



PERIYAR UNIVERSITY
Periyar Palkalai Nagar, Salem-636011
(Reaccredited with 'A' Grade by the NAAC)

DEPARTMENT OF ZOOLOGY

M.Phil. DEGREE

ZOOLOGY

[Choice Based Credit System (CBCS)]

OBE REGULATIONS AND SYLLABUS

(Effective from the academic year 2018-2019 and thereafter)

M. Phil. ZOOLOGY

OBE REGULATIONS AND SYLLABUS

(With effect from the academic year 2018-2019 onwards)

1. Preamble

Department of Zoology was started in the year 2012 with M.Sc., M.Phil., and Ph.D. courses. This Department strives to create a suitable environment that enables teaching and research to attain high levels of excellence (through Publications and Patents) and in which its members can achieve their full potential right from Molecular Cell Physiology to understanding and targeting diseases like cancer and vector borne diseases, impact of climate change on insect diversity and bat behavior, Cultivation to commercialization of earthworms etc. Zoology is central to our understanding of the world. Zoologists seek to discover the fundamental principles that pinpoint animal life focusing on the diversity, function and evolution of animals and thus providing the scientific basis for our knowledge regarding the life style, physiology, diseases and their curative measure in the natural environment by conducting research in insects to mammalian cells.

2. General Graduate Attributes

This programme will develop basic required qualities and knowledge for being a researcher. The budding researchers will be updated with all recent researches and techniques that are the basic amenities for a novel product oriented research. The researchers will enter into narrow subject specific workout from a broad program specific workout.

3. Programme Specific Qualification Attributes

This programme is a cap decorated with knowledge and specification for teachers teaching students at higher secondary or lower than that. Further, this a basic and non-compulsory course required for entering into research or teaching at higher education. It also provides opportunities to develop a research entrepreneur in each and every specification.

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

This course imparts knowledge on all basic research experimental techniques in Zoology. The researchers can gain knowledge on theoretical and experimental aspects of research methodology. Researchers also develop in-depth knowledge in their specialized topics.

- **Application level (K3)**

Each and every research findings are product oriented and applicable based on the research topic. Clinical and diagnostic laboratories can be established by every individual on completion of this course. Research entrepreneurs on sericulture, apiculture and aquaculture industries are developed.

- **Analytical level (K4)**

This course will develop an analyzing capacity of each and every problem. Problem analyzing is one of the major objectives of this course. In general, students can analyze each and every aspects of pathophysiology and biochemical reaction in animals including human being.

- **Evaluation capability level (K5)**

This course will develop ability to evaluate toxicity, environmental conditions, animal metabolism, and human pathological conditions.

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

This course will lead to synthesis of novel products related to all biological aspects based on the specificity of the selected subject. For example, productization and patenting of pesticides, drugs, biocomposites, etc are possible in this course. Development of novel varieties using genetic engineering is also possible on completion of this course.

4. **Vision**

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

5. **Programme Objectives and Outcomes**

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

Programme Educational Objectives

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

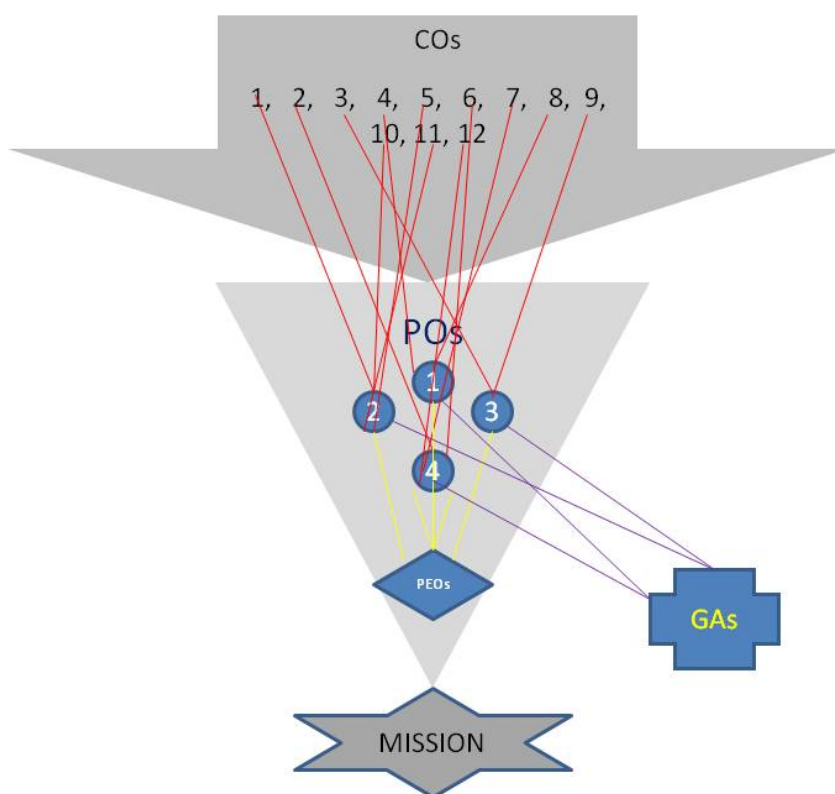
Programme Specific Objectives

- To train researchers on handling all basic and modern instruments required for basic and advanced research in Zoology.
- To input knowledge on finding out a problem, working out with the problem and finally come out with a solution that benefit the human population.

- To motivate our stake holders to adopt fundamental mathematical tools (statistics) and physical Principles (physics, chemistry) to the analysis of relevant biological situations.
- To train each and every researcher on a specific topic of their own interest in the field of Zoology.

Outcome of the Programme

- M.Phil. Zoology program offered by Periyar University will benefit the research community by transforming their theoretical knowledge into practical for the welfare of the human being and his environment. This programme can bring a need based outcome that acts to the situation, such as development of products related to COVID-19. This programme will also develop best teachers, researchers and also entrepreneurs' in the field of Zoology.



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

6. Candidate's eligibility for admission

Candidates who have qualified for post graduate degree in Zoology / Animal Science/ Animal Biotechnology/Wild Life Biology/ integrated course in Biology/ Life Sciences/

Advanced Zoology of this University or any other University recognized by the Syndicate as equivalent thereto shall be eligible to register for the Degree of Master of Philosophy (M.Phil.) in the respective subject and undergo the prescribed course of study in an approved institution or department of this University. Candidates who have qualified for their postgraduate degree in Zoology and or after the respective postgraduate degree to become eligible to register for the Degree of Master of Philosophy (M.Phil) in Zoology and undergo the prescribed course of study in the University Department.

For the candidates, who seek admission into M.Phil Course shall have obtained a minimum of 55% marks in his/her Master's Degree. However, for the candidates belonging to SC/ST community and those who have qualified for the Master's degree before 01.01.1991 the minimum eligibility marks shall be 50% in their Master's Degree.

7. Duration of the programme.

The duration of the M.Phil Course shall be over a period of **One Year** from the commencement of the course in each academic year.

8. Course of Study

The course of study of the degree shall consist of (a) Part-I comprising three Theory papers according to the Syllabus prescribed by the board of studies. Of which the third paper should be the Elective paper(s). The Elective paper syllabus is related to the expertise of the concern faculty and (b) Part-II Dissertation and *viva voce*.

9. CBCS- Structure of the Programme

Course Scheme and Scheme of Examinations for M.Phil (Zoology) with effect from 2018-2019 onwards.

Subject Code	Title of the paper	Internal Marks/25	External Marks/75	Total Marks/100
SEMESTER - 1				
19MPZ01	Research Methodology	25	75	100
19MPZ02	Recent Trends in Zoology	25	75	100
19MPZE01	Animal Cell culture and Stem Cell Biology	25	75	100
19MPZE02	Pathophysiology	25	75	100
19MPZE03	Developmental Biology and Endocrinology	25	75	100
19MPZE04	Medical Microbiology	25	75	100
19MPZE05	Vermitechnology	25	75	100
19MPZE06	Environmental Toxicology	25	75	100
19MPZE07	Aquaculture and Fishery Biology	25	75	100
19MPZE08	Nanomedicine	25	75	100
19MPZE09	Behavioural Ecology	25	75	100
19MPZE10	Biodiversity and Conservation Biology	25	75	100
19MPZE11	Entomology	25	75	100
19MPZE12	Sericulture	25	75	100
SEMESTER - 2				

18MPZD01	Dissertation and <i>viva voce</i>	100	50+50 I + E	200
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Credits allotted to the theory papers and project.

Part – I	
Research Methodology	4 Credits
Recent Trends in Zoology	4 Credits
Elective Paper	4 Credits

Part – I	
Dissertation and viva-voce	24 Credits (Dissertation: 16 Credits and <i>viva-voce</i> : 8 Credits)

Viva-Voce will be conducted with the following members

H.O.D – Member of the Viva Examination

Guide – Chairman of the Viva Examination

External examiner from other University from the related area – Member of the Board of Valuation.

Double valuation procedure will be adopted for **Dissertation**, one by the respective guide and the other by the external examiner, preferably by the *viva-voce* examiner.

Scheme of Examinations:

Part-I Theory Examination: (Three Theory Papers)

The examination of theory papers and Dissertation shall be held at the end of the year as per the examination procedures with the concurrence of Head of the Department. The duration for each paper shall be 3 hours carrying a maximum of 100 marks for theory papers and 200 marks is allotted for Dissertation and *viva voce*.

The examiners will be appointed from the panel of four names of each papers submitted by the Departments concerned. If the awarded total mark varies more than 10% between the Internal and External examiners, the paper will be valued by a third examiner whose award of marks will be final.

Part-II-Dissertation and *viva voce*

The exact title of the Dissertation shall be intimated within one month after the completion of the Theory paper examination. Candidates shall submit the Dissertation to the University through the Supervisor and Head of the Department at the end of the academic year from the commencement of the course, which shall be valued by internal examiner (Supervisor) and one external examiner appointed by the University from a panel of four names sent by the supervisor through the Head of the Department.

The examiners who value the Dissertation shall report on the merit of candidates as “Highly Commended” (75% and above) or “Commended” (50% and above and below 75%) or “Not Commended” (below 50%).

If one examiner commends the Dissertation and the other examiner, does not commend, the Dissertation will be referred to a third examiner and the third valuation shall be final. Submission or resubmission of the Dissertation will be allowed twice a year.

Passing Minimum:

A candidate shall be declared to have passed part-I of the examination if he/she secured not less than 50% of the marks in each paper including paper-III for which examination is conducted internally.

A candidate shall be declared as pass in the Dissertation *viva voce* examination if his/her dissertation is at least commended.

All other candidates shall be declared to be failed in the examination.

Restriction in number of chances:

No candidate shall be permitted to reappear for the written examination in any paper on more than two occasions or to resubmit a Dissertation not more than two times. Candidates shall have to qualify for the degree passing all the written papers and dissertation within a period of three years from the date of commence of the course.

Conferment of Degree:

No candidate shall be eligible for conferment of the M.Phil. Degree in Zoology unless he/she is declared to be passed both in the Theory papers and Dissertation and *viva voce* of the examination as per the Regulations.

PART-TIME

Eligibility:

- Teacher / Researchers/ candidates working in the University/college/school/research organization recognized by the State/ Central Government sectors and that should be approved by the concern authority of this university.
- Teacher candidates working in the affiliated colleges and whose qualifications are approved by the University.
- Teacher candidates working in polytechnics approved by the Director of Technical Education or in Higher Secondary Schools and High Schools approved by the State Board or Central Board of Secondary Education or Educational Institutions of IAF (within Periyar University jurisdiction) who possess a Master’s Degree. For the Master’s Degree qualified prior to 01.01.1991, no minimum marks is prescribed; but on or after 01.01.1991, a minimum of 55% of the marks is prescribed, provided that

for the candidates belonging to SC/ST community a concession of 5% marks will be given in the minimum eligibility marks prescribed.

Duration:

The course of study shall extend over a period of two years from the commencement of the course. The examination for part-I shall be taken at the end of the first year and part-II Dissertation at the end of the second year.

Course of Study:

The Regulations governing the full-time M.Phil., course with regard to course of study, scheme of examination passing minimum, etc. and qualifications of guide conducting the M.Phil., course shall apply to part-time candidates also.

Restriction in number of chances:

No candidate shall be permitted to reappear for the written examination in any paper on more than two occasions or to resubmit a Dissertation more than twice. Candidates shall have to qualify for the degree passing all the written papers and dissertation within a period of four years from the date of commencement of the course.

Subject Code: 19MPZ01

PERIYAR UNIVERSITY, SALEM – 636 011
DEPARTMENT OF ZOOLOGY
M.Phil / Ph.D DEGREE COURSE WORK
(For those admitted in 2018-2019 and later)

SEMESTER – I

THEORY PAPER – I

RESEARCH METHODOLOGY

Contact hours per week: 05

Contact hours per semester: 75

4 CREDITS

Course Objectives:

To enable the students

- to strive their mind towards research.
- to make the students to understand the concept of advanced level instrumentations.
- to understand the significance of high end statistical tools to justify their research outcome.

Course Outcomes:

- Students receive pre-research training in zoological science.
- Learn the principle and applications of high end instrumentations.
- The excellence in statistical tool handling makes them to fit for world class research.

UNIT I: PREPARATION OF THESIS/ DISSERTATION: Basic concepts of research: Method of writing Dissertation: Preparation of Abstract, Collecting information for Introduction and definition of the research problems- Collection of data for Historical resume, Development and standardization of materials and methods with specific objectives of research problem, Interpretation of data and results. Method and strategy of discussing your results. Tactics of Summarize the results.

(15 hours)

Unit-II: RESEARCH IS A NEVER-ENDING PROCESS. Defining and formulation of research problem- literature collection using internet and journals- way of interpretation of references cited in the Thesis/ dissertation. Development of research proposal- Origin of proposal Construction of Research hypothesis- and their types: null and alternate hypothesis and testing of hypothesis- theory, principles, law and concepts. Data collection technique. Selection of problem- stages in execution of research; preparation of Manuscript for journals. **Ethics in Research-** writing papers and proposals -impact of plagiarism.

(15 hours)

UNIT III: DESCRIPTIVE STATISTICS: Collection of data, Variables and observations, empirical distribution, bar chart, stems and leaf, histogram. Mean, Median, Mode formula and applications; Dispersion: range, variance, standard variance, standard deviation, inter-quartile range; Shape: modality, skewness. Probability: probability distributions- Bernoulli, binomial, Poisson, normal. Hypothesis – Formulation – Testing of Hypothesis – Normal, Binomial Poisson, t-test, χ^2 and F distribution, Multiple Correlation- simple Linear regression, Linear additive model- Anova.

(15 hours)

UNIT IV: COMPARISON OF MEANS AND MULTIVARIATE ANALYSIS: Testing significance: confidence interval- sample mean. Use of statistical tables & levels of significance. ANOVA and MANOVA. Tukey's, Dunnett's, SNK. correlation and regression analysis; Chi-square test, students' t-test. Multivariate analysis: basic principles and application. Use of correlation and regression, regression and correlation coefficients. Multivariate Analysis: Basic principles and applications of Multiple regression analysis, Principal Component Analysis (PCA), Discriminant Function Analysis (DFA), Cluster Analysis.

(15 hours)

UNIT V: BIOINSTRUMENTATIONS: Principle, structural components of instrument, method and applications of pH meter, UV-Visible spectrophotometer, IR spectrophotometer, NMR and Types, X-ray diffraction, Mass Spectrophotometer, MALDI, SELDI and MS-MS, GC-MS, HPLC, GLC and Different types of Microscopes used in Biological Sciences. Institutional Animal Ethics and its significance as per CPCSEA Guidelines.

(15 hours)

Correlation of Programme objectives with course outcomes

COURSE OUTCOME	PO1	PO2	PO3	PO4	PO5
• Students receive pre-research training in zoological science.		✓		✓	✓
• Learn the principle and applications of high end instrumentations.	✓		✓		
• The excellence in statistical tool handling makes them to fit for world class research.	✓	✓	✓	✓	✓

Unit wise programme specific qualification attributes

Unit	Unit Title	Intended Learning Chapters	Hours of Instruction
RESEARCH METHODOLOGY			
I	PREPARATION OF THESIS/ DISSERTATION	K1, K2, K4, K5	15
II	RESEARCH IS A NEVER-ENDING PROCESS	K1, K4, K5	15
III	DESCRIPTIVE STATISTICS	K1, K2, K3, K4	15
IV	COMPARISON OF MEANS AND MULTIVARIATE ANALYSIS	K2, K3, K4, K5, K6	15
V	BIOINSTRUMENTATIONS	K3, K4, K5, K6	15

REFERENCE BOOKS:

1. Davis, GB and CA Parker. 1997. Writing the doctoral dissertation. Barrons Educational series, 2nd Edition.
2. Kannan, S. M. Krishnan, R.Thirumurugan and S.Achiraman. 2012. Methods in Molecular Biology – From Cell to Molecules. First Edition, UVN- Press. India
3. Duncary P. 2003. Authoring a Ph.D thesis: How to plan, draft, write and finish a doctoral dissertation. Palgrave Macmillan.
4. Snedecor GW and WG Cochran. 1978. Statistical methods. Oxford and IBH publishing Co Pvt. Ltd.
5. Daniel WW. 2006. Biostatistics: A Foundation for Analysis in the Health Sciences (7thedn). JohnWiley & Sons, New York.
6. Zar, Jerrold H. 2008. Biostatistical Analysis (3rdedn.). Pearson Education Inc., New Delhi.

Subject Code: 19MPZ02

PERIYAR UNIVERSITY, SALEM – 636 011
DEPARTMENT OF ZOOLOGY
M.Phil / Ph.D DEGREE COURSE WORK
(For those admitted in 2018-2019 and later)

SEMESTER – I

THEORY PAPER – II

RECENT TRENDS IN ZOOLOGY

Contact hours per week: 05

Contact hours per semester: 75

4 CREDITS

Course Objectives:

- To gain theoretical knowledge, maintenance, and manipulation of animal cells *in vitro*.
- To understand the concept of biotechnology and its application to control insect pests.
- To understand the basics of gene cloning and vectors for genetic engineering, gene transfer methods and transgenic animal technology.

Course Outcomes:

- After completion, the students will undertake research in advanced zoology.
- Students will emphasize an overview of biotechnological control measures for management of pest populations.
- Students will understand the basic steps of gene cloning and vectors responsible for gene manipulation, transformation and genetic engineering.

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, cell bank. Applications of cell line. Gene transfer into animal cells, expression of foreign genes in animal cell lines.

(15 hours)

UNIT II: VIRAL VECTORS: Biology, adenovirus, adeno associated virus, retroviral vectors, Herpes virus, vaccinia virus. Stem cells – Definition, functions and origin, types, stem cell therapy, stem cell culture and applications. Impact of Oncolytic viruses in Cancer Treatment. Human Genome Project and its perspectives. Ethical issues in Animal Biotechnology.

(15 hours)

UNIT III: MOLECULAR PEST MANAGEMENT: Pest management using juvenile hormone analogues. Pheromones in genetic manipulations – Biotechnology of silk worms. Baculo viruses in biocontrol and foreign gene expression – Biotechnology in aquaculture – transgenic fishes. Animal bioreactor and molecular farming. Selected traits and their breeding into livestock. Applications of molecular genetics in improvement of livestock. Influence of Vitellogenin and its receptor in insect pest management.

(15 hours)

UNIT IV: CLONING AND RECOMBINANT PRODUCTS: Cloned genes and production of recombinant proteins and vaccines. Insulin, somatotrophin, somatostatin, -endorphin,

Human interferons. Hepatitis B virus vaccine, vaccine for foot and mouth disease virus – DNA vaccine. Development of RNAi to target various diseases like diabetes and cancer.

(15 hours)

UNIT V: TRANSGENIC ANIMALS: Mice, cattle, Gene knockout mice. Use of nucleic acid probes and antibodies in clinical diagnosis. DNA fingerprinting. Current trends in Gene therapy. Ethical issues in Animal Biotechnology. Current scenario of Next generation Sequencing and its application in biology. Recent achievements in DNA/ Protein Microarray and Biochip technology.

(15 hours)

Correlation of Programme objectives with course outcomes

COURSE OUTCOME	PO1	PO2	PO3	PO4	PO5
• Students will undertake research in advanced zoology	✓	✓	✓	✓	
• Biotechnological control measures for management of pest populations	✓	✓	✓	✓	✓
• gene manipulation, transformation and genetic engineering	✓	✓	✓	✓	

Unit wise programme specific qualification attributes

Unit	Unit Title	Intended Learning Chapters	Hours of Instruction
RECENT TRENDS IN ZOOLOGY			
I	Animal Cell Culture	K1, K2, K3, K4	15
II	Viral Vectors	K1, K2, K3, K4, K5	15
III	Molecular Pest Management	K1, K2, K3, K4, K5, K6	15
IV	Cloning And Recombinant Products	K1, K2, K3, K4, K5, K6	15
V	Transgenic Animals	K1, K2, K3, K4, K5, K6	15

REFERENCE BOOKS:

1. S. Kannan, M. Krishnan, R. Thirumurugan and S. Achiraman. 2012. Methods in Molecular Biology – From Cell to Molecules. First Edition, UVN- Press. India.
2. Butler, M., 2003. Animal Cell Technology: Principles and Products, Open University Press, New York.
3. Winnacker, E.L., 2005. From Genes to Clones: Introduction to Gene Technology, VCH Publications, Germany.
4. Epplen, J.T., and Lubjuhn, T., 2004. DNA Profiling and DNA Fingerprinting, Birkhauser Verlag, Basel.

5. Gupta, P.K, 2012, Biotechnology and Genomics, Rastogi Publications, Meerut, India.
6. Marx, J.L., 2007. A Revolution in Biotechnology, Cambridge University Press, Cambridge.
7. Mather, J.P. and Barnes, D., 2008., Methods in Cell Biology, Vol 57 Animal Cell Culture Methods, Academic Press, New York.
8. Potten, C.S, 2006. Stem Cells, Academic Press, London.
9. Flickinger, M.C. and Drew, S.W., 2003. Encyclopedia of Bioprocess Technology: Fermentation, Biocatalysis and Bioseparation, Vol. I to V, John Wiley and Sons Publications, New york..
10. Strachan, T. and Read, A.P., 2006. Human Molecular Genetics, John Wiley & Sons, Pvt., Ltd., Singapore.

Subject Code: 19MPZE01

PERIYAR UNIVERSITY, SALEM – 636 011
DEPARTMENT OF ZOOLOGY
M.Phil / Ph.D DEGREE COURSE WORK
(For those admitted in 2018-2019 and later)

SEMESTER - I

ELECTIVE PAPER 1

ANIMAL CELL CULTURE AND STEM CELL BIOLOGY

Contact hours per week: 05

Contact hours per semester: 75

4 CREDITS

Course 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.

Course Outcome:

- ❖ Students will be 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.
- ❖ Students will have basic and novel ideas for future research.

UNIT - I

ANIMAL CELL CULTURE: Historical Background , Importance and progress in Animal Cell Culture Technology, Biology of Animal Cell; Cellular Interactions, Cell Line Preservation, Cell Line Characterization.

(15 hours)

UNIT – II

MEDIA PREPARATION: Importance of Serum and Serum Free Media. Need of Antibiotics for animal cell culture. Culturing and Sub-Culturing of Animal Cells. In Vitro Transformation of Animal Cells and Cloning of Animal Cells. Animal Cell as Bioreactor to produce therapeutic agents. Applications of animal cells in tissue engineering and treatment of non-communicable diseases like cancer, diabetes and obesity.

(15 hours)

UNIT III

PRINCIPLE AND APPLICATIONS: Chromosome Spreading and Karyotype Analysis, Micro-dissection of Chromosomes, MTT Assay, XTT Assay, TUNEL Assay. Staining Techniques – Acridine orange, Ethidium bromide, Hoechst, DAPI and Immunohistochemistry. Mycoplasma: Detection and Control. Applications of Monoclonal Antibody and its Production strategy. Insect Cell Culture: An Overview.

(15 hours)

UNIT IV

STEM CELL TECHNOLOGY: Historical background of Stem cell Technology. Stem Cell culture and steps involved in cultivation of stem cells. How Stem Cell Works in understanding diseases and disease treatment. Types of Stem Cells: embryonic, pluripotent, multipotent, mesenchymal, cancer and adult stem cells and their applications.

(15 hours)

UNIT V

TISSUE ENGINEERING WITH BIOPOLYMERS: Structure and functions of Gelatin, Collagen, Chitosan, Fibroin, Sericin, Cellulose, and Elastin like peptide (ELP). Characterization of biomaterials- Physical, Chemical: Principles and applications of UV-Vis Spectrophotometer, Nano-drop, IR, GC-MS, Electron Microscopy – SEM, TEM, STEM, and biological methods: Cell viability test, Culture of Neurons, Significance of Neuronal Stem Cells. Delivery of stem cell for treatment. Principles and applications of Cell Therapy. Scope and applications of Tissue engineering.

(15 hours)

Correlation of Programme objectives with course outcomes

COURSE OUTCOME	PO1	PO2	PO3	PO4	PO5
❖ Students will expertise in cell culture theory and practices.	✓	✓		✓	✓
❖ On completion of the course students can fit themselves in the international nanotechnology laboratories reproducing your experience the study period.	✓		✓	✓	✓
❖ students will have basic and novel ideas for future research on monotherapy for various diseases	✓	✓	✓	✓	✓

Unit wise programme specific qualification attributes

Unit	Unit Title	Intended Learning Chapters	Hours of Instruction
ANIMAL CELL CULTURE AND STEM CELL BIOLOGY			
I	Animal Cell Culture	K1, K2, K3, K4	15
II	Media Preparation	K1, K2, K3	15
III	Principle and Applications	K1, K2, , K4, K6	15
IV	Stem cell Technology	K3, K4, K5, K6	15
V	Tissue Engineering- biopolymers	K4, K5, K6	15

REFERENCES BOOKS

- 1 Al-Rubeai M (2017) Animal Cell Culture, Springer.
- 2 Davis JM (2019) Animal Cell Culture: Essential Methods, Wiley-Blackwell, USA.
- 3 Dubey RC (2018) A Text Book of Biotechnology, S. Chand Co., New Delhi.
- 4 Gupta PK (2017) Biotechnology and Genomics, Rastogi Publications, Meerut, India.
- 5 Mather JP and Barnes D (2018) Methods in Cell Biology, Vol 57 Animal Cell Culture Methods, Academic Press, New York.
- 6 Potten CS (2018) Stem Cells, Academic Press, London.
- 7 David J Lockwood (2012) FRSC: Introduction to Nanoscale Science and Technology, National Research Council of Canada Ottawa, Ontario, Canada.
- 8 Kirkland AI and Hutchison JL (2012) Nanocharacterisation, Department of Materials, Oxford University, Oxford, UK.
- 9 Yury Gogotsi (2017) Nanomaterials Handbook, Taylor and Francis Group, Boca Raton London, New York.

Subject Code: 19MPZE02

PERIYAR UNIVERSITY, SALEM – 636 011
DEPARTMENT OF ZOOLOGY
M.Phil / Ph.D DEGREE COURSE WORK
(For those admitted in 2018-2019 and later)

SEMESTER – I

ELECTIVE PAPER - 2

PATHOPHYSIOLOGY

Contact hours per week: 05

Contact hours per semester: 75

4 CREDITS

Course Objectives:

- ❖ Students are motivated to impart knowledge and practical skills on pathophysiology
- ❖ It is also to provide a basic and advanced understanding of functions of organs.
- ❖ This subject also aims to provide knowledge practical skills on Physiological Processes.

Course Outcome:

- ❖ Students gain experience in Diagnosis of Human Diseases.
- ❖ On completion of the course students can lead a Diagnostic laboratories
- ❖ Students will be benefitted and propose novel ideas for future research on human physiology.

Unit-I: HUMAN ANATOMY : Basic structure and functions of various components of Human systems:- Circulatory, Digestive, Excretive, Endocrine, Immune, Nervous, Reparative and Reproductive Systems and their associated disorders.

(15 hours)

Unit – II : FOOD POISONING – types, causative factors, symptoms, diagnosis and treatment. Common Blood Disorders: Etiology, Epidemiology, Diagnosis and treatment anemia, bleeding disorders : hemophilia, blood clots, and blood cancers : leukemia, lymphoma, and myeloma. Life Style Diseases : Diabetes- types and treatment strategies. Impact of Obesity research and its current scenario.

(15 hours)

Unit-III: NEURODEGENERATIVE DISEASES : Etiology and epidemiology of Parkinson's disease, fronto-temporal dementia, Huntington's disease, amyotrophic lateral sclerosis (Lou Gehrig's disease), progressive supra-nuclear palsy, spino-cerebellar ataxia, Pick's disease and, prion disease. Landmarks in Alzheimer disease research- Molecular biology of Amyloid beta peptide. Introduction to Cognitive Science- Learning, Memory, Mechanism of hearing and Speech, Cognitive behavioural genetics- sensation and perception. Significance of AD Biomarkers.

(15 hours)

Unit-IV: REPRODUCTIVE PHYSIOLOGY:, Physiology of oestrus, menstrual cycle and Ovulation, mechanism of oogenesis. Andrology: Spermatogenesis, Components, Seminogram / Sperm function tests. Board outlines of causes of male and female infertility. Significance of Assisted reproductive technology. Embryology laboratory: Culture media, Egg identification, Insemination, Fertilization and cleavage check. Embryo transfer technique: Blastocyst culture, Embryo hatching. Techniques of intracytoplasmic sperm injection. Cryopreservation Principles of cryopreservation, Semen freezing / Embryo freezing, Slow freeze techniques / Nitrication of germ cells.

(15 hours)

Unit-V: IMMUNO-BIOLOGY: Physiology of Immune organs and immune cells and their functions. Types of immunity and their involvement in defence mechanism. Principle and applications of Immuno electrophoresis, ELISA and RIA. Anatomy and Patho-physiology of Excretory organs: Skin, lungs, liver and Kidney. Types of excretory wastes and mechanism of nitrogenous waste removal. Diagnosis and treatment : Kidney failure, Kidney stones, urinary tract infection, Uremia, Renal cell carcinoma, Bright Disease, Diabetic nephropathy and Nephrotic syndrome.

(15 hours)

Correlation of Programme objectives with course outcomes

COURSE OUTCOME	PO1	PO2	PO3	PO4	PO5
• Students gain experience in Diagnosis of Human Diseases.	✓	✓	✓	✓	
• On completion of the course students can lead a Diagnostic laboratories	✓	✓		✓	✓
• Students will be benefitted and propose novel ideas for future research on human physiology.	✓		✓	✓	✓

Unit wise programme specific qualification attributes

Unit	Unit Title	Intended Learning Chapters	Hours of Instruction
PATHOPHYSIOLOGY			
I	HUMAN ANATOMY	K1, K2, K3, K4	15
II	FOOD POISONING	K1, K3, K4, K6	15
III	NEURODEGENERATIVE DISEASES	K1, K2, K3, K4,	15
IV	REPRODUCTIVE PHYSIOLOGY	K1, K4, K5, K6	15
V	IMMUNO-BIOLOGY	K1, K4, K5,	15

Reference Books

1. S. Grossman and C.M. Porth, 2018. Essential of Pathophysiology: Concepts of Altered Health states. 9th Edition, Wolters Kluwer Publications. Germany.
2. Kathryn L. McCance and Sue E. Huether 2014. Study Guide : Understanding Pathophysiology. Elsevier Publication. USA.
3. Arthur C. Guyton and John E. Hall, 2012. Textbook of Medical Physiology, 12th Edition, Saunders Publication, NY.
4. K. Sembulingam and S. Prema, 2018. Essentials of Medical Physiology, 7th Edition. Jaypee Medical Publications. India

Subject Code: 19MPZE03

PERIYAR UNIVERSITY, SALEM – 636 011

DEPARTMENT OF ZOOLOGY

M.Phil / Ph.D DEGREE COURSE WORK

(For those admitted in 2018-2019 and later)

SEMESTER - I

ELECTIVE PAPER 3

DEVELOPMENTAL BIOLOGY AND ENDOCRINOLOGY

Contact hours per week: 05

Contact hours per semester: 75

4 CREDITS

Course Objectives

- To gain indepth knowledge about embryology and endocrinology
- To understand the pathways of hormone synthesis and mode of action
- To know about the embryonic and organogenesis associated techniques

Course Outcome

- Students get a chance to work as technician in the Clinical Laboratory
- May enter into higher education for research
- Can start-up Reproductive Clinical Laboratories as entrepreneur

UNIT - I

CONCEPT OF EMBRYOLOGY: Gametes – Types of sperm and eggs. Fertilization – Biochemistry of fertilization. Early development – Cleavage – Patterns of cleavage, Chemical changes during cleavage, formation of blastula, types of blastula. Gastrulation – Fate map, Morphogenetic movements – Epiboly- Emboly – types of embolic movements. Neurulation – mechanism of neural tube formation.

(15 hours)

UNIT - II

ORGANOGENESIS : Derivatives of ectoderm, mesoderm and endoderm. Development of Brain, Eye, Heart, Reproductive system, Regeneration – Regenerative ability in animals – Types – Autotomy, reparative and physiological regeneration – Mechanism of regeneration in Salamander limb, factors affecting regeneration. Metamorphosis in amphibians, Insects, Hormonal regulation of metamorphosis.

(15 hours)

UNIT - III

MAMMALIAN ENDOCRINE SYSTEM: Pituitary gland- hormones of the pituitary gland - Chemistry & biochemical functions - neurovascular hypothesis; pineal gland- hormones of the pineal gland- Chemistry& biochemical functions.

(15 hours)

UNIT - IV

ENDOCRINE CONTROL SYSTEM: Pineal organ - Structure and functions. The gonads: Structure of testis and ovary – Steroid hormones and their functions - Endocrine control of osmoregulation in fish. Chemical nature of hormones: Hormone Delivery - Hormonal feedback in homeostasis. Thyroid Gland - Biosynthesis of thyroid hormones, Control of secretion and Physiological roles. Parathyroid Gland.

(15 hours)

UNIT - V

BIOSYNTHESIS AND PATHWAYS- Testis: Organization, Physiological roles of androgens and Inhibin. Ovary: Organization, Physiological roles of Estrogen, Progesterone and Relaxin and Inhibin. Adrenal gland: Structure and functions. Pancreas: Biosynthesis and

physiological actions of Insulin and Glucagon. Role of parathormone: Calcitonin and vitamin D in calcium homeostasis. Current scenario of endocrine disorders and human health. Clinical evaluation of endocrine functions-over view.

(15 hours)

Correlation of Programme objectives with course outcomes

COURSE OUTCOME	PO1	PO2	PO3	PO4	PO5
• Students get a chance to work as technician in the Clinical Laboratory		✓	✓	✓	
• May enter into higher education for research	✓			✓	✓
• Can start-up Reproductive Clinical Laboratories as entrepreneur	✓		✓	✓	✓

Unit wise programme specific qualification attributes

Unit	Unit Title	Intended Learning Chapters	Hours of Instruction
DEVELOPMENTAL BIOLOGY AND ENDOCRINOLOGY			
I	CONCEPT OF EMBRYOLOGY	K1, K2, K3, K4	15
II	ORGANOGENESIS	K1, K3, K4	15
III	MAMMALIAN ENDOCRINE SYSTEM	K1, K2, K3, K4,	15
IV	ENDOCRINE CONTROL SYSTEM	K1, K2, K5, K6	15
V	BIOSYNTHESIS AND PATHWAYS	K1, K4, K5, K6	15

REFERENCE BOOKS:

- Pedro J. Chedrese (2009) Reproductive Endocrinology (A Molecular Approach), Springer publications
- Peter C. K. Leung, Aaron J. W. Hsueh, Henry G. Friesen (1999.) Molecular Basis of Reproductive Endocrinology, Springer publications
- Stanley R. Glasser, Joy Mulholland Alexandre Psychoyos (1994) Endocrinology of Embryo-Endometrium Interactions, Plenum Press, New York
- Arthur C. Guyton, John E. Hall, (2015)Text book medical physiology, 13th edition, Saunders Publications
- Hadley (2009) Endocrinology, 6th edition, Pearson Publications
- Gilbert, S.F. (2009). Developmental Biology, Sinauer Associates, Inc. Publishers, Sunderland, Massachusetts.
- Balinsky, B.I. (2012). Introduction to Embryology, Holt Saunders International, 5th Edition, Philadelphia.
- Wolpert, L. (2007). Principles of Development, Oxford Publication.
- Kalthoff, K. (1996). Analysis of Biological Development, McGraw-Hill Publishers, New York.
- Berril, N.J. (1986). Developmental Biology, Tata McGraw-Hill Publication Co. Ltd., New Delhi.
- Nussey SS and Whitehead SA (2013) Endocrinology: an integrated approach, CRC Press.

Subject Code: 19MPZE04

PERIYAR UNIVERSITY, SALEM – 636 011

DEPARTMENT OF ZOOLOGY

M.Phil / Ph.D DEGREE COURSE WORK

(For those admitted in 2018-2019 and later)

SEMESTER – I

ELECTIVE PAPER - 4

MEDICAL MICROBIOLOGY

Contact hours per week: 05

Contact hours per semester: 75

4 CREDITS

Course Objectives:

- To provide a general understanding of bacteriology and microbial diseases
- To describe the attributes and characteristics of harmful microbial pathogens
- To understand the Diagnosis and treatment of Microbial pathogens.

Course Outcomes:

- Students will understand the fundamental concepts of Medical Microbiology
- Students will be able to demonstrate host – pathogens interaction
- Students will be able to evaluate the environmental quality, public health, and sustainability with reference to microbiomes.

Unit-I

BACTERIOLOGY: Morphology of bacteria, Bacterial taxonomy and classification. Growth and nutrition of bacteria and method of cultivation. Isolation and identification of bacteria, Bacterial genetics and variation.

(15 hours)

Unit-II

MICROBIAL PATHOGENESIS: zoonoses, epidemiology and transmission. Medically important microbes. Microbial diseases - sources, route of transmission. Pathogenesis - adhesion, invasion, host cell damage, release of pathogens. Microbial virulent factors - Signs and symptoms of microbial diseases. Treatment, Prevention and control of Bacterial and viral infections.

(15 hours)

Unit-III

DEFENCE SYSTEM: Immunity to different organisms, pathogen defense strategies, avoidance of recognition, inactivation of host-immune effectors mechanisms. Anatomy, development and functions of immune system, Host and parasite relationship, Biology of immune response, Microbial pathogenicity and host immune response, Infection and immunity

(15 hours)

Unit-IV

DIAGNOSIS: Microbial diseases - Collection, transport and preliminary processing of clinical pathogens. Clinical, microbiological, immunological and molecular diagnosis of microbial diseases. Modern methods of microbial diagnosis.

(15 hours)

Unit-V

THERAPEUTICS: Classification of antibiotics on the basis of structure and mode of action. Assay of antibiotics, antibiotic spectrum Naturally produced drugs. Antibiotics produced by bacteria, actinomycetes and fungi used in chemotherapy.

(15 hours)

Correlation of Programme objectives with course outcomes

COURSE OUTCOME	PO1	PO2	PO3	PO4	PO5
• Students will understand the fundamental concepts of Medical Microbiology	✓	✓	✓		
• Students will be able to demonstrate host – pathogens interaction	✓		✓	✓	✓
• Students will be able to evaluate the environmental quality, public health, and sustainability with reference to microbiomes.	✓	✓		✓	

Unit wise programme specific qualification attributes

Unit	Unit Title	Intended Learning Chapters	Hours of Instruction
MEDICAL MICROBIOLOGY			
I	BACTERIOLOGY	K1, K2	15
II	MICROBIAL PATHOGENESIS	K1, K4, K5	15
III	DEFENCE SYSTEM	K1, K3, K4, K5,	15
IV	DIAGNOSIS	K1, K4, K5, K6	15
V	THERAPEUTICS	K3, K4, K5, K6	15

Reference books

- Gerard J. Tortora , Berdell R. Funke Christine L. Case Microbiology: An Introduction 13th Edition. Pearson publisher (2018)
- Topley & Wilson's Microbiology and Microbial infections. 10th edition. Volumes 1-6: 2008 Arnold, London
- Pedro Escoll Bacterial Evasion of the Host Immune System 2017 Caister academic Press
- Bailey and Scott's Diagnostic Microbiology 9th Ed. C V Mosby, St. Louis, 2003. Brooks, Geo F Jawetz Medical Microbiology 22nd Ed. Mc Graw Hill 2001
- Subash Chandra Parija. Textbook of Microbiology & Immunology 3rd Edition Elsevier 2016
- Lansing M. Prescott, John P Harley, Donald A. Klein; Microbiology, McGraw Hill. Ed. 6; 2005.
- Michael T. Madigan, John M Martinko, Brock's Biology of Microorganisms, Pearson-Prentice Hall. Ed. 11; 2006
- David Greenwood, Richard B. Slack John F. Peutherer Medical Microbiology, Churchill Livingstone, London. 18th Edn., 2012.
- Pelczar Jr MJ, Chan ECS and Kreig NR. Microbiology, 5th edition. Mc. Graw Hill. Inc, New York. 2013

Subject Code: 19MPZE05

PERIYAR UNIVERSITY, SALEM – 636 011

DEPARTMENT OF ZOOLOGY

M.Phil / Ph.D DEGREE COURSE WORK

(For those admitted in 2018-2019 and later)

SEMESTER – I

ELECTIVE PAPER - 5

VERMITECHNOLOGY

Contact hours per week: 05

Contact hours per semester: 75

4 CREDITS

Course Objectives:

- To impart knowledge on earthworm culture technology.
- 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
- On successful completion, students can apply vermitechology in organic waste management, soil fertility, and bioremediation process.
- Students can become an entrepreneur by selling earthworms and vermicompost on completion of this course.

Unit-I: EARTHWORMS – Taxonomic position and diversity. Types – morphological and anatomical characteristics. Biology of *Lampito mauritii*. Ecological grouping – Epigeic, Anecic, and Endogeic species. Ecological role and economic importance of earthworms – Need for earthworm culture.

(15 hours)

Unit-II: VERMICULTURE – Scope and application. Common species for culture – Environmental requirements. Culture methods – Wormery – Breeding techniques. Indoor and outdoor cultures – Monoculture and Polyculture – Relative merits and demerits.

(15 hours)

Unit-III: VERMICOMPOSTING & APPLICATIONS – Small scale and Large scale Vermicomposting Methods – Factors affecting vermicomposting- pH, Moisture, Temperature, etc., Use of Vermicastings in Organic farming/Plantation/Agricultural Crops & Horticulture, Earthworms for management of municipal organic solid wastes – as feed/bait for capture/culture fisheries. Nutrient value of worm cast/vermicompost, Quality Control – Effect of vermicompost on plants.

(15 hours)

Unit-IV: VERMICULTURE PRODUCTS & FUTURE PERSPECTIVES: Marketing the products of vermiculture – Socio-Economic value of Vermiculture – Creating the demand by awareness and demonstration, advertisements, packaging and transport, direct marketing. Predator, Parasite, and pathogen control in Wormeries. Role of Farmers/NGO's in promoting Vermiculture/Vermicompost in India.

Unit-V: TECHNIQUES IN VERMITECHNOLOGY: Earthworm collection Techniques – Assessment of nutrient content of Vermicompost – Estimation of Nitrogen, Phosphorus, and Potassium and micronutrient content – Enzymatic activity – pH and Electrical Conductivity.
(15 hours)

Correlation of Programme objectives with course outcomes

COURSE OUTCOME	PO1	PO2	PO3	PO4	PO5
• Understand Concepts of Vermiculture & Vermicomposting	✓	✓	✓	✓	
• Applications of Vermitechnology	✓	✓	✓	✓	✓
• Development of Entrepreneurship Skills	✓	✓	✓	✓	

Unit wise programme specific qualification attributes

Unit	Unit Title	Intended Learning Chapters	Hours of Instruction
VERMITECHNOLOGY			
I	Earthworms	K1, K2, K3	15
II	Vermiculture	K1, K2, K3, K4	15
III	Vermicomposting & Applications	K1, K2, K3, K4, K6	15
IV	Vermiculture Products & Future Perspectives	K1, K2, K3, K4, K5, K6	15
V	Techniques in Vermitechnology	K1, K2, K3, K4, K5, K6	15

REFERENCE BOOKS:

1. Edwards, C.A. and Bohlen, P.J. 1996. Biology and Ecology of Earthworms, 3rd Edition, Chapman & Hall, London.
2. Ismail, S.A. 1997. Vermicology: The Biology of Earthworms, 1st Edition, Orient Longman, India.
3. Ismail, S.A. 2005. The Earthworm Book, 2nd Edition, Other India Press, Apusa, Goa, India.
4. Ranganathan, L.S. 2006. Vermibiotechnology – From Soil Health to Human Health, Agrobios, India.
5. Edwards, C.A. Arancon, N.Q. and Sherman, R. 2011. Vermiculture Technology: Earthworms, Organic Wastes, and Environmental Management, CRC Press, Boca Raton, FL.
6. Edwards, C.A. Hendrix, P and Arancon N. 2014. Biology and Ecology of Earthworms, Springer Publications.

Subject Code: 19MPZE06

PERIYAR UNIVERSITY, SALEM – 636 011

DEPARTMENT OF ZOOLOGY

M.Phil / Ph.D DEGREE COURSE WORK

(For those admitted in 2018-2019 and later)

SEMESTER – I

ELECTIVE PAPER - 6

ENVIRONMENTAL TOXICOLOGY

Contact hours per week: 05

Contact hours per semester: 75

4 CREDITS

Course Objectives:

- To provide a general understanding of toxicology related to the environment.
- To describe the attributes and characteristics of harmful chemicals.
- To understand the toxicity of pollutants in biological and environmental systems.

Course Outcomes:

- On successful completion of this course, the student will understand the fundamental concepts, methods, and approaches of environmental toxicology
- Students will be able to demonstrate toxicological effects in the living organisms associated with exposure to toxic agents.
- Students will be able to evaluate the occurrence of major environmental toxicants and apply them in the context of the environmental quality, public health, and sustainability.

Unit I: Introduction to Toxicology: Scope and types – Classification of toxic agents, toxicity, hazard, risk, Routes of exposure, duration and frequency of exposure – Drug toxicity, biochemical basis of toxicity and mechanisms of toxicity, receptor-mediated events – Acute and chronic toxicity, LC₅₀ and LD₅₀.

(15 hours)

Unit II: Environmental Toxicology and Risk Assessment: Biomonitoring of environmental contaminants – Bioindicators of environmental pollutants – Aquatic Toxicology – Pesticides, heavy metals, hydrocarbons, and volatile organic compounds – Bioaccumulation and biomagnification of toxic materials in food chain. Xenobiotics – Risk Assessment Procedures.

(15 hours)

Unit III: Environmental Contaminants and Remediation Technologies: Organic and inorganic environmental pollutants – Soil and water quality parameters – Physical, chemical and biological remediation technologies – Bioremediation – Technologies used for remediation of contaminated terrestrial and aquatic environments – Advantages and Limitations of remediation technologies.

(15 hours)

Unit IV: Natural Resources and Management: Status and exploitation of water, land, forest, mineral, energy and wild life resources – Sustainable use of resources – Carbon sequestration – Renewable and non-renewable energy resources – Energy recovery from wastes, Energy conservation policies – Energy balance and energy audit – Principles of remote sensing, GIS and its environmental applications.

Unit-V: Environmental Ethics and Intellectual Property Rights: Composition of Institutional evaluation Ethical Committee (IEC) – GM crops/GM organisms and their environmental issues - Intellectual Property Right (IPR): Definition – Types of Intellectual Property Right (IPR): Patents, Copyrights, Industrial Design Rights, and Trademarks – Case studies of patents with reference to Turmeric and Neem – Patent procedure in India.

(15 hours)

Correlation of Programme objectives with course outcomes

COURSE OUTCOME	PO1	PO2	PO3	PO4	PO5
• Fundamental concepts, methods, and approaches of environmental toxicology	✓	✓	✓	✓	
• Toxicological effects in the living organisms associated with exposure to toxic agents	✓	✓	✓	✓	✓
• Environmental quality, public health, and sustainability	✓	✓	✓	✓	

Unit wise programme specific qualification attributes

Unit	Unit Title	Intended Learning Chapters	Hours of Instruction
ENVIRONMENTAL TOXICOLOGY			
I	Introduction to Toxicology	K1, K2, K3, K4	15
II	Environmental Toxicology and Risk Assessment	K1, K2, K3, K4, K5	15
III	Environmental Contaminants and Remediation Technologies	K1, K2, K3, K4, K5, K6	15
IV	Natural Resources and Management	K1, K2, K3, K4, K5, K6	15
V	Environmental Ethics and Intellectual Property Rights	K1, K2, K3, K4, K5, K6	15

REFERENCE BOOKS

1. Botkin, D.B. and Keller, E.A. 2012. Environmental Science, 8th edition, Wiley India Pvt. Ltd., New Delhi.
2. Walker, C.H., Sibly, R.M., Hopkin, S.P. and Peakall, D.B. 2012. Principles of Ecotoxicology, CRC Press, Boca Raton, FL, USA.
3. Manahan, S.E. 2013. Fundamentals of Environmental Toxicology and Toxicological Chemistry – Sustainable Science, 4th Edition, CRC Press, Boca Raton, FL, USA.
4. Amiard-Triquet, C. Amiard, J.C. and Rainbow, P.S. 2013. Ecological Biomarkers – Indicators of Ecotoxicological Effects, CRC Press, Boca Raton, FL, USA.
5. Aswathanarayana, U. 2012. Natural Resources: Technology, Economics and Policy, Taylor and Francis, UK.
6. Canter, L.W. 1996. Environmental Impact Assessment, McGraw Hill, New York.

7. Grebner, D.L., Bettinger, P. and Siry, A. 2013. Introduction to Forestry and Natural Resources, Academic Press, UK.
8. Ostrom L.T. and Wilhelmsen C.A. 2012. Risk Assessment – Tools, Techniques and their Applications, John Wiley & Sons Inc., NJ, USA.
9. Venkateswar Rao, G. 2012. Intellectual Property Rights: Patent Laws in India, SSDN Publishers & Distributors, New Delhi.
10. Wu, Y., Carroll J.J. and Du, Z. 2011. Carbon Dioxide Sequestration and Related Technologies, John Wiley & Sons Inc., USA.
11. Singh, D.K. 2012. Pesticide Chemistry and Toxicology, Bentham Books, USA.

Subject Code: 19MPZE07

PERIYAR UNIVERSITY, SALEM – 636 011

DEPARTMENT OF ZOOLOGY

M.Phil / Ph.D DEGREE COURSE WORK

(For those admitted in 2018-2019 and later)

SEMESTER - I

ELECTIVE PAPER - 7

AQUACULTURE AND FISHERY BIOLOGY

Contact hours per week: 05

Contact hours per semester: 75

4 CREDITS

Objectives:

- ❖ Students are motivated to understand the principles and application of aquaculture
- ❖ It is also provide a basic knowledge and advanced techniques in fishery biology

Outcome:

- ❖ Students are expertise in aquaculture culture techniques
- ❖ Students will have basic and advanced knowledge for future research on fishes and other aquatic animals.
- ❖ Acquiring knowledge for marketing the aquaculture products.

UNIT - I

HISTORICAL STATUS OF AQUACULTURE: purpose and importance of aquaculture. Traditional, extensive, semi-intensive, intensive, super-intensive culture systems. Characteristic features of cultivable species (Indian major carps, murrels, catfish and tilapia). Selection criteria of cultivable species. Cryopreservation of gametes and embryos.

(15 hours)

UNIT - II

TYPES OF CULTURE SYSTEM: Freshwater, brackishwater and marine water culture, merits and demerits, Design, construction and management of ponds, types of ponds. Control of aquatic weeds and predators. Composite fish culture: Mono sex culture, culture of air-breathing fishes, sewage fed fish culture, Fish-cum duck culture.

(15 hours)

UNIT - III

ADVANCE CARE SYSTEMS OF AQUACULTURE: Induced breeding of carps, Broodstock management. Vaccines and therapeutics for broodstock management. Cryopreservation of fish and shellfish gametes; Methods to identify quality seeds - stress test, microscopic examination. Artificial insemination. Advances in seed production of commercially important finfishes and shellfishes. Effluent treatment in Hatcheries. Seed transportation methods.

(15 hours)

UNIT - IV

DISEASE AND CONTROL MEASURES : Identification of Fish diseases: Parasitic, protozoan, bacterial, fungal and viral diseases and their control measures. Protocol for Fish processing and preservation, fishery by-products.

(15 hours)

UNIT - V

AQUATIC TOXICOLOGY : Genotoxicology, Reproductive toxicology, Immunotoxicology, Respiratory toxicology, Nephrotoxicity, Neurotoxicity, Pharmaceutical toxicology.

(15 hours)

Correlation of Programme objectives with course outcomes

COURSE OUTCOME	PO1	PO2	PO3	PO4	PO5
❖ Students are expertise in aquaculture culture techniques	✓		✓	✓	
❖ Students will have basic and advanced knowledge for future research on fishes and other aquatic animals.	✓	✓	✓		
❖ Acquiring knowledge for marketing the aquaculture products.			✓	✓	✓

Unit wise programme specific qualification attributes

Unit	Unit Title	Intended Learning Chapters	Hours of Instruction
AQUACULTURE AND FISHERY BIOLOGY			
I	HISTORICAL STATUS OF AQUACULTURE	K1, K2, K3	15
II	TYPES OF CULTURE SYSTEM	K1, K2, K5	15
III	ADVANCE CARE SYSTEMS OF AQUACULTURE	K3, K5, K6	15
IV	DISEASE AND CONTROL MEASURES	K1, K2, K3,	15
V	AQUATIC TOXICOLOGY	K2, K4, K5, K6	15

REFERENCE BOOKS:

1. P. Santhanam, A.R. Thirunavukkarasu, P. Perumal (2015) Advances in Marine and Brackishwater Aquaculture, Springer publications.
2. B. B. Jana, R. N. Mandal, P. Jayasankar (2018) Wastewater Management Through Aquaculture. Springer publications.
3. Marianne Holmer, Kenny Black, Carlos M. Duarte, Nuria Marbà, Ioannis Karakassis (2008) Aquaculture in the Ecosystem. Springer publications.
4. Alexandra Adams (2016) Fish Vaccines. Springer publications.
5. Philip C. Burcham (2014). An Introduction to Toxicology, Springer publications.
6. Jason M. Hansen, Louise M. Winn (2019), Developmental Toxicology (Methods and Protocols), Springer publications.
7. Jhingran VG (1991) Fish and fisheries of India. Hindustan Publishing Corporation, New Delhi.
8. Pillai TVR (1993) Aquaculture Principles and Practices. Fishing News Agency, London.
9. Biswas SP (1993) Manual of Methods in Fish Biology, International Book Co., Absecon Highlands, New Jersey.
10. Bose AN, Yang CT and Misra A (1991) Coastal Aquaculture Engineering. Oxford and IBH Publishing Co., Pvt. Ltd., New Delhi.
11. MPEDA Hand book of Aquafarming (1992) Freshwater Fishes, Marine Products Export Development Agency, Kochi.

Subject Code: 19MPZE08

PERIYAR UNIVERSITY, SALEM – 636 011

DEPARTMENT OF ZOOLOGY

M.Phil / Ph.D DEGREE COURSE WORK

(For those admitted in 2018-2019 and later)

SEMESTER – I

ELECTIVE PAPER - 8

NANOMEDICINE

Contact hours per week: 05

Contact hours per semester: 75

4 CREDITS

COURSE OBJECTIVES

- To train the students to understand the need of nanotechnology for biologists
- To enable the students to understand the high throughput technology
- To equip our students to know the current applications of nanotechnology in medicine

COURSE OUTCOMES

- By studying this course students can develop up-to-date knowledge about nanomedicine
- Students can develop concept note for their future research
- Students can enter into the world class industries/ institutes of biomedical Sciences

UNIT-I Current Scenario of Nanomedicine: Nanoparticle as drug carriers- Nanoparticles as gene carrier- Nanoparticle as RNAi carriers. Development of nanomedicine to target cancer and Diabetes. Commercialized nanocarriers for cancer treatment. Impact of nano in cancer biology. Tumor immunology, immunodiagnosis and therapy with monoclonal antibodies.

(15 hours)

UNIT II Synthesis and characterization of Nanoparticles: Methods, types and use of chemical and biological- Fungi, Yeast, Bacteria and Actinomycetes for production of metallic and non-metallic nanoparticles. Collision/Coalescence mechanism of primary particle and aerogels. Use of nanoparticles as molecular imaging probes. Techniques used in Nanobiotechnology- Optical microscopy, Atomic force microscopy, optical microscopy and x-ray diffraction to study the dynamic events in cell.

(15 hours)

UNIT-III. Application and benefits of nanotechnology: Basics tools for nanotechnology – Principles of scanning force microscopy, Scanning electron microscopy, Transmission electron microscopy; Biomolecular recognition. Tissue Engineering: Preparation of hydrogel and biopolymer for wound healing. Development of Bioprinting 2D and 3D Bioprinters, Bio inks for Tissue Engineering.

(15 hours)

UNIT IV: Bionanotechnology: Microarray technology. Nanopore technology. Nano - biotechnology for Human health- A remedy for all diseases. In vitro diagnosis. Medical Applications of Nanoparticles & Nanosystems. Nano drug delivery. Conventional drug delivery & targeted drug delivery and advantages. Delivery profile, Role of Nanotechnology in drug delivery & Cancer Biology.

(15 hours)

UNIT V: Advances in Bio-Techniques: Principle and applications of microscopy – phase contrast, polarizing, fluorescence, interference and electron microscope (SEM, TEM and STEM) – AFM & CLSM - microscopic measurements, LASER- principle and applications, Spectrophotometer. UV-Vis, NMR & ESR spectroscopy, structure determination using X ray

diffraction and NMR, Mass spectrometry, surface plasma resonance. Zeta analyser, DLS for nanoparticle characterization.

(15 hours)

Correlation of Programme objectives with course outcomes

COURSE OUTCOME	PO1	PO2	PO3	PO4	PO5
• By studying this course students can develop up-to-date idea on nanomedicine	✓	✓	✓	✓	
• Students can develop concept note for their future research	✓		✓	✓	✓
• Students can enter into the world class industries/ institutes of biomedical Sciences	✓	✓	✓	✓	✓

Unit wise programme specific qualification attributes

Unit	Unit Title	Intended Learning Chapters	Hours of Instruction
NANOMEDICINE			
I	Current Scenario of Nanomedicine	K3, K4, K6	15
II	Synthesis and characterization of Nanoparticles	K1, K2, K3	15
III	Application and benefits of nanotechnology	K3, K4, K5, K6	15
IV	Bionanotechnology	K3, K4, K5, K6	15
V	Advances in Bio-Techniques	K1, K3, K4,	15

REFERENCE BOOKS :

Babiuk, L.A., John, P. Philips and Murray Moo Young (1989). Animal Biotechnology, Pergamon Press, Oxford.

Glick, B.R. and Pasterick Jack, J., (2001) Molecular Biotechnology. ASM Press, London.

GorDard and Lucessen, E. (1993) In-vitro Culture of Animal Cells. Butter worth – Heinemann Publications.

Higgins, I. J., Best, D.J. and Jones, J., (1988) Biotechnology - Principles and Applications. Blackwell Scientific Publications, Oxford.

Marx, J.L., (1989) A revolution in Biotechnology. Cambridge University Press.

Old, R. W. and Primrose, S.B., (1991) Principles of Gene Manipulation. Blackwell Scientific Publications.

Primrose, S.B., (1999) Molecular Biotechnology. Panima Publications, New Delhi.

Primrose SB and R.M.Twyman (2006) Principles of Gene Manipulation and Genomics
Blackwell Publishing

Smith John, E., (1990) Biotechnology New Revolution.Orbis, London

VandanMohod, (1999) Biotechnology - Recent development.Book enclave, Jaipur.

Watson, J.D., Michael Gilman, Jan Witkowski and Mark Zoller., (1999) Recombinant
DNA.Scientific American Books W. H. Freeman & Company, New York

Subject Code:19MPZE09

PERIYAR UNIVERSITY, SALEM – 636 011
DEPARTMENT OF ZOOLOGY
M.Phil / Ph.D DEGREE COURSE WORK
(For those admitted in 2018-2019 and later)

SEMESTER- I

ELECTIVE PAPER – 9

BEHAVIOURAL ECOLOGY

Contact hours per week: 05

Contact hours per semester: 75

4 CREDITS

Course objectives:

- To motivate the students about various behaviours of animals and the methods of recording and analyzing the behaviour
- To gain knowledge about the pheromones and animal communication

Course outcome:

- At the end of the semester, students will be able to understand the animal behaviour
- Record and analyze the behavior of animals in the field to explore the reality
- Understand the concepts of molecular ethology, pheromone biology and chronobiology

UNIT I

ETHOLOGY AT A GLANCE: Introduction- Founding fathers of animal behaviour- Proximate and ultimate causation of behaviour- Methods of studying animal behaviour- Ethograms- Adlibitum sampling, Focal animal sampling. Animal learning- Trial and error learning- Classical conditioning- Operant conditioning- Insightful learning- Habituation- Imprinting.

(15 hours)

UNIT II

PHEROMONE BIOLOGY: Chemical Ecology, Semiochemicals, Types of Semio Chemicals- Allelochemicals, Pheromones, Allomones, Kairamones. Pheromones- Types and their sources. Role of Pheromones in pest management programme. Mammalian Pheromones and their effects- Lee Boot Effect, Bruce Effect, Vandenberg Effect. Pheromones in Reproductive Endocrinology. Methods of Isolation, Identification and characterization of pheromones- Principles and working protocol of GC-MS, LC-MS, IR and NMR Spectroscopy. Reproductive behaviour of mammals: Lordosis and Flehmen behaviour

(15 hours)

UNIT III

FORAGING BEHAVIOUR- Group and solitary foraging- Eavesdropping- Territoriality- Resource sharing and partitioning- Factors affecting foraging – Optimal foraging theory. Foraging Behaviour in insects, fishes, bats and other mammals. Adaptive flexibility in Foraging Behaviour of fishes, Waggle dance in honey bee.

(15 hours)

Unit IV

MOLECULAR ETHOLOGY: Monogamy, Polygamy, Polyandry- Resource defense polygyny- Advantages of roosting together- Parental care in animals Molecular ecology:- DNA markers –DNA fingerprinting - Minisatellites - Microsatellite - Mitochondrial DNA - PCR – RAPD – RFLP.

(15 hours)

Unit V

CHRONOBIOLOGY- Introduction- Different types of biological rhythm- Ultradian, Circadian and Infradian rhythms- Zeitgebers, Free running and entrainment of rhythms- Animals with varying circadian rhythms- Molecular Biology of Clock genes and its impact on animal behaviour. Role of abiotic factors in Biological clocks of animals- Photoperiodism, effect of temperature.

(15 hours)

Correlation of Programme objectives with course outcomes

COURSE OUTCOME	PO1	PO2	PO3	PO4	PO5
• will be able to understand the animal behaviour	✓	✓	✓		
• Record and analyze the behavior of animals	✓		✓	✓	
• Understand the concepts of molecular ethology, pheromone biology and chronobiology	✓		✓	✓	✓

Unit wise programme specific qualification attributes

Unit	Unit Title	Intended Learning Chapters	Hours of Instruction
BEHAVIOURAL ECOLOGY			
I	ETHOLOGY AT A GLANCE	K1, K3	15
II	PHEROMONE BIOLOGY	K1, K2	15
III	FORAGING BEHAVIOUR	K1, K3, K5	15
IV	MOLECULAR ETHOLOGY:	K1, K2, K6	15
V	CHRONOBIOLOGY	K2, K4, K5, K6	15

REFERENCE BOOKS

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

Subject Code: 19MPZE10

PERIYAR UNIVERSITY, SALEM – 636 011
DEPARTMENT OF ZOOLOGY
M.Phil / Ph.D DEGREE COURSE WORK
(For those admitted in 2018-2019 and later)

SEMESTER- I

ELECTIVE PAPER - 10

BIODIVERSITY AND CONSERVATION BIOLOGY

Contact hours per week: 05

Contact hours per semester: 75

4 CREDITS

Course objectives:

- To enable the students to impart knowledge about biodiversity and its importance
- To motivate the students to learn wildlife protection and conservation measures

Course outcome:

- At the end of the semester, students will be able to realize the need of conservation biology
- Gain knowledge about monitoring biodiversity and the threats of living system
- Know about the importance of wildlife conservation and conservative methods

Unit I

BIODIVERSITY : Concept and Use- consumptive use, productive use, social, ethical, aesthetic and option values of biodiversity. Biodiversity at global, regional and local levels. Monitoring & measurement of Biodiversity; useful indices. Threats like overexploitation, fragmentation, habitat loss & poaching of wildlife

(15 hours)

Unit II

ex situ MANAGEMENT: Role of zoos, biodiversity parks, gene banks, tissueculture etc. in biodiversity management. Introduction to the concepts of captive breeding. Examples of captive breeding and re-introduction programmes in maintaining biodiversity

(15 hours)

Unit III

in situ MANAGEMENT Introduction to protected area system in India and its role in biodiversity management. Review of existing protected areas and analysis of coverage of biodiversity values by protected areas. Wildlife corridors- Human wildlife conflict.

(15 hours)

Unit IV

ANIMAL CENSUS TECHNIQUES - Their applications, Line transects – Belt transects – Point counts: fixed and variable width – Call counts - Mark-recapture method – Principles of mist-netting - Types of marking animals: rings/bands, flags, tags, dyes, and natural markers – Radio-tracking & satellite telemetry

(15 hours)

Unit V

MODES OF CONSERVATION: Major international conventions pertaining to biodiversity protection, Ramsar convention, CITES, Convention on biological diversity, IUCN and WWF –International. National and global organization and treaties involved in regulation and control of biodiversity commerce and trade.

(15 hours)

Correlation of Programme objectives with course outcomes

COURSE OUTCOME	PO1	PO2	PO3	PO4	PO5
• At the end of the semester, students will be able to realize the need of conservation biology	✓	✓	✓	✓	
• Gain knowledge about monitoring biodiversity and the threats of living system	✓	✓	✓		
• Know about the importance of wildlife conservation and conservative methods	✓	✓		✓	✓

Unit wise programme specific qualification attributes

Unit	Unit Title	Intended Learning Chapters	Hours of Instruction
BIODIVERSITY AND CONSERVATION BIOLOGY			
I	BIODIVERSITY	K1, K2	15
II	<i>ex situ</i> MANAGEMENT	K1, K4, K5	15
III	<i>in situ</i> MANAGEMENT	K1, K3, K5	15
IV	ANIMAL CENSUS TECHNIQUES	K1, K2, K4	15
V	MODES OF CONSERVATION	K1, K4, K6	15

References

1. NY. Hunter Jr., M. L. 2002. Fundamentals of Conservation Biology. Blackwell Science, Malden, Massachusetts, U.S.A.
2. Leveque, C., and J.-C. Mounolou. 2003. Biodiversity. John Wiley and Sons, West Sussex, England.
3. Covello. Mills, L. Scott 2006. Conservation of Wildlife Populations. Blackwell Science, Oxford, U. K.
4. Morris Gosling L & WJ Sutherland (eds) 2000. Behaviour and Conservation. Cambridge University Press, Cambridge.
5. Morris, W. F., and D. F. Doak. 2002. Quantitative Conservation Biology: Theory and Practice of Population Viability Analysis. Sinauer Associates, Sunderland, Massachusetts, U.S.A.

Subject Code: 19MPZE11

PERIYAR UNIVERSITY, SALEM – 636 011
DEPARTMENT OF ZOOLOGY
M.Phil / Ph.D DEGREE COURSE WORK
(For those admitted in 2018-2019 and later)

SEMESTER – 1

ELECTIVE PAPER - 11

ENTOMOLOGY

Contact hours per week: 05

Contact hours per semester: 75

4 CREDITS

Objectives:

- ❖ Main objective is to provide in-depth knowledge on the insect morphology and physiology of different systems.
- ❖ The units are framed to provide basic knowledge on the insects of economical, medical and social interest.
- ❖ This topic is designed to provide knowledge on novel techniques in pest management programme.

Outcome:

- ❖ Strong foundation on the largest group of animals in the animal kingdom will be laid.
- ❖ You will be an expert and public advisor in insect transmitted diseases.
- ❖ Study on this topic fits you for leading pesticide companies and advisor for crop pest management.

UNIT 1: INSECT PHYSIOLOGY, DIVERSITY, EVOLUTION, IDENTIFICATION AND CLASSIFICATION: Morphology: external features and their articulation. Comparative study of head - antennae, mouth parts; thorax – legs, wings; abdominal appendages, genitalia. Basic methods to Identify insects and Barcoding technique for Identification. Structure and physiology of integumentary, digestive, excretory, circulatory, respiratory, endocrine, reproductive, and nervous system. Methods to estimate growth, food consumption and enzyme activity in Insects.

(15 hours)

UNIT 2: AGRICULTURAL INSECT PESTS: Classical identification techniques of following insect pests of Agricultural importance: Rice stem borer, Mango hoppers, Sugarcane borers, Cotton Jassid, Citrus caterpillar, Rice weevil. Chemical and bio-control methods in pest management.

(15 hours)

UNIT 3: INSECTS OF MEDICAL IMPORTANCE: Identification tools for Mosquitoes, Housefly, Sand fly, Bedbug, Rat flea, Human lice and Tsetse fly. Data collection methods for mosquito distribution. Techniques to develop bio and nano products to control animal pests.

(15 hours)

UNIT 4: INSECT SOCIOBIOLOGY: Life cycle and Social organization of termites, honeybees and ants. Study on societies among bees and factors affecting the society; social significance of the nest; caste determination in bees; Foraging and orientation; Defence mechanisms in bees.

(15 hours)

UNIT 5: PEST MANAGEMENT AND CONTROL STRATEGIES: Pest control methods: Mechanical, chemical and biological methods-merits and demerits of these methods in pest control. Microbial control: Pathogens used in microbial control (Fungi, Bacteria,

Viruses, Protozoans, Nematodes etc.). Nanotechnology and recent advances in Pest management.

(15 hours)

Correlation of Programme objectives with course outcomes

COURSE OUTCOME	PO1	PO2	PO3	PO4	PO5
<ul style="list-style-type: none"> • Strong foundation on the largest group of animals in the animal kingdom will be laid. • Students will be an expert and public advisor in insect transmitted diseases. • Study on this topic fits the students to the leading pesticide companies and advisor for crop pest management. 	✓	✓	✓		
	✓	✓	✓		
	✓	✓	✓	✓	✓

Unit wise programme specific qualification attributes

Unit	Unit Title	Intended Learning Chapters	Hours of Instruction
ENTOMOLOGY			
I	INSECT PHYSIOLOGY, DIVERSITY, EVOLUTION, IDENTIFICATION AND CLASSIFICATION	K1, K3, K4	15
II	AGRICULTURAL INSECT PESTS	K1, K2, , K4, K5	15
III	INSECTS OF MEDICAL IMPORTANCE	K1, K2, K3, K5,	15
IV	INSECT SOCIOBIOLOGY	K1, K2, K3,	15
V	PEST MANAGEMENT AND CONTROL STRATEGIES	K2, K4, K5, K6	15

REFERENCE BOOKS

1. Atwal, A.S., Dhaliwal, G.S. 1997. Agriculture pests of South Asia and their management, Kalyani Publishers, New Delhi.
2. Imms, A. D., Chapman, Hall. 1977. A general text book of entomology, UK.
3. Snodgrass, R. E. 1935. Principles of Insect Morphology, Cornell University Press, USA.
4. Chapman, R. F. 1982. The Insects: Structure and function, Cambridge University Press, UK.
5. Klowden, M. J. 2007. Physiological system in Insects, Academic Press, USA.
6. Shrivastava, K.P. 1996. A textbook of applied Entomology, Kalyani Publishers, New Delhi.

7. Sathe, T.V., Bhoje, P.M. 2000. Biological Pest Control, Daya Publishing House, Delhi.
8. Hill, D.S. 1974. Agricultural insect pests of the tropics and their control. Cambridge University Press, New York.
9. Michener, C.D. 1981. The social behavior of the bees. The Belknap Press of Harvard University, Cambridge.

Subject Code: 19MPZE12

PERIYAR UNIVERSITY, SALEM – 636 011
DEPARTMENT OF ZOOLOGY
M.Phil / Ph.D DEGREE COURSE WORK
(For those admitted in 2018-2019 and later)

SEMESTER – 1

ELECTIVE PAPER - 12

Elective Paper: SERICULTURE

Contact hours per week: 05

Contact hours per semester: 75

4 CREDITS

Objectives:

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

Outcome:

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

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

(15 hours)

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

(15 hours)

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

(15 hours)

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

(15 hours)

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

(15 hours)

Correlation of Programme objectives with course outcomes

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

Unit wise programme specific qualification attributes

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

REFERENCE BOOKS

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

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