project of *Escherichia coli* and *Yeast*. Metagenomics concepts and Significance. Microbial control – Physical and chemical agents

**UNIT IV:**

Host parasite interaction: Principles of Disease and Epidemiology , Microbial Mechanisms of Pathogenicity Innate Immunity: Nonspecific Defenses of the Host Adaptive Immunity: Specific Defenses of the Host

**UNIT V:**

Industrial Microbiology: Microbial fermentation Microbial production of Antibiotics: penicillin, streptomycin, Vaccines - genetic recombinant vaccines. Bioremediation- Principles and applications.

## **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 Foundations in Microbiology 10<sup>th</sup> Edition. 2018 Mc Graw Hill Education Publishers, USA.
7. Gerard J. Tortora, Berdell R. Funke, Christine L. Case, Microbiology: An Introduction, 12th Edition (2017) Pearson publishers, USA

**Elective Paper: 02**

**Paper Code: 18ZOOE02**

**PERIYAR UNIVERSITY, SALEM**

**Department of Zoology**

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

(This syllabus is applicable to the students who are admitted on or after 2018-2019 academic year onwards)

**SOFT SKILL DEVELOPMENT**

**Course objectives:**

- To establish positive attitude.
- To learn to understand the interpersonal skills.
- To develop skill-oriented employability

**Course outcome:**

On successful completion of this course, the student will be get motivation to assess the interpersonal skill and will provide job opportunity / counselling to others.

**UNIT I**

**Capacity Building:** Self-awareness - building self - esteem - importance of having a strong self- esteem – developing positive attitude -. Anchoring on principles: Universal principles and values – forming & inculcating values.

**UNIT II**

**Interpersonal skills:** Trust-trustworthiness - interpersonal communication – art of listening, reading and writing – art of writing e-mails and e-mail etiquettes – building relationship-networking.

**UNIT III**

**Corporate skills:** Vision, mission and goals: Concepts, vision setting, goal setting- goals for roles. Group goal – concept of synergy – team building – group skills.

**UNIT IV**

**Management skills:** Developing Body Language – Practicing etiquette and mannerism – Stress Management –Time Management: Important and urgent activities - time management to move towards life vision.

**UNIT: V**

**Employability Skills:** Writing Resume / CV – interview skills – Group Discussion – Mock Interview – Mock GD – Career Planning.

**REFERENCE BOOKS:**

Alex K. (2012) Soft Skills – Know Yourself & Know the World, S. Chand & Company Ltd. New Delhi

Meena K. Ayothi V. (2013). A Book on Development of Soft Skills (Soft Skills: A Road Map to Success), P.R. Publishers & Distributors, Trichy.

Francis Thamburaj S.J. (2009). Communication soft skills for Professional Excellence, 1<sup>st</sup> Ed., Grace Publishers.

Rathan Reddy B. (2005). Team Development and Leadership, Jaico Publishing House, Mumbai.

**Core Paper: 06**

**Paper Code: 18ZOOC06**

**PERIYAR UNIVERSITY, SALEM**

**Department of Zoology**

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

(This syllabus is applicable to the students who are admitted on or after 2018-2019 academic year onwards)

**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, Temperature Regulation in homeotherms, Physical, chemical and neural regulation. **Osmotic and ionic regulation:** Response to hyperosmotic and hyposmotic media with reference to fishes. **Stress and adaptations:** Adaptations to pressure - High altitude.

**UNIT II**

**Respiration-** Comparative physiology of respiration in relation to different habitats- Aquatic habitat: Fishes, Terrestrial: Human respiratory system, Aerial: Birds and Insects, neural and chemical regulation of respiration.

**UNIT III**

**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. Comparative physiology of excretion in relation to different habitats, kidney - urine formation, concentration, elimination and regulation of water balance.

**UNIT IV**

**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



## **UNIT V**

### **Nervous system and sensory physiology:**

Gross anatomy of brain and spinal cord, Structure of neuron, nerve conduction, interneuron transmission, Synoptic theories, Central and peripheral nervous system - **Receptors:** Chemoreception- Chemical senses, taste and smell, Phonoreception – Physiology of hearing, Photoreception - Photochemistry of vision.

## **REFERENCE BOOKS**

Eckert, Roger, Randall, D.J., Burggren, Warren, French, Kathleen. (2011) Eckert's Animal Physiology, Fifth Edition. W.H.Freeman & Co Ltd. USA

Gordon, M. S., Bartholomew, G. A., Grinnel, A. D., Jorgensen, C. B. White, F.N., (1971) Animal Function - Principles and Adaptations. Macmillan Co. London.

Hall, J. E (2015) Guyton and Hall Text Book of Medical Physiology. Thirteenth Edition, Elsevier Sander Publications, USA.

Ian Kay, (2006) Animal Physiology Pear Tree Press Ltd., Singapore.

Knut Schmidt-Nielsen, (2011).. Animal Physiology: Adaptation and Environment, Sixth Edition, Cambridge University Press, UK.

Moyes, C. D., and P. M. Sculte (2016) Principles of Animal Physiology, 2<sup>nd</sup> Edition, Pierson Education, India.

Prosser, C.L. and Brown (1985) Comparative Animal Physiology III Ed. W.B. Saunders Company, Philadelphia

Richard W. Hill, ( 2016). Animal Physiology. 4<sup>th</sup> Edition, Sinauer Associates, Inc. USA.

**Core Paper: 07**

**Paper Code: 18ZOOC07**

**PERIYAR UNIVERSITY, SALEM**

**Department of Zoology**

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

(This syllabus is applicable to the students who are admitted on or after 2018-2019 academic year onwards)

**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 themselves to do research in the topic of interest.

**UNIT I**

**Basic concepts of development:** Eggs and their types-Polarity, symmetry and chemo-differentiation of egg. Gamitogenesis: Spermatogenesis and Oogenesis. 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.

**UNIT II**

Role of maternal contribution in early embryogenesis – masked RNA. Molecular perspectives of fertilization: Recognition of egg and sperm, sperm attraction, acrosome reaction, species – specific recognition, cortical reaction, activation of egg metabolism, fusion of genetic material.

**UNIT III**

Totipotency and pluripotency of cleavage 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.

## **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 development in vertebrates. Post embryonic development – larval formation, metamorphosis, Environmental regulation of development.

## **UNIT V**

Differentiation – definition, differentiation at tissue level - epithelio-mesenchymal interaction, differentiation at organ level – cyclopia and acephaly, role of Hox D gene, Hoxa gene. Concept of gene knock out, abnormal differentiation – teratoma and teratogens. Mechanism of Programmed cell death (Apoptosis).

## **REFERENCE BOOKS**

1. Frederick R Bailey (2018), Text-Book of Embryology, Forgotten Books.
2. Datta A. K. (2017), Essentials of Human Embryology (7<sup>th</sup> Ed.), Current Books International
3. Subhadra Devi V (2017), Inderbir Singh's Human Embryology (11<sup>th</sup> Revised Ed.), Jaypee Brothers Medical Publishers
4. Vishram Singh (2017) Textbook of Clinical Embryology, Elsevier
5. Scott F. Gilbert (2016), Developmental Biology (11<sup>th</sup> edition), Sinauer.
6. Sadler (2016), Langman's Medical Embryology (13<sup>th</sup> Ed.), Wolters Kluwer.
7. Tickle, Martinez Arias Wolpert (2015), Principles of Development 5<sup>th</sup> Ed) Oxford University Press.
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.
11. Gerald P. Schatten (2006) Current Topics in Developmental Biology (1<sup>st</sup> Ed.), Academic Press.
12. Jonathan M. W. Slack (2005), Essential Developmental Biology, (2<sup>nd</sup> Ed), Wiley-Blackwell
13. Lewis Wolpert, Rosa Beddington, Thomas Jessell, Peter Lawrence, Elliot Meyerowitz, Jim Smith (2001), Principles of Development (2<sup>nd</sup> Edition), OUP Oxford

**Core Paper: 08**

**Paper Code: 18ZOOC08**

**PERIYAR UNIVERSITY, SALEM**

**Department of Zoology**

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

(This syllabus is applicable to the students who are admitted on or after 2018-2019 academic year onwards)

**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: Early ideas of evolution – Lamarckism, Neo-Lamarckism – Charles Darwin: The voyage on the Beagle – Neo-Darwinism – Species concepts – The Biological Species concept – A general theory of speciation and its impacts.

**UNIT – II**

Hardy-Weinberg equilibrium – The causes of evolution – Mutation and Gene flow with reference to Rates of evolutionary change; Genetic drift and Non-random breeding – Reproductive isolating mechanisms: Models of population growth – Variation in natural populations. Phenotypic variation: Polygenic traits.

**UNIT – III**

Natural selection I: Stabilizing, directional, and disruptive selection- Natural selection II: The general selection model- Group selection, kin selection, and sociobiology- Ecogeographic rules: Subspecies concepts- Clines and hybrid zones

**UNIT – IV**

Phenetics and cladistics- Tracing ancestor-descendant relationships- The molecular clock- Phyletic patterns and biogeography- Evolutionary trends and laws: Gradualism and

punctuated equilibria- Adaptation and adaptive radiation with reference to convergent and divergent evolution.

## **UNIT – V**

Ontogeny and phylogeny: Historical perspective; allometry and Species selection. 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.

### **REFERENCE BOOKS:**

1. Cain, A. 2018. Animal Species and Their Evolution. Princeton University Press.
2. Parker, S. and Roberts, A. 2015. Evolution: The Whole Story. Thames and Hudson Publishers.
3. Hall, B.K. and Hallgrímsson, B. 2014. Strickberger's Evolution. Jones and Bartlett Publishers.
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.
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.
8. Darwin, C. 1958. The Autobiography of Charles Darwin 1809-882., The Norton Library, New York.
9. Darwin, C. 1845. The Voyage of the Beagle. John Murray, London.

**Core Paper: 09**

**Paper Code: 18ZOOC09**

**PERIYAR UNIVERSITY, SALEM**

**Department of Zoology**

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

(This syllabus is applicable to the students who are admitted on or after 2018-2019 academic year onwards)

**ANIMAL BEHAVIOUR AND ENDOCRINOLOGY**

**Course Objectives:**

- To enable the students to impart knowledge about the different types of behaviour.
- To gain basic understanding about endocrinology.
- To know how the animals, communicate.

**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 to animal behaviour-** History of Animal behaviour- Karl Von Fritz, Tinbergen and Lorenz contribution- Methods for studying animal behaviour- Proximate and ultimate causation of behaviour- **Behavioural patterns-** Orientation, animal navigation and migration- Instinct Vs Learnt behaviour- Associative learning- Classical and Operant conditioning- Habituation, imprinting.

**Unit II**

**Social behaviour and animal signalling-** Altruism- Honey bee, Vampire bats- Hamilton's rule, Kin Selection-Group foraging and its advantages- Dispersion- migration- territoriality- Animal Communication in birds, bees and wild mammals- Warning colouration, mimicry and deception.

**Unit III**

**Mating system-** Sexual dimorphism- Male- Male competition- Female choice- Leks- Alternative mating tactics-satellite males- monogamy- Polyandry- Polygyny- Sperm competition- Parental care.

**Unit IV**

**Pheromone Biology-** Chemical Signals– Types and uses. Pheromones in invertebrates, Insect pheromones in pest management programme. Pheromones in vertebrates. Pheromone

perception: Olfactory and Accessory olfactory systems in animals. Pheromones and reproductive behavior: Lee Boot effect, Vandenberg effect, Bruce effect. Mammalian Pheromones: Sources and types, mode of action in mammals, neuro-endocrine regulation of pheromone function. Role of Pheromones in animal behaviour. Biology of Human Pheromone communication.

## **Unit V**

**Endocrinology and Chronobiology**- Basic mechanisms of hormone action- Neuroendocrine mechanism in insect growth and reproduction- Endocrine glands: Pituitary, Thyroid, Parathyroid and adrenal- Functions and disorders- **Biological rhythm**- Types and characteristics of biological rhythm- photic and non-photoc zeitgebers, Entrainment and free running rhythm- short term and long-term rhythm- Circadian rhythm, Pace maker, Melatonin and clock genes.

## **REFERENCES**

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

**Core Practical Paper: 02**

**Paper Code: 18ZOOP02**

**PERIYAR UNIVERSITY, SALEM**

**Department of Zoology**

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

(This syllabus is applicable to the students who are admitted on or after 2018-2019 academic year onwards)

**LAB COURSE-II**

**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 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. Case Study Report: 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

#### **REFERENCE BOOKS**

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

**Elective Paper: 03**

**Paper Code: 18ZOOE03**

**PERIYAR UNIVERSITY, SALEM**

**Department of Zoology**

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

(This syllabus is applicable to the students who are admitted on or after 2018-2019 academic year onwards)

**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:** Earthworm – morphology and anatomy – Biology of *Perionyx excavatus*. – Ecological grouping – Epigeic, Anecic and Endogeic species; Ecological role and economic importance of earthworms.

**UNIT- II:** Vermiculture – definition, scope and importance; Common species for culture; Environmental requirements; Culture methods – indoor and outdoor cultures – monoculture and polyculture. Different methods for setting-up of vermicomposting units.

**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 – Effect of vermicompost on plants.

**UNIT- IV:** Advantages of Vermitechnology – Marketing the products of vermiculture – creating the demand by awareness and demonstration, advertisements, packaging and transport, direct marketing.

**UNIT- V:** Predators, Parasites, and Pathogens of Earthworms and their control. Future perspectives – Potentials and constraints for vermiculture in India.

## **REFERENCES**

Edwards, C.A. Arancon, N.Q. and Sherman, R. 2011. Vermiculture Technology: Earthworms, Organic Wastes, and Environmental Management. CRC Press, Boca Raton, FL.

Karaca, A. 2011. Biology of Earthworms (Soil Biology Book-24). Springer Publishers.

Ranganathan, L.S. 2006. Vermibiotechnology – From Soil Health to Human Health. Agrobios, India.

Ismail, S.A. 2005. The Earthworm Book. Second Edition, Other India Press, Apusa, Goa, India.

Edwards, C.A. 2004. Earthworm Ecology. CRC Press, Boca Raton, FL.

Ismail, S.A. 1997. Vermicology: The Biology of Earthworms. 1st Edition, Orient Longman, India.

**Elective Paper: 04**

**Paper Code: 18ZOOE04**

**PERIYAR UNIVERSITY, SALEM**

**Department of Zoology**

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

(This syllabus is applicable to the students who are admitted on or after 2018-2019 academic year onwards)

**ECONOMIC ENTOMOLOGY**

**Objectives:**

- ❖ Main objective is to provide basic knowledge on the largest group of animals in the world.
- ❖ The units are designed to provide basic and advanced knowledge and practical skills on the beneficiary insects.
- ❖ The subject is also designed to learn and overcome the problems faced during culture of silkworms and bees.

**Outcome:**

- ❖ You will have a strong foundation on classification, structure and behavior of insects as whole.
- ❖ You could be a leading entrepreneur by using the gained knowledge and practical skills on sericulture and apiculture.
- ❖ You will able to provide novel ideas and techniques to farmers from the experience and knowledge gathered during the study.

**UNIT -I:**

**AN OVERVIEW OF CLASS INSECTA:** Classification of Insects. External morphology of Insects – Types of mouthparts, Antennae, wings and legs. Life cycle of insects – Types of metamorphosis.

**UNIT -II:**

**ECONOMIC IMPORTANCE AND SILKWORM BIOLOGY:** Prospects and status - *Bombyx mori* - life cycle - Structure of the silk gland - Physiology of molting - Genetics - mutation breeding. **MORICULTURE:** Mulberry - varieties & distribution - methods of cultivation and preparation – Harvesting methods - Pest and diseases.

**UNIT-III:**

**DISEASES AND PEST:** Viral, bacterial, fungi and protozoan diseases - control mechanisms. Uzifly menace. **SILKWORM REARING AND SILK REELING:** Rearing

operations - Selection and construction of rearing house Incubation - Reeling techniques – Lacing, skinning and re-reeling.

#### **UNIT-IV:**

**APICULTURE:** Introduction and present status. Distribution and behavior of *Apis dorsata*, *Apis cerana indica*. Structure & Morphology, Life cycle, colony organization, division of labour and communication.

#### **UNIT-V:**

**BEE REARING:** Beekeeping equipments, beekeeping and its products. Diseases and pests of Bees: Bacterial, fungal and viral diseases. Bee pests: Mites, beetles and moths. Management of pests and diseases.

#### **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.

R. F. Chapman (1998). The Insects: Structure and Function. Cambridge University Press - 770 pages.

Mishra, R.C., and Garg, R (1997). Prospectives in Indian Apiculture, Agro-Botanica New Delhi, p - 412.

Sardar Singh, (1962). Bee keeping in India, Indian Council of Agricultural Research, The University of Michigan.

Roger, M (1990). The ABC and Xyz of Bee Culture: An Encyclopedia of Beekeeping, Kindle Edition.

**Supportive Paper: 01**

**Paper Code: 18ZOOS01**

**PERIYAR UNIVERSITY, SALEM**

**Department of Zoology**

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

(This syllabus is applicable to the students who are admitted on or after 2018-2019 academic year onwards)

**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 histopathologists 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.

**UNITII**

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

**UNITIII**

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.

### **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.

**PERIYAR UNIVERSITY, SALEM**

**Department of Zoology**

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

(This syllabus is applicable to the students who are admitted on or after 2018-2019 academic year onwards)

**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**

Earthworms – Taxonomic position and diversity; types – morphological and ecological grouping – Epigeic, Anecic and Endogeic species; Ecological role and economic importance of earthworms.

**UNIT - II**

Vermiculture – definition, scope and importance; Local and exotic species for culture; Environmental requirements; Culture methods – wormery – breeding techniques; indoor and outdoor cultures – monoculture and polyculture.

**UNIT - III**

Applications of vermiculture – Vermicomposting – use of vermicastings in organic farming, Earthworms for management of municipal organic solid wastes. Nutrient value of worm cast/vermicompost – Effect of vermicompost on plants.



#### **UNIT - IV**

Marketing the products of vermiculture – quality control, market research, marketing techniques – creating the demand by awareness and demonstration, advertisements, packaging and transport.

#### **UNIT - V**

Future perspectives – Predator/pathogen control in wormeries; Potentials and constraints for vermiculture in India.

#### **REFERENCE BOOKS:**

Edwards, C.A. Arancon, N.Q. and Sherman, R. 2011. Vermiculture Technology: Earthworms, Organic Wastes, and Environmental Management. CRC Press, Boca Raton, FL.

Karaca, A. 2011. Biology of Earthworms (Soil Biology Book-24). Springer Publishers.

Ranganathan, L.S. 2006. Vermibiotechnology – From Soil Health to Human Health. Agrobios, India.

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**PERIYAR UNIVERSITY, SALEM**

**Department of Zoology**

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

(This syllabus is applicable to the students who are admitted on or after 2018-2019 academic year onwards)

**IMMUNOLOGY**

**Course Objectives:**

- To motivate students to learn the lymphoid organs of our body
- To make them understand the different types of immune globulins
- 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

**UNIT I**

Historical perspectives, lymphoid organs. Cells of immune system, T and B cell activation and maturation, Haematopoiesis, Haematopoietic stem cells, Class switching, Antigens. The molecular basis of antigen and antibody interactions, Complement system, Types of immunity, Immunization.

**UNIT II**

Immunoglobulins: Structure and functions of immunoglobulin classes. Hybridoma technology for monoclonal antibody production and designer monoclonal antibodies. Cytokines, interleukins, complement system; Immunostimulation and Immunosuppression and their clinical significance.

**UNIT III**

MHC gene in human and mouse, Genetics of MHC class I and class II molecules. Autoimmune diseases. Transplantation Immunology- Tissue typing and organ transplantation. Immunobiology of HIV infection.

**UNIT IV**

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.

## **UNIT - V**

Principles and applications of immune techniques: Radio Immuno Assay, ELISA, Western Blotting, Immunofluorescence technique, immunohistochemistry. Microarray as a tool for detection of human genetic disorders. Immunodiagnostics and immunotherapy in virology – Serological methods for detection and quantitation of viruses: Hepatitis and Influenza viruses.

### **REFERENCE BOOKS:**

Abbas, A. K., and A. H. Lichtman (2017) Cellular and molecular immunology, First- South Asia Edition, Elsevier

Delves, P., S. Martin, D. Burton and I. M. Roitt, (2017), Roitt's Essential Immunology, 13<sup>th</sup> Edition, Wiley – Blackwell publications, USA

Murphy, K.M., and Weaver, C (2017) Janeway's Immunology, 9<sup>th</sup> edition, W.W. Norton & Company, USA

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Tizard, I.R. (1995) Immunology-An introduction IV Ed. Saunders College Publications, Philadelphia, USA.

**PERIYAR UNIVERSITY, SALEM**

**Department of Zoology**

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

(This syllabus is applicable to the students who are admitted on or after 2018-2019 academic year onwards)

**ANIMAL CELL CULTURE AND NANOBIO TECHNOLOGY**

**Objectives:**

- ❖ Students are motivated to impart knowledge and practical skills on isolation, culture and preservation of animal cells.
- ❖ It is also to provide a basic and advanced understanding of pluripotent stem cells.
- ❖ This subject also aims to provide knowledge practical skills on the synthesis, characterization and application of different nanoparticles.

**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**

Animal cell culture: Stages of culturing - cell culture media, cell lines, large scale culture, bioreactor models for animal cell culture, characterization and maintenance of cell lines – telomerase and cellular aging. Cryopreservation and cell bank. Applications of cell line in understanding the basic cell biology.

**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.

**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. Synthesis of Gold, Silver, Ormosil and Iron oxide nanoparticles. Monodispersion of Nanoparticles.

#### **UNIT – IV**

Characterization of Nano materials: Physical Method – Zeta potential, SEM, TEM and AFM. Chemical Method – Principle and Applications of UV visible Spectrophotometer, FT-IR spectroscopy, NMR and XRD. Biological Methods: MTT Assay, XTT Assay.

#### **UNIT – V**

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

#### **REFERENCE BOOKS**

Al-Rubeai M (2015) Animal Cell Culture, Springer.

Davis JM (2011) Animal Cell Culture: Essential Methods, Wiley-Blackwell, USA.

Dubey RC (2012) A Text Book of Biotechnology, S. Chand Co., New Delhi.

Gupta PK (2014) Biotechnology and Genomics, Rastogi Publications, Meerut, India.

Mather JP and Barnes D (2003) Methods in Cell Biology, Vol 57 Animal Cell Culture Methods, Academic Press, New York.

Potten CS (2010) Stem Cells, Academic Press, London.

David J Lockwood (2004) FRSC: Introduction to Nanoscale Science and Technology, National Research Council of Canada Ottawa, Ontario, Canada.

Kirkland AI and Hutchison JL (2007) Nanocharacterisation, Department of Materials, Oxford University, Oxford, UK.

Yury Gogotsi (2006) Nanomaterials Handbook, Taylor and Francis Group, Boca Raton London, New York.

**PERIYAR UNIVERSITY, SALEM**

**Department of Zoology**

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

(This syllabus is applicable to the students who are admitted on or after 2018-2019 academic year onwards)

**ENVIRONMENTAL BIOLOGY**

**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.

**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. **Ecosystem:** Structure and function; energy flow and mineral cycling (CNP); primary production and decomposition; structure and function of some Indian ecosystems: terrestrial (forest, grassland) and aquatic (fresh water, marine, eustarine).

**UNIT II**

**Pollution:** **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 - BOD, COD. Waste water treatment - eutrophication. - biomagnifications. **Oil pollution:** Coastal pollution - Oil Slicks and Spills, Post-gulf war effects. **Land pollution:** Solid waste accumulation, hospital waste and management.

**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.

#### UNIT IV

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

#### UNIT V

**Environmental Stress and Management:** Major classes of contaminants. Uptake, biotransformation, detoxification, elimination and accumulation of toxicants. Impact of chemicals on biodiversity. Bioindicators and biomarkers of environmental health. **Disaster Management:** Natural Disasters – Earthquakes, Volcanic Eruption, Landslides, Cyclones, Tsunamis and Droughts. Man Made Disasters- Fires and Forest Fires. Nuclear, Biological and Chemical disaster.

#### 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 Managment. Wiley-Blackwell Publishers.
- 9) Sinha, R.K. 1996. Biodiversity - Global Concerns. Common Wealth Publishers.



**Core Paper: 13**

**Paper Code: 18ZOOC13**

**PERIYAR UNIVERSITY, SALEM**

**Department of Zoology**

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

(This syllabus is applicable to the students who are admitted on or after 2018-2019 academic year onwards)

**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, murrels, catfish and tilapia). Selection criteria of cultivable species.

**UNIT - II**

Types of aquaculture: Freshwater aquaculture, brackish water aquaculture and mariculture, merits and demerits, Design, construction and management of ponds, types of ponds. Control of aquatic weeds and predators.

**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.

**UNIT - IV**

Fish diseases: Parasitic, protozoan, bacterial, fungal and viral diseases and their control measures. Fish processing and preservation, fishery by-products.

**UNIT - V**

Inland fisheries: 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, Prawns, Crabs, Lobsters and Molluscs (Mussels, clams and scallops).

#### **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, Kitab Mahal, New Delhi.

**Core Practical Paper: 03**

**Paper Code: 18ZOOP03**

**PERIYAR UNIVERSITY, SALEM**  
**Department of Zoology M.Sc. Zoology**  
**Course - SEMESTER-III**

(This syllabus is applicable to the students who are admitted on or after 2018-2019 academic year onwards)

**LAB COURSE-III**

**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 Grass land Ecosystems in Periyar University Campus.

## **SPOTTERS**

1. MCF-7 cells
2. A549 Cells
3. ZR751Cells
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

## **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.

**Elective Paper: 05**

**Paper Code: 18ZOOE05**

**PERIYAR UNIVERSITY, SALEM**

**Department of Zoology**

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

(This syllabus is applicable to the students who are admitted on or after 2018-2019 academic year onwards)

**CANCER AND STEM CELL BIOLOGY**

**Course Objectives:**

- To motivate students to learn the fundamentals of cancer
- To enable the students to know how the stem cells are functioning
- To get knowledge about different types of molecular techniques.

**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 stem cell culture and their applications. Cell culture-based vaccines. Cancer proteomics at a glance.

**UNIT II**

Cell Signaling in Cancer Cells and Signaling at the cell surface level, Types of signaling pathways that control gene activity in m=normal and cancer cells, endocytotic and exocytotic proteins in membranes and organelles, Vascular traffic, Metabolism and movement of lipids.

**UNIT III**

Etiology, epidemiology, diagnosis and treatment of Breast, Lung, and colo-rectal, cancers. Current scenario of micro-RNA technology in cancer medicine. Role of DNA vaccination in cancer treatment.

**UNIT IV**

Introduction to Stem cells– Stem cell definition, origin and hierarchy; stem cell properties, Identification and Characterization- potency and differentiation; niche of stem cell; overview

of different stem cell types (embryonic stem cell, adult stem cell and induced pluripotent stem cells)

#### **UNIT V –**

Characterization and properties of ES cells -pluripotency and self-renewal of ES; molecular mechanisms regulating pluripotency Mesenchymal stem cell (MSC) Haematopoietic stem cell (HSC) pluripotent stem cell (iPSC), Gene therapy - Therapeutic cloning. Ethical and Social consideration of Stem cell research.

#### **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.

**Elective Paper: 06**

**Paper Code: 18ZOOE06**

**PERIYAR UNIVERSITY, SALEM**

**Department of Zoology**

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

(This syllabus is applicable to the students who are admitted on or after 2018-2019 academic year onwards)

**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

**Unit II**

Cryotechniques - Cryopreservation of cells and tissues, freeze drying. Separation techniques. -Chromatography, principle type and application. Electrophoresis, Principles, types and applications -PAGE and agarose gel electrophoresis. Immunological techniques - Immunodiffusion (Single & Double) - Immuno electrophoresis Techniques

**Unit III**

Cell culture techniques. - Design and functioning of tissue culture laboratory - Culture media, essential components and Preparation - Cell viability testing.Principle and Applications of Flowcytometry, *in situ* hybridization (radio labelled and non-radio labelled methods) - FISH - Polymerase chain reaction (PCR), Blotting DNA Sequencing types and applications

**Unit IV**

Introduction, Statistical data, organization, classification and tabulation of data; Frequency distribution and graphical representation of data Measures of central tendency (Mean, Median and Mode), Measures of dispersion variance, standard deviation, coefficient of variance

Basics of Probability and Probability distribution.

## **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

### **REFERENCES:**

1. Keith Wilson and John Wlaker (2014) Principles and techniques of Practical Biochemistry and molecular biology 10<sup>th</sup> Edition. Cambridge University Press.
2. Geofferoy M. Cooper (2013) The Cell- A Molecular Approach. ASM Press New York.
3. Frederick M. Ausubel, Roger Brent, Robert E. Kingston, David D. Moore, J. G. Seidman, John A. Smith, Kevin Struhl 2010 Short Protocols in Molecular Biology, 5th Edition, 2 Volume Set. Wiley publication.
4. Gurumani, N. 2004. Introduction to Biostatistics, M.J.P. Publishers, Delhi.
5. Das, D and Das, A. 2004. Statistics in Biology and Psychology Academic Publishers, Kolkata.
6. R. Ian Freshney. 2011 Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications, 6<sup>th</sup> Edition. Wiley publication.
7. Robert D Braun (1987) Introduction to instrumental analysis- -McGraw Hill.
8. B L Williams and K Wilson (1981) A biologist Guide to principles and Techniques of Practical Biochemistry. Edward Arnold, London. 1981.



**PERIYAR UNIVERSITY, SALEM**

**Department of Zoology**

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

(This syllabus is applicable to the students who are admitted on or after 2018-2019 academic year onwards)

**ENTREPRENEURIAL ZOOLOGY**

**Objectives:**

- ❖ This subject provides knowledge on all the entrepreneurial aspects of fauna.
- ❖ Every unit is designed to deliver in-depth knowledge on marketing of highly valuable animal products.
- ❖ The subject is also designed to learn and overcome the problems faced during culture and marketing of animal products.

**Outcome:**

- ❖ You will develop knowledge of decision making on appropriate technique based on the environment and conditions.
- ❖ Students completing the course will have all entrepreneur qualities especially in selecting the right business at the right environment.
- ❖ Economically poor students could also develop small scale business based on the available sources.

**UNIT I:**

Sericulture: History and present status - Sericulture in India - Types of silkworms and distribution. Silkworm rearing technology, Food plant cultivation, seed production, reeling, re-reeling, twisting, doubling and weaving. Diseases and pests of Silkworm: Protozoan, Viral, Bacterial and fungal diseases. Silkworm pests: —Indian Uzifly and Dermistid beetles

**UNIT II:**

Introduction to Aquaculture. Culture systems. Types of aquaculture. Pond Ecology - Preparation of ponds. Prevention and control of weeds. Parasitic, protozoan, bacterial, fungal and viral diseases and management. Culture of Prawns. Processing, preservation and commercialization of the products.

**UNIT III:**

Apiculture: Introduction and present status. Distribution and behavior of *Apis dorsata*, *Apis cerana indica*. Structure & Morphology, Life cycle, colony organization, division of labour

and communication. Beekeeping equipments, beekeeping and its products. Diseases and pests of Bees: Bacterial, fungal and viral diseases. Bee pests: Mites, beetles and moths. Management of pests and diseases.

#### **UNIT IV:**

Introduction to Live feeds. Live feed species and their nutritional value. Rearing and maintenance of live feeds. Habitat maintenance for natural feed production. Mass culture techniques: Rearing and maintenance of phytoplankton and zooplanktons, Methods of collection, Different media used in culture, Application in hatcheries.

#### **UNIT V:**

Oyster culture: History and present status. Seed production of oysters and collection methods. Habitat management – Preparation of nurseries, Feed and nutrition, Factors affecting nurseries and development. Edible oysters and Pear oysters. Predators, Diseases and Environmental factors that affect oysters.

#### **References:**

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.

Ganga, G. and SulochanaChetty, J. (1997).An Introduction to Sericulture. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.

Hisao Aruga. (1994). Principles of Sericulture (Translated from Japanese). Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.

Mahadevappa, D., Halliyal, V.G., Shankar, D.G. and Bhandiwad, R., (2000). Mulberry Silk Reeling Technology Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.

Otsuki, R. and Sato, S.(1997). Silkworm Egg Production (Translated from Japanese). Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.

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.

Veda, K., Nagai, I. and Horikomi, M. (1997). Silkworm Rearing (Translated from Japanese).

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**Supportive Paper: 04**

**Paper Code: 18ZOOS04**

**PERIYAR UNIVERSITY, SALEM**

**Department of Zoology**

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

(This syllabus is applicable to the students who are admitted on or after 2018-2019 academic year onwards)

**ADVANCES IN ZOOLOGY**

**Objectives:**

**To strive the minds of our stake holders to**

- ❖ gain knowledge on tools and techniques adapted to produce transgenic animals.
- ❖ cater the in-depth knowledge on valuable animal products and their applications.

**Outcome:**

- ❖ Altogether, this subject will bring our students to develop transgenic animals and that could be more useful to the scientific community to solve various animal related problems.

**UNIT I**

**Recent Advances in Animal Biotechnology:** Tools and techniques in gene manipulation - antisense RNA technology, DNA and protein chip – Protein engineering – Gene knock out-RNAi and Gene silencing - Application of genetic engineering in medical, agriculture, animal husbandry – Transgenesis Bioethics and IPR.

**UNIT II**

**Current Scenario of Nanomedicine:** Nanoparticle as drug carriers- Nanoparticles as gene carrier- Nanoparticle as RNAi carriers. Development of nanomedicine to target cancer. Commercialized nanocarriers for cancer treatment. Impact of nano in cancer biology. Tumor immunology, immunodiagnostics and disease tragetting with monoclonal antibodies.

**UNIT III**

**Behavioural Genetics:** Beyond Mandal Laws, Biological Clock and its genetic regulation. Pathways between genes and behaviour, Epigenesis, Genetic and Environmental influences of behaviour. Proteome of Circadian rhythm in Mammals.

**UNIT IV**

**Immunity in Health Care:** Cell fusion methods. Hybridoma technology and its applications. Stem cell research; haemopoietic stem cells, embryonic stem cells in health care. Cell culture

products. Production of interferons, interleukins and vaccines through mammalian cell cultures.

## UNIT V

**Molecular Entomology:** Insect Molecular Physiology an Over view- Insect Pest Management, Role of Storage proteins in Insect Development (Embryo and Metamorphosis)- Vitellogenin in and receptor interaction in insect - Nanoparticles in Insect Pest Management. Pros and cons of Bacillus thuriengensis in Pest Management.

## REFERENCES

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.

Bruce Alberts, Dennis Bray, Julian Lewis, Martin Raff, Keith Roberts, James D. Watson. (2014). Molecular Biology of the Cell, 3<sup>rd</sup> Edition, International Students Publication.  
USA

Primrose SB and R.M.Twyman (2015) Principles of Gene Manipulation and Genomics Blackwell Publishing, USA.

Salle AJ (1999) Fundamental Principles of Bacteriology. 7<sup>th</sup> edition, Tata- McGraw Hill.

Yury Gogotsi (2006) Nanomaterials Handbook, Taylor and Francis Group, Boca Raton London, New York.

**PERIYAR UNIVERSITY, SALEM**

**Department of Zoology**

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

(This syllabus is applicable to the students who are admitted on or after 2018-2019 academic year onwards)

**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.

**Extra Credit Paper: 01**

**Paper Code: 18ZOOEC01**

**PERIYAR UNIVERSITY, SALEM**

**Department of Zoology**

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

(This syllabus is applicable to the students who are admitted on or after 2018-2019 academic year onwards)

**SOFT SKILL DEVELOPMENT (Extra Credit Paper)**

**STATISTICAL PACKAGE FOR THE SOCIAL SCIENCES (SPSS)**

**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.

**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.

**UNIT III**

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

#### **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.

#### **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.

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

#### **REFERENCE BOOKS**

Einspruch, E. L. (2004) Next steps with SPSS. Sage Publications, International educational and Professional Publisher, Thousand Oaks, London, New Delhi.

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.