

C. ABDUL HAKEEM COLLEGE [AUTONOMOUS]
[Affiliated to Thiruvalluvar University, Vellore]
MELVISHARAM – 632509



Syllabus under CBCS
Learning Outcome Based Curriculum Frame work
[LOCF]
with effect from 2018-2019 onwards

M.Phil. & Ph.D. Zoology

Prepared By
PG & Research Department of Zoology

PG and Research Department of Zoology [M.Phil Syllabus]

Course Scheme M.Phil - Zoology												
Academic Year 2019-2020												
S.No	E/D	Category	Type	Subject Code	Subject Name	In.M ax	Int. Min	Ext.M ax	Ext. Min	Pass Marks	Credits	Part
Semster I		Subject Count	3			Total credits = 20						
1	E	Theory	Main	M19MZL101	Research Methodology	25	0	75	38	50	5	III
2	E	Theory	Main	M19MZL102	Recent Advances in Zoology	25	0	75	38	50	5	III
3	E	Theory	Guide	M19MZL103	Aquaculture (Internal)	25	0	75	38	50	5	III
4	E	Theory	Guide	M19MZL104	Crustacean Pathology (Internal)	25	0	75	38	50	5	III
5	E	Theory	Guide	M19MZL105	Marine Environmental Monitoring and Assessment (Internal)	25	0	75	38	50	5	III
6	E	Theory	Guide	M19MZL106	Biodiversity and Environmental Monitoring (Internal)	25	0	75	38	50	5	III
7	E	Theory	Guide	M19MZL107	Nanotechnology & Bioactive Natural Products (Internal)	25	0	75	38	50	5	III
8	E	Theory	Guide	M19MZL108	Diseases of Aquatic Animal (Internal)	25	0	75	38	50	5	III
Semster II		Subject Count	1			Total credits = 21						
8	E	Theory	Dissertation	M19MZL201	Dissertation with Viva Voce	20	0	80	40	50	21	III

CORE COURSE I
RESEARCH METHODOLOGY

OBJECTIVES

To comprehend the various types of research, design and techniques involved, data collection and analysis.

Course Outcomes

After completing this course, students shall be able to

CO1	Outline the basic types of research and able to obtain fund from research agencies
CO2	Build a research design for his experiment
CO3	Analyse the collected data for his research
CO4	Formulate and develop a research article/Thesis of his own

UNIT-I: RESEARCH METHODOLOGY Meaning of research - Objectives of research - motivation of research - Types, approaches and significance - Methods versus methodology - Research in scientific methods - Research process - Criteria for good research - Problem encountered by research in India - Funding agencies.

UNIT-II: RESEARCH DESIGN Research Problem: Selecting the problem - Necessity of defining the problem - Techniques involved in defining the problem - Research design - Needs and features of good design - Different research design - Basic principles of experimental designs.

UNIT-III: DATA COLLECTION AND DOCUMENTATION Data collection methods - Data types - Processing and presentation of data - Techniques of ordering data - Meaning of primary and secondary data - The uses of computers in research - The library and internet - Uses of search engines - virtual libraries - common software for documentation and presentation.

UNIT-IV: DATA AND ERROR ANALYSIS Statistical analysis of data - Standard deviation - Correlation - Comparison of sets of data - Chi squared analysis for data - Characteristics of probability distribution - Binomial, Poisson and normal distribution - Principle of least square fittings - Curve 2 fitting - Measurement of errors - Types and sources of errors - Determination and control of errors.

UNIT-V: RESEARCH COMMUNICATION Meaning of research report - Logical format for writing thesis and paper - Essential of scientific report: abstract, introduction, review of literature, materials and methods and discussion - Write up steps in drafting report - Effective illustrations: tables and figures - Reference styles: Harvard and Vancouver systems.

REFERENCE BOOKS:

1. Research Methodology, Methods and Techniques - C.R. Kothari - Wishwa Prakasam Publications, II Edition.
2. Research: An introduction - Robert Ross - Harper and Row Publications.
3. Research methodology - P. Saravanel - Kitlab Mahal, Sixth Edition.
4. A Hand book of Methodology of Research - Rajammal P.A. Devadass - Vidyalaya Press
5. Introduction to Computers - N. Subramanian

6. Statistical methods - G.W. Snedecor and W. Cochran - Oxford and IBH, New Delhi.
7. Research Methodology Methods and Statistical Techniques - Santosh Gupta.
8. Statistical Methods - S.P. Gupta
9. Scientific social surveys and research - P. Young - Asia Publishers, Bombay.
10. How to write and publish a scientific paper - R.A. Day - Cambridge University Press.
11. Thesis and Assignment writing - Anderson - Wiley Eastern Ltd.

CORE COURSE II
RECENT ADVANCES IN ZOOLOGY

OBJECTIVES

To comprehend the various types of advanced techniques and their principles applied in Zoological research

Course Outcomes

After completing this course, students shall be able to

CO1	Experiment with the cell culture techniques
CO2	Outline the various biochemical and molecular biology techniques
CO3	Explain the enzyme kinetics in energy metabolism
CO4	Compare the various bioenergetics mechanisms

UNIT-I: Cell and Tissue Culture in Animals - Primacy Culture - Cell Line - Cell Clone - Callus Culture - Micro Propagation etc.

UNIT-II: Structure and Organization of Membranes - Ion Translocation - Neurotransmitters Systems - Model Membranes.

UNIT-III: Biochemistry and Molecular Biology of Cancers, Oncogenes, Chemical Carcinogenesis, Genetics and Metabolic Disorders, Hormonal Imbalance.

UNIT-IV: Immunoglobulin Classes, Lymphokinesis, T-Cell Receptors, HLA, Autoimmunity, Regulation of Immune Responses, Mechanism of Antibody Diversity.

UNIT-V: Enzyme Kinetics (Negative And Co-Positive) - Regulations of Enzymatic Activity - Active Sites, Co - Enzyme - Activities Inhibits and Iso - enzymes.

UNIT-VI: Energy Metabolism - Thermodynamic Principles in Biology - Energy Rich Bond, Weak Interactions Couple Reactions and Oxidative Phosphorylation, Group Transfers Biological Energy - Transducers, Bioenergetics.

REFERENCE BOOKS:

1. Watson, J.D, 1980. Molecular Biology of Gene, W.A. Benjamin & Co., New York.
2. Ayala, F.J, 1980. Modern Genetics, The Mc Millar Co., New York.
3. Sinnet, E.W and Dobzhensky, 1958. Principles of Genetics, McGraw Hill Co., New York.
4. E.D.P De Robert's 1980. Cell and Molecular Biology, Hort Saunders Co.,
5. James D. Watson., Tania A. Baker and Stephen.P. Bell etc. 2004. Molecular Biology of the Gene.
6. Williams. S and Michael.K. 2003. Concepts of Genetics.

OBJECTIVES

To comprehend the various aquaculture practices and techniques

Course Outcomes

After completing this course, students shall be able to

CO1	Explain the various basic aquaculture practices
CO2	Analyse the nutritional requirement of cultured organisms
CO3	Inspect the coastal hatchery techniques
CO4	Survey and analyse the various diseases of aquatic species

Unit - I PRINCIPLES OF AQUACULTURE

AQUACULTURE SYSTEMS AND METHODS: Scope, origins and growth of aquaculture; biological and technological basis; Traditional, Extensive, Semi intensive and Intensive culture; Different culture methods viz., Monoculture, Polyculture, Composite, Mixed, Monosex; Cage, Pen, Raft, Race way culture system etc., including Recirculatory systems; warm water and cold water aquaculture; sewage - fed fish culture, integrated fish farming.

Unit - II NUTRITION

NUTRITION: Importance of Nutrition; Nutritional requirements of finfish with an emphasis on carps, cat fishes, shrimp and prawn; Major nutrients namely Carbohydrates, Proteins and Lipids and their importance. Natural food and live feed culture: Methods of collection of live feed organisms; Identification, Isolation and Maintenance of phyto and zooplanktons; Mass culture of *Spirulina* and *Azolla*, culture of Rotifers (*Brachionus* and *Moina*) and *Artemia* sp.

Unit - III COASTAL AQUACULTURE

SHRIMP HATCHERY MANAGEMENT: Collection of Seed from the natural resources, Identification of Larval stages, Broodstock management, Induced breeding by deploying Antennary gland extirpation, Larval rearing of *Penaeus monodon* and *Fenneropenaeus indicus*. **CRAB CULTURE:** Culture of *Scylla serrata*, *Scylla oceanica*, *Scylla tranquebarica*.

LOBSTER FISHERY: Distribution – Biology of spiny Lobster – Abundance of spiny Lobster - Culture of spiny Lobster – Processing and preservation of Lobsters.

Unit - IV MICROBIOLOGY AND FISH DISEASES

Preparation and sterilization of microbial media. Quantitative determination of microorganisms by dilution plate technique. Staining methods of microorganisms. Antibiotic sensitivity. Isolation and characterization of intestinal pathogens. Measurement of the size of the cell. Collection and Preservation of Diseased Fish. External & Internal investigation of diseased finfish and shellfish. Rapid Killing of Fish. Inspection of internal organs through Autopsy. Maceration and squash preparation of organs and microscopic observation. Identification of disease causing microbes. Identification of various diseases in fin and shellfishes.

Unit - V HEALTH MANAGEMENT

Review of various diseases of finfish and shellfish relevant to aquaculture practices; Diagnostic procedures and their application in aquaculture. Prophylaxis, Hygiene and therapy of fish and shellfish diseases. Vaccines and vaccination, Probiotics and bioremedial measures; Immunostimulants and their role. Application of health management of standard operating procedures (SOP) and biosecurity principles in aquaculture.

References:

1. Pillai, T.V.R., Aquaculture and the environment. 1st edition, Fishing news Books, England, 1992.
2. Pandian, T.J., Sustainable indian fisheries, 2001
3. S. Paulraj., Shrimp farming techniques, problems and solutions-1995
4. Kurian, C.V and V.O. Sebastian. Prawns and prawn fisheries of India IV edition 1993
5. Vijayan, K.K. et al., 2007. Indian Fisheries: A progressive outlook. CMFRI Publications, Kochi.
6. Mohan Joseph Modayil and Jayaprakash, A.A. 2003. Status of exploitory marine fisheries research of India. CMFRI Publications, Kochi.
7. Sandhu, G.S. 2010. A text book of fish and Fisheries of India. Wisdom Press, New Delhi.

PAPER III - CRUSTACEAN PATHOLOGY

UNIT I

Major pathogens of commercially important cultured crustaceans with special reference to shrimp and freshwater prawn pathogens: viral, bacterial, fungal and parasites.

UNIT II

Biology, morphology, diagnostic methods, clinical signs and symptoms and pathological changes associated with these pathogens.

UNIT III

Bacterial diseases: Vibriosis; necrotizing hepatopancreatitis, rickettsial diseases, mycobacteriosis.

UNIT IV

Fungal diseases: Larval mycosis, fusarium disease; Parasitic diseases: Microsporidians, Haplosporidians, Ciliates, Cephaline gregarines. Diseases of non-infectious etiology: gas bubble disease, hemocytic enteritis.

UNIT V

Serology of microbial disease – agglutination precipitation and ELISA methods in disease diagnosis. Processing tissue samples for virological examination. Techniques for isolation of viruses. Serological tests for identification of viruses.

Molecular virology and pathogenesis of selected viruses infecting fish and shellfish such as IPN, VHS, IHN, VHS.

Nodavirus infection of fish and freshwater prawns, WSSV, YHV.

Antiviral drugs, viral vaccines, emerging viruses and evolution of new viruses.

Suggested Readings

Bell AT & Lightner DV. 1988. A Handbook of Normal Penaeid Shrimp Histology. World Aquaculture Society, Louisiana, USA.

Lightner DV. 1996. A Handbook of Shrimp Pathology and Diagnostic Procedures for Diseases of Cultured Penaeid Shrimp. World Aquaculture Society, Louisiana, USA.

OBJECTIVES

To comprehend the marine environment and its various concepts, ecosystems, pollution and its monitoring and assessment methods and advanced statistical methods

Course Outcomes

After completing this course, students shall be able to

CO1	Explain the role of ecological factors in Marine Environment
CO2	Analyse the energy flow in a marine ecosystem
CO3	Examine the various environmental monitoring methods
CO4	Survey and analyse the various marine resources

PAPER III: MARINE ENVIRONMENTAL MONITORING AND ASSESSMENT**UNIT I**

Marine environment-ecological factors-light, temperature, salinity, pressure. Classification of marine environment -pelagic environment, planktonic and nektonic adaptations, benthic environment -intertidal, interstitial and deep-sea adaptation. Other coastal environments-coral reefs, estuaries, mangroves, sea grass beds, kelp forests, polar seas and hydrothermal vents.

UNIT II

Marine Ecosystems concepts- principal components- marine food chains-trophic structure, Biogenic habitats and their importance- food web- ecological pyramids- energy flow. Marine algae and Seagrasses of India and their importance in monitoring studies. Marine Geology-natural sources of Uranium and thorium in Indian coastal belts- High background natural radiation areas (HBNRA's).

UNIT III

Global environmental monitoring methods: Status and objectives, limitations for monitoring critical pollutants-biological indicators - natural bioaccumulations (mussel watch programme) and test organisms. Radionuclides and heavy metals-role of nuclear reactors and their waste management in India-Use of analytical instruments AAS, ICP, alpha, beta and gamma radiation counting system-principle and application.

UNIT IV

Marine organisms as indicators-Economically important groups of fishes- general account and identification of pelagic and demersal fish groups, crustaceans and molluscs of Southeast and west coast of India. EEZ and its importance-Sampling of sediments, algae, plankton and fishes. Population dynamics – growth and mortality. Length – weight relationship, condition factor. Fishbase and its application.

UNIT V

Statistics in marine monitoring Assessment- Outlier's-Dixon's test, discordance test, Rosner's test, Walsh's test, multivariate outlier's. Values below detection limits-substitution methods, Cohen's mean, Trimmed mean, Winsorized mean, Atchison's method. Test for distributional assumptions-W test and Filliben's statistic. Test for comparison of means- The Chen test, Satterthwaite's test, Quantile test, Dunnet's test. Uncertainty analysis-bootstrap resampling technique-types of bootstraps-ProUCL software and its application in monitoring studies.

Reference Books

1. USEPA (2006) Guidance for Data Quality Assessment: Practical methods for Data analysis. EPA-QA/G9, USEPA, Washington.
2. Barnes R. S. K , 1999, Introduction to Marine Ecology, Blackwell Science.
3. Jeffery S. Levinton 2000 Marine Ecology, Biodiversity and Function. Oxford University Press.
4. Bertness, M.D, S. D. Gaines and M.K. Hay 2000. Marine Community Ecology Sinauer Associates.
5. Bal. D.V and K.V Rao 1990. Marine Fisheries of India Tata Mcgraw Hill Pub Co.
6. Clark R.B 1992. Marine pollution 3rd edition Clavendron, Press Oxford.

PAPER - III**BIODIVERSITY AND ENVIRONMENTAL MONITORING****Course Outcomes**

After completing this course, students shall be able to

CO1	Acquire knowledge on basic concepts on biodiversity and define the scope and constraints of biological diversity.
CO2	Understand and appreciate the values and uses of different types of bio-diversity
CO3	Familiarized with current practices and aware about conservation act and organization involved.
CO4	Enable the students to collect and analysed the samples related to EIA.
CO5	Equip the students to employ statistical packages and interpret the results.

CO Number	Knowledge Level (K1 – K5)
CO1	Define (K1)
CO2	Understand and appreciate (K2)
CO3	Familiarized and aware (K2)
CO4	Analyse (K4)
CO5	Apply and infer (K3 & K4)

UNIT-I: Biodiversity Science: Definition, Scope and Constraints

Concept and definition, scope of biological diversity studies, constraints of biodiversity science. Species distribution and concept of biodiversity Hot-spot.

UNIT-II: Types, Values and Uses of Biodiversity

Genetic diversity, Species diversity, Agro-biodiversity, Urban-biodiversity and Ecosystem diversity. Biodiversity values, Ethical and Aesthetic values, Uses of Plants, Animals and Microbes.

UNIT-III: Biodiversity Conservation and Management

Current practices in conservation, top-down and bottom-up strategies, In-situ and ex-situ conservation, ecosystem restoration, Indian biodiversity Act, role of different institutions / organizations in conservation. Mass-media and awareness programs.

UNIT-IV: Environmental and Bio-monitoring

Environmental sample (water & soil) collection and analysis, RTU-Recognizable Taxonomic Unit, Inventory and monitoring, concept of Bio-indicators and surrogate species, Environmental impact assessment (EIA).

UNIT-V: Field Ecology and Quantitative Techniques

Sampling techniques of animals (quadrats - transects), Introduction to computers, use of spreadsheets and statistical packages (MS XL and Biodiversity Pro) for performing statistical tests. Graphical representation and interpretation of results.

REFERENCE BOOKS:

1. Krishnamoorthy, K.V. (2009) Advance textbook of biodiversity: principles and practice, oxford IBH , New Delhi.
2. Gaston, K.J. and Spicer, J.I. (2004) Biodiversity: An introduction. 2nd ed., Blackwell
3. Wilson, E.O. (2010) The Diversity of Life. Harvard university press.
4. Magguran, A.E. (2004) Measuring Biological Diversity. Blackwell, Oxford
5. Gadgil, M. (2005) A methodology manual for scientific inventorying, monitoring and conservation of biodiversity. CES-IISC publications
6. Sutherland, W. J. (2006) Ecological census technique. Cambridge university press.

PAPER III: NANOTECHNOLOGY AND BIOACTIVE NATURAL PRODUCTS

Course Outcomes

After completing this course, students shall be able to

CO1	Describe the extraction methods, functions and applications of Chromatography.
CO2	Outline the plant based nanoparticles synthesis and its applications.
CO3	Relate different characterization techniques of nanotechnology.
CO4	Employ the knowledge of parasitology and Nanomedicine to treat the infectious diseases.
CO5	Explain different strategies applied in insect pest and vector control management.

UNIT – I

Introduction to natural products - Collection of plant materials - Preparation of plant extracts - Extraction methods: Crude extracts. Distillation, Separation procedures. Isolation and estimation of phytoconstituents - Chromatography: Principles, working procedure, functions and application of column chromatography, Thin layer chromatography, Paper chromatography, Gas chromatography and High performance liquid chromatography. Role of ethnobotany in relation to drug discovery in India.

UNIT – II

Nanotechnology in natural product research - Introduction to nanotechnology, applications, types of nano formulations. Synthesis of nanomaterials by Physico-chemical approaches. Plants based nanoparticle synthesis and its applications, Preparation and characterization of nano formulations for plant secondary metabolites. Nanomedicine for parasitic diseases, pest and vectors.

UNIT – III

Characterization techniques related to nanoscience and nanotechnology: Microscopies - Optical microscopy, Fluorescence and Confocal microscopy, Scanning electron microscopy (SEM) - Transmission electron microscopy (TEM). Probe techniques - Scanning tunnelling microscopy (STM), Atomic force microscopy (AFM), Spectroscopic Techniques - UV - Vis Spectroscopy, X-Ray diffraction spectroscopy (XRD), Energy dispersive X-ray spectroscopy (EDX) and Fourier transform infrared (FTIR) spectroscopy.

UNIT – IV

Parasitology - Introduction to parasites, parasitic diseases - Malaria, Filariasis and Leishmaniasis, parasite biology, Association between parasite and host, Effect of parasites on host, Morphology and life cycle of parasites, transmission, pathogenesis, drug treatment and resistance, control of parasitic infections, Infectious diseases. Use of animals in experiments. Immunity to parasitic infections (natural and acquired).

UNIT – V

Insect Pest and Vector Management. Biological control of insect pest, Pest of crops, Pest of stored products, detection and estimation of infestation. Management of store product pests.

Vector control: Introduction to the life - cycles of vectors, their ecology and role in transmission, vector / parasite interactions and current developments in vector control strategies.

REFERENCE BOOKS

1. Canel, J.P. 1998. Natural Products Isolation. Humana Press, New Jersey, USA.

2. Bhat, S.V., Nagasampagi, B.A., Sivakumar, M. 2010. Chemistry of natural products (5th Edition - Narosha Publication).
3. Bohlin, L. and Bruhn, J.G. 1999. Bioassay methods in Natural Product research and Drug Development. Kluwer Academic Publishers, Netherlands.
4. Harborne, J. B. and Baxter, H. 1993. Phytochemical dictionary - a handbook of bioactive compounds from plants. Taylor and Francis Limited, London.
5. Khan, I. A. and Khanum, A. 1999. Role of Biotechnology in Medicinal and Aromatic Plants, Vol. II. Ukaaz Publications, Hyderabad, India.
6. Introduction to Nanoscience by Gabor L. Hornyak, Joydeep Dutta, Harry F. Tibbals, Anil K. Rao. CRC Press, 2008.
7. Nanostructures & Nanomaterials: Synthesis, Properties, and Applications by Guozhong Cao, Imperial College Press, London, 2004.
8. David, B.V., and Ananthkrishnan, T.N. 2004. General and Applied Entomology. Tata-McGraw Hill, New Delhi.
9. Arora, B. 2010. Medical Parasitology (3rd Edition - CBS Publication).

PAPER - III
DISEASES OF AQUATIC ORGANISMS

UNIT I - General principles of diseases in aquaculture. Disease causing agents: physical, chemical and biological agents. Basic disease terminology. Basic principles of pathology and epidemiology.

UNIT II - Viral diseases of finfish - Viral Nervous Necrosis (VNN), Infectious Pancreatic Necrosis Virus (IPNV), Snakehead Rhabdovirus (SHRV) and Viral Hemorrhagic Septicemia Virus (VHSV). Disease diagnostics: Epidemiology, laboratory studies and histopathological studies. Control methods.

UNIT III - Viral diseases of shrimp - White spot syndrome virus (WSSV), Hepatopancreatic parvovirus (HPV), *Monodon Baculo Virus* (MBV) and Infectious Hypodermal and Hematopoietic Necrosis Virus (IHHNV). Viral Diseases of prawn - *Macrobrachium rosenbergii* Nodavirus (MrNV) and Extra Small Virus (XSV). Disease diagnostics: Epidemiology, laboratory studies and histopathological studies. Control methods.

UNIT IV - Bacterial diseases of fish, shrimp and prawn - goldfish ulcer disease and furunculosis, Yersiniosis, Vibriosis, Columnaris disease, Bacterial gill disease, Bacterial kidney disease, Mycobacteriosis and Rickettsial disease. Disease diagnostics: Epidemiology, laboratory studies, microbiological and histopathological studies.

UNIT V - Other diseases – Fungal diseases (*Oomycetosis*, *Branchiomycosis*, *Fusarium sp.*). Protozoan diseases (*Ichthyophthirius multifiliis*, *Myxobolus exiguus* and *Myxobolus luciopercae*). Parasitic diseases (Trematodes, cestodes, nematodes and acanthocephala). Chemotherapeutic agents: types and modes of action. Applications of biotechnology in the diagnosis and control of diseases.

REFERENCE BOOKS:

- Biswas, K. P. 1995. Prevention and Control of Fish and Prawn Diseases. Daya Publishing House, New Delhi.
- Luky. 1994. Methods for the Diagnosis of Fish Disease. Daya Publishing House, New Delhi.
- Kabatza, Z. 1985. Parasites and Diseases of Fish Cultured in the Tropics. Taylor and Frances, London.
- Van Duijn, C. 1973. Diseases of Fishes. London Life Books Ltd.
- Conroy, D. A. and Herman, R. L. 1968. Text Book of Fish Diseases. T.F.H. (Gt. Britain) Ltd.
- Das, M. K. and R. K. Das. 1997. Fish and Prawn Diseases, Inland Fisheries Society of India, Barrackpore.
- Chakrabarthi, N. M. 1995. Diseases of Cultivable Fresh Water Fishes and Their Control. Daya Publishing House, New Delhi.
- Ellis, Anthony E. (Edr.) 1995. Fish and Shell Fish Pathology. Daya Publishing House, New Delhi.
- OIE Diagnostic Manual for Aquatic Animal Diseases Third Edition, 2000.