

**PROGRAMME STRUCTURE FOR THE P.G. DEGREE M.Sc. ZOOLOGY IN
UNIVERSITY DEPARTMENT**

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

MANONMANIAM SUNDARANAR UNIVERSITY, TIRUNELVELI

Learning Outcome Based Curriculam Framework System

Programme Objectives

| Programme Objectives | Title of the Programme | |
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| | M.Sc. Zoology | ➤ Develop an individual from rural, unreached socio-economically downtrodden society with academic integrity, values and ethics. |
| | | ➤ 2. Impart high level of education and understand the multidisciplinary, innovative, contemporary knowledge and will be able to do independent and applied research to be competent at national and international level. |
| | | ➤ 3. Motivate and develop a passion for lifelong learning with capability in technique and analytical methods in the core and applied research. |
| | | ➤ 4. Impart skill based, value added, employable, entrepreneurial, research oriented programmes to be self reliant. |
| | | ➤ 5. Offer a milieu for basic and advanced research to develop research outputs that are transferrable technologies, patents and publications. |
| | | ➤ 6. Offer courses and impart hands on scientific training for designing and execution of experiments to acquire higher education, research skills and employability in the reputed regional, national and international institutions |

Programme Specific Outcomes

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| Title of the programme | <ul style="list-style-type: none"> ➤ Identify the diversity of organisms, differentiate them phylogenetically, morphologically and understand their habit and habitat, evolutionary significance, and their economic importance |
| M.Sc. Zoology | <ul style="list-style-type: none"> ➤ Understand the cellular and molecular mechanisms of organisms, know the microbial interactions and biochemical modifications in various organisms. |
| | <ul style="list-style-type: none"> ➤ Understand the cell differentiation, genetic inheritance, developmental process of an organism, and know the modern techniques viz. rDNA, Tissue engineering and the Artificial Reproductive Technology process. |
| | <ul style="list-style-type: none"> ➤ Learn the basics of the animal physiology, know the immune cells and immune organs, process of innate and acquired defence mechanisms and their role in allergy and organ transplantation. |
| | <ul style="list-style-type: none"> ➤ Design the experiments, know the methods of data collection and execute the experiments with modern instruments and interpret the data with recent statistical tools. |
| | <ul style="list-style-type: none"> ➤ Acquire knowledge on computational biological tools, know the biological database and sequence analysis methods, able to do molecular modelling and pharmacophore generation. |

Course Outcome

| SL.N o | Nature of Course | Title of the subject/course | Course outcome |
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| Semester I | | | |
| 1 | CORE PAPER I | STRUCTURE AND FUNCTION OF INVERTEBRATES | Describe the basics of taxonomy and nomenclature system and organization of body plan of invertebrates |
| | | | Understanding the locomotory structure and their function of the diverse groups of non-chordates |
| | | | Learn the physiology of respiratory and excretory system of invertebrates |
| | | | Knowledge on the structure and function of nervous and reproductive system of invertebrates |
| | | | Learn the evolutionary significance of larval forms of major and minor phyla of invertebrates. |
| 2 | CORE PAPER II | COMPARATIVE ANATOMY OF CHORDATES | Know the general characters, taxonomy and Classification upto level of order of vertebrates. |
| | | | Understand Diversity and Evolutionary history of vertebrates, |
| | | | Understand the adaptive radiation in Chordates Aquatic, Terrestrial, Aerial, Arboreal vertebrates. |

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| | | | Understand the functional system of vertebrates and association with comparative anatomy of chordates. |
| | | | Able to understand the development and function of integument system of vertebrates. |
| 3 | CORE PAPER III | ENVIRONMENTAL BIOLOGY | Describe the interaction of living organisms with the environment, energy transfer between the trophic level and know the cycling of elements in the environment. |
| | | | Understand the complex dynamics and spatial patterning of populations and of entire assemblages of multiple species across diverse environment. |
| | | | Know the types of living organisms in various each ecosystem, conservation and sustainable utilization of natural resources. |
| | | | Know the impact of pollution in the environment and its control measures; acquire knowledge on environmental education and environmental laws. |
| 4 | CORE PAPER IV | ANIMAL BIODIVERSITY | Understand the types of biodiversity, biological classification system, Phylogenetic relationship of organisms and Global Biodiversity hotspots. |
| | | | Acquire knowledge on diversity and types of organisms in various ecosystems, threats to biodiversity, rate of extinction of species and IUCN red list of species. |
| | | | Learn about basics of concepts of remote sensing, components of GIS and its application in biodiversity conservation and management. |
| | | | Know about the importance, duties, functions and powers of various biodiversity regulating agencies. |
| | | | Analyze and measure the diversity of organisms using various computation methods. |
| | | | Understand the types of biodiversity, biological classification system, Phylogenetic relationship of organisms and Global Biodiversity hotspots. |
| | | | Acquire knowledge on diversity and types of organisms in various ecosystems, threats to biodiversity, rate of extinction of species and IUCN red list of species. |
| | | | Learn about basics of concepts of remote sensing, components of GIS and its application in biodiversity conservation and management. |
| 5 | CORE PRACTICAL I | STRUCTURE AND FUNCTION OF | To learn the epidemiology of protozoans and helminthes parasites. |

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| | | INVERTEBRATES & COMPARATIVE ANATOMY OF CHORDATES | |
| | | | To analyze the evolutionary significance of life stages of major and minor phyla of invertebrates |
| | | | Understand the salient features, structural affinities and evolutionary significance of various vertebrates. |
| | | | Develop the skill on handling, mounting techniques of mouth parts of Honey bee. |
| | | | Acquire the skill of Mounting the appendages of Prawn and know the handling techniques of dissection of nervous system and reproductive system. |
| | | | To learn the epidemiology of protozoans and helminthes parasites. |
| | | | To analyze the evolutionary significance of life stages of major and minor phyla of invertebrates |
| | | | Understand the salient features, structural affinities and evolutionary significance of various vertebrates. |
| | | | Develop the skill on handling, mounting techniques of mouth parts of Honey bee. |
| | | | Acquire the skill of Mounting the appendages of Prawn and know the handling techniques of dissection of nervous system and reproductive system. |
| 6 | CORE PRACTICAL – II | ENVIRONMENTAL BIOLOGY AND ANIMAL BIODIVERSITY | Acquire knowledge on primary productivity in an aquatic ecosystem. |
| | | | Develop skill to analyze physico-chemical parameters of water. |
| | | | Measure and assess the diversity, density and richness of the species through biodiversity index. |
| | | | Understand various steps to remove contaminants from the waste water. |
| | | | Know the process of preserving fauna using various methods. |
| 7 | ELECTIVE I: | 1. ANIMAL CELL BIOTECHNOLOGY (E- PATHSALA-1) | Know the history of animal cell culture, laboratory requirements, equipments and media requirements for animal cell culture and applications of animal cell culture technique. |

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| | | | Understand the basic concept of tissue culture, organ culture, tissue engineering, application of tissue engineering in organ generation and ethical implication in tissue engineering. |
| | | | Types modifying enzymes their uses in animal cell biotechnology. concept of transgenic animals , ethical, social and legal concern related to transgenic animals, applications of transgenic animals, Construction of recombinant animal viral vectors, different animal viral vectors. application of animal viral vectors |
| | | | Concept & Methods of Genetic Engineering, manipulation of gene expression in eukaryotes, generation of transgenic animals; RNA interference (RNAi), Antisense oligodeoxynucleotide Technology - gene knock out/ gene targeting, Applications of the gene knock out/ targeting. |
| | | | Pregnancy Diagnosis in Animals; Sperm and Embryo sexing; Stem Cell Technology and Therapeutics; Cell Cryopreservation and Animal Conservation; GLP Ethical Issues related to the Animal Cell culture. |
| 8 | | 2.ENTREPRENEURIAL MUSHROOM CULTIVATION | Will understand the structure and morphology of mushroom, Nutritive value of mushroom, Pharmaceutical value Types of mushroom -Life cycle of mushroom |
| | | | Will know the different units in Mushroom cultivation- Machinery, Equipments and instruments in mushroom production, Farm Design for mushroom production- Pure culture of mushroom and its preservation techniques, Raw materials and Sterilization |
| | | | Will understand the pawning and casing and culture practice-Ingredients, formulation of substrate preparation and crop management of oyster mushroom, Traditional and modern cultivation technologies of paddy straw mushrooms. |
| | | | Will understand the Growth regulators for mushroom yield enhancement, Post-harvest handling of fresh mushrooms, Recycling of spent mushroom waste, Microbial diseases of mushroom and their management. |
| | | | Will understand the Value added products preparation of Mushroom, Marketing of mushroom :Global and domestic, Entrepreneurial capital, SWOT analysis, Licenses legal frame work , Government |

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| | | | Schemes |
| | | 3. APICULTURE | Analyze major trends in a given economic sector / sub-sector and identify Business Opportunities |
| | | | Develop effective personal management skills like time management and communication skills. |
| | | | Devise a simple marketing and sales strategies and plan for a small business |
| | | | Knowledge on the processing of honey and byproducts of honey. |
| | | | Work out Business plan and economics of the project |
| | | 4. SEAWEED CULTURE AND ITS BIOPROSPECTING | Understand the classification, biology and global status of seaweeds. |
| | | | Acquire knowledge on various methods of cultivating commercially important seaweeds. |
| | | | Learn about the nutraceutical potentials of seaweed derived compounds. |
| | | | Know about the pharmacological activity of active principles obtained from seaweeds. |
| | | | Know the methods of extraction, characterization of polysaccharides from seaweeds and their immunomodulatory property in finfish and shell fish culture. |
| | | | Understand the classification, biology and global status of seaweeds. |
| | | | Acquire knowledge on various methods of cultivating commercially important seaweeds. |
| | | | Learn about the nutraceutical potentials of seaweed derived compounds. |
| | | | Know about the pharmacological activity of active principles obtained from seaweeds. |
| | | | Know the methods of extraction, characterization of polysaccharides from seaweeds and their immunomodulatory property in finfish and shell fish culture. |
| | | 5. AQUACULTURE | Know the scope and importance of Aquaculture and structure of fin fish and shell fish, understand the types of aquaculture-Global and Indian scenario. Major cultured species, systematic and biology breeding and reproduction. |
| | | | Understand the different types of hatchery - Design, construction and maintenance larval |

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| | | | stages-larval rearing- Post larvae management. Know the larval feed and water quality management in hatchery. Designing, layout and construction of aqua farms. |
| | | | Know the importance of nutrition, nutritional requirements of cultivable fin, shell fish. Understand the culture aspects Preparation and formulation of artificial feed – Utilization of probiotics in aquaculture. |
| | | | Be acquainted with physiology of hormone and genetic approach to modern aquaculture and fish genetics- understand the fertilization and seed selection and stocking. Improve RAS and Biofloc technology. |
| | | | Know the importance of PCR in health assessment - Development of new techniques for aquaculture cryopreservation techniques for sperms- Application of remote sensing in conservation of management of fish faunal diversity. |
| | | | Know the scope and importance of Aquaculture and structure of fin fish and shell fish, understand the types of aquaculture-Global and Indian scenario. Major cultured species, systematic and biology breeding and reproduction. |
| | | | Understand the different types of hatchery - Design, construction and maintenance larval stages-larval rearing- Post larvae management. Know the larval feed and water quality management in hatchery. Designing, layout and construction of aqua farms. |
| Semester II | | | |
| | CORE PAPER V | BIOCHEMISTRY | Understand the structure, function and metabolic pathways of carbohydrates |
| | | | Learn the classification, structural organization of proteins, types of bonds involved in protein stabilization and to understand types of enzymes, mechanism of enzyme action, regulation and inhibition. |
| | | | Acquire knowledge on the basic lipid biochemistry and further to understand the properties, biological functions and important disorders of lipid metabolism. |
| | | | Know the structure of nucleic acids, various forms of DNA, RNA and understand the structure and metabolism of vitamins. |
| | | | Learn about the structure of endocrine glands, different types of hormones, receptors and its |

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| | | | role in signal transduction. |
| | CORE PAPER VI | CELL AND MOLECULAR BIOLOGY | The understand the structure and function of cell and mechanism of transportation of molecules in and out of the cell |
| | | | Learn the role of cytoskeleton on ordering the cell division process and apoptosis. |
| | | | Know the mechanism of cell communication, signalling receptors and its pathway |
| | | | Describe the genome organization, chromosome structure, functioning of coding and non coding genes, gene expression and regulation |
| | | | Learn the technique for identify, structure and function of proteins and understand the mechanism of ageing. |
| | CORE PAPER VII | DEVELOPMENTAL BIOLOGY | Understand the origin and basic concepts of developmental biology-cell theory, mosaic and regulative development, cell division, differentiation, signaling, patterning, Potency, commitment and cytoplasmic determinants. |
| | | | Develop the knowledge of gametogenesis early development zygote formation, cleavage formation of blastula, germ layer Spermatogenesis,embryogenesis, vitellogenesis and storage of maternal transcripts, transcription of lampbrush chromosomes, |
| | | | Familiar with the awareness of Species specific sperm attraction, recognition of egg and sperm, acrosome reaction, Types of eggs and cleavage patterns and Concept in Pattern formation. |
| | | | Understand the developmental mechanism of polarity gradients, cell aggregation differentiation, sex determination and pattern formation in various organisms, metamorphosis and role of hormones in environment regulation of development. |
| | | | Aware the regenerative capacity in the Animal Kingdom in various animals, Asexual reproduction, factors influencing regeneration knowledge of cryo-preservation of gametes and enable of aging and senescence also, importance of assisted reproductive technology related with Screening of genetic disorders. |
| | CORE PAPER VIII | MICROBIOLOGY | Know the taxonomy and Classification of bacteria, fungi, yeast and virus – Ultra Structure and function of bacteria and viruses.- Phases of bacterial growth curve- Different Staining methods |
| | | | Understand the physical and chemical methods of Sterilization– Media preparation – Methods |

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| | | | of collection of sample – Methods of estimation of microorganisms– Isolation and identification of bacteria – Biochemical tests. |
| | | | Be aware of the microbial Pathogenesis– Host parasite interaction- Epidemiology and Control of microbial diseases– Antimicrobial therapy & antimicrobial resistance, types and mode of action of antibiotics. |
| | | | Understand the ecological significance of microorganisms ecosystem - Microbial interactions between plant and animals– Metagenomics concepts-Food borne diseases and Microbial Food pathogens |
| | | | Recognize the industrially important microorganisms – Fermentation process-. Bioconversion –Bioremediation–Food and additives- Single cell protein - Production of industrial microbial products – |
| | CORE PRACTICAL – III | BIOCHEMISTRY & CELL AND MOLECULAR BIOLOGY | Analyze the biomolecules in the tissue and blood samples. |
| | | | Separate aminoacids and bioactive compounds using chromatography technique and to estimate glucose, urea and creatinine |
| | | | Enable to handle different types of microscope used in biological research, understand the functional differentiation of eukaryotic and prokaryotic cells. |
| | | | Acquire knowledge on the structure of blood components and blood biochemical parameters such as blood counting, grouping and ESR. |
| | | | Analyze the mechanism of mitosis, meiosis and enumerate the structure of polytene chromosome of chironomous larvae. |
| | CORE PRACTICAL – IV | DEVELOPMENTAL BIOLOGY & MICROBIOLOGY | Study and understand the growth and development of organisms, to know the regenerating ability of amphibian. |
| | | | Learn the metamorphosis of insects and staining of chick blastoderm. |
| | | | Isolate, enumerate and cultivate bacteria. |
| | | | Identify bacteria through various staining methods and measure the size and determine the growth of bacteria. |
| | | | Perform antibiotic sensitivity pattern for pathogenic bacteria. |
| Semester III | | | |

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| | CORE PAPER IX | CORE PAPER IX: COMPARATIVE ANIMAL PHYSIOLOGY | Know the mechanism of adaptation and significance of body size, Concepts of homeostasis. Understand the adaptations of different environments and biology of Parasitic habitats. |
| | | | Be familiar with the Physiology Animal digestion and absorption and Role of salivary glands, importance of intestinal glands and regulation of body temperature. Know the physiological adaptation to and osmoregulation in aquatic and terrestrial environments. |
| | | | Know the Structure and function of respiratory system of different animal and transport of respiratory gases. Understand the Anatomy and Physiology of the respiratory tract-transport and regulation of respiration. |
| | | | Be aware of mechanism of excretion, physiology and adaptations of excretion to environment and know about excretory products. Understand the structure of mammalian kidney formation of urine, waste elimination, regulation of water and acid balance. |
| | | | Understand the function of neurons, nerve impulse, central and Peripheral Nervous system. Know the Basic mechanisms of hormone action and endocrine glands in mammal. |
| | CORE PAPER X | IMMUNOLOGY | The students will know the types of Immunity–Lymphoid-system: Primary and secondary lymphoid organs, tissues. Cells of immune-system |
| | | | The students will know the types of antigens-Types of antibodies and properties and antigen antibody interactions |
| | | | The students will know the Primary and secondary humoral immune response-Complement System Classical pathway, Alternate pathway- Types of hyper sensitivity. |
| | | | The students will know the autoimmunity diagnosis and treatment Autoimmune disease-Transplantation immunology |
| | | | The students will know the Vaccine – types Detection methods of antigens and antibodies |
| | CORE PAPER XI | GENETICS | Understand the mechanism of Mendelian inheritance in Human, Geneic Interaction;, Linkage and crossing over. |
| | | | Learn the gene cloning methods and their application in agriculture, medicine and |

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| | | | disease therapy. |
| | | | Describe the mechanism of gene expression, protein synthesis, translation and transcription. |
| | | | Knowledge on the aware of mutagenic agents and their impact on human. |
| | | | Gain knowledge on the inbreeding/out breeding , factors altering the gene pool and gene frequency of organisms. |
| | CORE PAPER XII | BIOINSTRUMENTATION | Understand various types of microscopes and its application in the field of biology. |
| | | | Know how to separate, purify and identify bioactive metabolites/proteins using chromatographic techniques. |
| | | | Know the techniques involved in determining the molecular weight of proteins and nucleic acids. |
| | | | Quantify various biological micro- and macromolecules using spectroscopy techniques. |
| | | | Know different methods to determine radioactivity and its application in medicine. |
| | CORE PRACTICAL – V | COMPARATIVE ANIMAL PHYSIOLOGY & IMMUNOLOGY | Know the impact of Oxygen, temperature and salinity on living organism and estimate the RQ value of organism. |
| | | | Acquire knowledge on enzymatic activity with aid of digestion process of an organism. |
| | | | Learn the calculation of body mass index and correlate the energy level. |
| | | | Understand the antibody-antigen interaction and involved the determination of blood group. |
| | | | Describe the various immunological technique. |
| | CORE PRACTICAL – VI | GENETICS AND BIOINSTRUMENTATION | Know the preparation of karyotypes of metaphase chromosome of human and identify the disease causing gene by karyotyping. |
| | | | Acquire knowledge on genetic drift or bottle neck principle operating on a small population. |
| | | | Construct the family chart for the sex linked inheritance |
| | | | Estimate proteins, lipids and carbohydrates in the tissue samples, Count viable and dead cells using haemocytometer. |
| | | | Separate aminoacids by paper chromatography and proteins by electrophoresis |
| | ELECTIVE II | 1.ESSENTIALS OF BIOLOGICAL | Know the Types of Research, methods of Research, designing Research – Data |

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| | | RESEARCH | Collection and analysis |
| | | | Different systems of citing References - References without article – Journal abbreviation – Plagiarism and its significance |
| | | | Title – Author and address – Abstract – Summary – Synopsis – Keywords – Review of Literature – Materials & methods – Result – Discussion – Acknowledgement – Appendixes – References |
| | | | Bio safety levels in Lab acquired infections – Safety measures – Additional Hazards – Safety in Genetic Engineering – Safety of Laboratory animals – Biological model system – CPCSEA guidelines for Laboratory Animal Facility |
| | | | Protection of IPR- Patent – Copy right – Trademark – Geographical Indexing – Plant variety and farmers right protection – Trade secret – Copy left - Traditional knowledge – Bio-diversity – Bio-piracy |
| | | 2. APPLIED ENTOMOLOGY | Describe the bee keeping technique and their management. |
| | | | Learn the biology and rearing aspects of silkworm. |
| | | | Learn the economic importance of various insects |
| | | | Construct the package of pests management practices of agricultural crops |
| | | | Learn the biotechnological application of insects. |
| | | 3. BIOFOULING AND BIOREMEDIATION | Understand the stages and factors influencing the process of biofouling in the marine environment. |
| | | | Know the distribution of fouling organisms, impacts and economic loss pertained to biofouling. |
| | | | Learn about the toxicity of antifouling biocide on marine organisms and natural product antifoulants. |
| | | | Acquire knowledge on the sources, composition and toxicity of various pollutants on marine biota. |
| | | | Understand the process of utilizing promising microbes to clean up the environmental pollutants. |
| | | 4. FISH PROCESSING TECHNIQUES | Understand the functional properties of seafood proteins and know the pigments, enzymes, hydrolases, oxidoreductases, collagen and skin characteristics of seafood. |

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| | | | Be familiar with the technological aspects of freezing, processing, packaging - Determination of freezing points from time-temperature plots- preparation of fish for freezing. |
| | | | To know the advantages of canning in relation to other preservation methods and understand the spoilage of canned foods - types, causes and preventive measures-hygiene and sanitation and waste disposal. |
| | | | Understand the Importance of packaging in fish processing, - Properties of packaging materials, Labelling and bar coding - methods of transportation of frozen fish. |
| | | | Know the procedure on fish liver oil extraction, purification, preservation, storage application. Usage of shrimp wastes chitin, chitosan-production and its pharmaceutical importance. |
| Semester IV | | | |
| | CORE PAPER XIII | EVOLUTION | Understand the history and theories of evolution. |
| | | | Study the evolutionary changes of an organism at molecular level. |
| | | | Acquire knowledge on analyzing the evolutionary relationship between the organisms using different phylogenetic methods. |
| | | | Know the method to identify a species through DNA barcoding. |
| | | | Know the genetic variation among organisms and application of artificial intelligence in animal ecology. |
| | | BIostatistics & COMPUTER APPLICATION | Know the variables, sample value and population, types of variable. Understand the graphical representation of data using simple statistics. Analyse the Sampling methods and types of diagrams, graphs, frequency distribution. |
| | | | Know the measures of central tendency and average, objectives and types of average. Understand the types of probability, Sampling distribution, confidence Interval and Levels of significance, and application of Chi square test. |
| | | | Familiar with the awareness of student's t- test, Regression and Correlation, Karl Pearson's coefficient of correlation-Analysis of frequencies t-test, Analysis of variance |

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| | | | Principle of ANOVA and Applications of ANOVA. |
| | | | Perceive the dynamic programming of BLAST, FASTA and Application of BLAST tool in phylogenetic analysis. Be aware of ORIGIN PRO, SPSS and One way ANOVA with SPSS in multible comparison test. |
| | | | Understand the classification and hardware components of computers and application of Industrial and digital information processing. Understand the Database management and statistical software packages also, know the operating library Information System. |
| | ELECTIVE II | COMPUTATIONAL BIOLOGY (E-PATHSALA-2) | Know the various Databases in Biology- Data Format-Data Generation & Associated Organization-Structural Database-Chemical Databases. |
| | | | Shall know the Two sequence alignment:- Sequence Comparison-Multiple Sequence Alignments-Sequence Comparison- and Matrices for Sequence Alignment |
| | | | Database Searching -Text Search and BLAST- the BLAST family of program- Pattern Recognition Methods in Sequence Analysis.- Introduction to Chemoinformatics& Chemical databases-Graph Theory Based Approach to chemicals and functional descriptors- Chemical Descriptors-Relationships between chemical structure and biological activity (QSAR & QSPR) |
| | | | Introduction to Ligand Based design- Ligand based design: pharmacophore generation- pharmacophore based 3D Searching Database,- Three dimensional approaches to Chemical Database Searching- 3D QSAR & Data driven Predictions- Prediction of ADME & Toxicity |
| | | | Prediction of 2D & 3D Structure of Proteins-I: Secondary Structure Prediction-Tertiary structure prediction-High throughput gene annotation/ Genomics/GWAS,Proteomics, Transcriptomics and Metabolomics, metabolic modeling in biology-Metabolic modeling in biology |
| | CORE PRACTICAL – VII | EVOLUTION & BIostatISTICS AND COMPUTER APPLICATIONS | Know the evolutionary history of living system and understand the connecting link between the phyla. |
| | | | Acquire knowledge on the construction of phylogenetic tree to understand the evolutionary history. |

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| | | | Apply the statistical tools in the biological research |
| | | | Understand the variation among the sample by statistical method. |
| | | | Learn the test of significance of variable, goodness of fits, ANOVA, regression and correlation coefficient between the variables. |

**DEPARTMENT OF ANIMAL SCIENCE MANONMANIAM SUNDARANAR
UNIVERSITY, TIRUNELVELI**

M. SC. ZOOLOGY (With effect from the academic year 2019-2021 onwards)

Course Structure under Choice Based Credit System

Programme Objectives

| Programme Objectives | Title of the Programme | |
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| | M.Sc. Zoology | To Impart knowledge on Animal diversity, biosystematics, genetics and Immunology. |
| | | To Enrich knowledge on Environment, Nutrition and Animal interaction |
| | | To Provide knowledge on significance and economic value of animals |

Programme Specific Outcomes

| Title of the programme | |
|-------------------------------|---|
| | Identify the diversity of organisms, differentiate them phylogenetically, morphologically and understand their habit and habitat, evolutionary significance, and their economic importance |
| M.Sc. Zoology | Understand the cellular and molecular mechanisms of organisms, know the microbial interactions and biochemical modifications in various organisms. |
| | Understand the cell differentiation, genetic inheritance, developmental process of an organism, and know the modern techniques viz. rDNA, Tissue engineering and the Artificial Reproductive Technology process. |
| | Learn the basics of the animal physiology, know the immune cells and immune organs, process of innate and acquired defence mechanisms and their role in allergy and organ transplantation. |
| | Design the experiments, know the methods of data collection and execute the experiments with modern instruments and interpret the data with recent statistical tools. |
| | Acquire knowledge on computational biological tools, know the biological database and sequence analysis methods, able to do molecular modelling and pharmacophore generation. |
| | Understand the structure and functional properties of manmade ecosystems, impact of climate change and global warming on living organisms, and conservation of natural resources, able to do EIA analysis. |
| | Acquire skill based aquaculture techniques, value added post harvest storage methods of fishery biology, employable animal husbandry techniques, and entrepreneurial apiculture and sericulture methods. Economic importance of animal species. |

Course outcome

| Sl.No | Nature of Course | Title of the subject/course | Course outcome |
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| 1 | CORE PAPER I | STRUCTURE AND FUNCTION OF INVERTEBRATES | <ul style="list-style-type: none"> ➤ Understand the classification of animal kingdom. ➤ Learn the ecology, ethology and reproductive system of invertebrates. ➤ Know about the coral reefs and sponges and their biological significance. ➤ Understand the medical importance of various classes of invertebrates. ➤ Know the morphological features and reproductive biology of Pseudocoelomates, Eucoelomates and molluscs. ➤ Learn about the adaptive feature of invertebrates. ➤ Understand the origin and evolution of invertebrates. |
| | CORE PAPER II | COMPARATIVE ANATOMY OF CHORDATES | <ul style="list-style-type: none"> ➤ Understand the classification of animal kingdom. ➤ Learn the ecology, ethology and reproductive system of chordates. ➤ Understand the medical importance of various classes of chordates. ➤ Learn about the adaptive feature of chordates. ➤ Understand the origin and evolution of chordates ➤ Appreciate the economic importance of each phylum of chordates. |
| | CORE PAPER III | ENVIRONMENTAL BIOLOGY | <ul style="list-style-type: none"> ➤ Understand the structure and functional properties of natural and manmade ecosystems. ➤ Realize the unique features of marine natural resources ➤ Acquire knowledge on habitat ecology, population ecology and growth. ➤ Know the importance of conservation tools. ➤ Learn laws related to environmental pollution. ➤ Enable to understand the impact of climate change and global warming on living organisms and conservation of natural |

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| | | | resources. |
| | CORE PAPER IV | ANIMAL BIODIVERSITY | <ul style="list-style-type: none"> ➤ Understand the ecosystem, diversity of organisms and their ecological relationship. ➤ Know the genetic relationship of an animals, animal distribution and biological hotspot areas. ➤ Realize the importance of animal classification and taxonomy; species concept and their evolutionary significance. ➤ Inculcate conservation strategies of ecosystem and various enactments relating to conservation policy at national and international status. ➤ Learn the measurement of biodiversity richness, species evenness and geometric analysis. |
| | ELECTIVE PAPER 1 | ANIMAL CELL BIOTECHNOLOGY (E-PATHSALA – 1) | <ul style="list-style-type: none"> ➤ Understand the various cell culture,, organ culture methods, equipments for animal cell culture. ➤ Understand the r DNA methods and Vectors and recombinant selection methods ➤ Know the Concepts of Assisted reproductive Technologies Ethical Issues related to the Animal Cell Culture. |
| | CORE PRACTICAL I | Structure and function of Invertebrates & Comparative Anatomy of Chordates | <ul style="list-style-type: none"> ➤ Understand the energy production, energy flow and energy utilization in the ecosystem. ➤ Acquired Knowledge on the water sample analysis and waste water treatment. ➤ Learnt the sterilization process and preparation of culture media for microbial culture. ➤ Learnt the isolation and purification of |

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| | | | DNA, RNA and chromosome. |
| | Practical II | Environmental Biology & Animal Biodiversity | <ul style="list-style-type: none"> ➤ Analysis the biodiversity of phytoplankton and zooplankton. ➤ Learn the biodiversity indices ➤ Enable to understand the TLC, UV-Spectroscopy, Electrophoresis and Centrifuge. ➤ Learn the physiological process of digestive, nervous and reproductive systems of fish, insects and prawn. ➤ Learn the structure of polytene chromosome. ➤ Learn the mitosis process in onion. |

SEMESTER – II

| Sl.No | Nature of Course | Title of the subject/course | Course outcome |
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| 1 | CORE PAPER V | BIOCHEMISTRY | <ul style="list-style-type: none"> ➤ Know the structure of atoms, bonding nature of molecules, pH and their molecular interactions. ➤ Understand the energy production, metabolism and catabolism of biological molecules, ATP synthesis and energy utilization of organisms. ➤ Learn the biosynthesis pathway, structure and function of proteins. ➤ Know the metabolism and catabolism of protein. ➤ Realize the classification, structure and function of carbohydrate and lipids. ➤ Learn the Glyconeogenesis, Glycolysis and oxidation of lipids and bioenergetics. ➤ Imbibe the knowledge on enzymes |

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| | | | <p>classification, biocatalytes and kinetics of enzymes.</p> <ul style="list-style-type: none"> ➤ Enable to know the structure, function and classification of hormones, ➤ Know the biological mechanism of hormones. |
| 2 | CORE PAPER VI | CELL AND MOLECULAR BIOLOGY | <ul style="list-style-type: none"> ➤ Understand the chemical composition of biomembranes. ➤ Acquire knowledge about function of cytoskeleton. ➤ Enable to know the cell signalling pathways. ➤ Structure and regulation of gene and chromosome. ➤ Understanding the sequencing of proteins and softwares used in sequencing. |
| 3 | CORE PAPER VII | DEVELOPMENTAL BIOLOGY | <ul style="list-style-type: none"> ➤ Understand the structural and functional differentiation of eukaryotes and prokaryotes. ➤ Know the structure and function of various cell organelles. ➤ Acquire knowledge about the structure and function of chromosomes. ➤ Imbibe the knowledge about the cell cycle and related diseases. ➤ Enable to know the chemical and biological nature of DNA. ➤ Understand DNA repairing mechanism and protein synthesis. ➤ Know the construction method and application of rDNA. ➤ Learn the regulation of gene expression in prokaryotes and eukaryotes. ➤ Know the gene rearrangement and reversible protein phosphorylation. |

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| 4 | CORE PAPER VIII | MICROBIOLOGY | <ul style="list-style-type: none"> ➤ Identify standard protocol for the isolation, identification, culturing and characterization of microorganisms ➤ Enable to know the isolation, identification of microbes for commercial application. ➤ Carry out experiments to evaluate microbial quality of food products, water and soil. |
| 5 | CORE PRACTICAL III & IV | BIOCHEMISTRY & CELL AND MOLECULAR BIOLOGY | <ul style="list-style-type: none"> ➤ Enable to understand the TLC, UV-Spectroscopy, Electrophoresis and Centrifuge. ➤ Learn the structure of polytene chromosome. ➤ Learn the mitosis process in onion. |
| 6 | Practical IV | DEVELOPMENTAL BIOLOGY & MICROBIOLOGY | <ul style="list-style-type: none"> ➤ Understand the growth and metamorphosis of an organisms. ➤ Acquire Knowledge on the identification of blood group and blood cells counting. ➤ Understand the function of gene and their hereditary mechanisms <p style="text-align: center;">Microbiology</p> <ul style="list-style-type: none"> ➤ Understand the structural peculiarities and adaptive characteristic of organisms. ➤ Acquire Knowledge on the identification and taxonomy of microbes. ➤ Learn the antibiotic and enzymatic assay of microbes. ➤ Understand the physiological functions of animals (Osmoregulation, excretion and respiration etc.) |

| Sl.No | Nature of Course | Title of the subject/course | Course outcome |
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| 1 | CORE PAPER IX | COMPARATIVE ANIMAL PHYSIOLOGY | <ul style="list-style-type: none"> ➤ Understand the structure and function of muscles. ➤ Know the biological functions, structural arrangement of nervous system. ➤ Enable to know the structure and function of various systems of human body. ➤ Know the biological significance of hormones. ➤ Acquired knowledge on the respiration, circulatory process and BMR. ➤ Learn to maintain the cardiac rhythm and maintain, measure the blood pressure. ➤ Understand the excretory system and eliminate the metabolic byproducts. ➤ Enable to understand the biological clock mechanism of organisms. ➤ Know the mechanism of hormonal action. |
| 2 | CORE PAPER X | IMMUNOLOGY | <ul style="list-style-type: none"> ➤ Understand the function of immune system. ➤ Enable to know the Antigen – Antibody interaction. ➤ Learn the synthesis, transport and mode of action of Immunoglobulins. ➤ Know the Hybridoma technology and their use in cancer treatment. ➤ Realize the principle for vaccine production and vaccination for |

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| | | | <p>various kinds of diseases.</p> <ul style="list-style-type: none"> ➤ Imbibe the knowledge on disease diagnosis and treatment. |
| 3 | CORE PAPER XI | GENETICS | <ul style="list-style-type: none"> ➤ Understand the transmission of hereditary characters in populations. ➤ Know the phenotypic and genotypic expression of gene. ➤ Learn the structure and function of genome of organisms. ➤ Enable to know the mutagenic substance and their biological impacts. ➤ Realize the structural and numerical aberrations of chromosomes. ➤ Understand the concept sex determination pattern of organisms. ➤ Know the gene expression for protein synthesis and post transcriptional modifications of protein products. |
| 4 | Core Paper XII | BIOINSTRUMENTATION | <ul style="list-style-type: none"> ➤ Understand the working mechanism of major and advanced instruments and microscopes. ➤ Know the macro and micromoles separation techniques by using advanced instrumentations (TLC, HPLC, CCMS, LCMS and FPLC) ➤ Learn the electrophoresis technique, PCR amplification, SDS-PAGE, Blotting techniques. ➤ Know to isolate and analyze the DNA and RNA molecules. ➤ Understand the instrumentation and application of spectroscopy. ➤ Enable to know the radio isotope and their medical applications. |
| 5 | CORE PRACTICAL V & VI | PRACTICAL V : COMPARATIVE ANIMAL | <ul style="list-style-type: none"> ➤ Understand the structural peculiarities and adaptive characteristic of organisms. |

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| | | PHYSIOLOGY & IMMUNOLOGY | <ul style="list-style-type: none"> ➤ Acquire Knowledge on the identification and taxonomy of microbes. ➤ Learn the antibiotic and enzymatic assay of microbes. ➤ Understand the physiological functions of animals (Osmoregulation, excretion and respiration etc.) |
| 6 | | IMMUNOLOGY | <ul style="list-style-type: none"> ➤ Understand the growth and metamorphosis of an organisms. ➤ Acquire Knowledge on the identification of blood group and blood cells counting. ➤ Understand the function of gene and their hereditary mechanisms |
| | | PRACTICAL VI : GENETICS & BIOINSTRUMENTATION | <ul style="list-style-type: none"> ➤ Understand the Mendelian inheritance. ➤ Acquire knowledge about Buccal smear to show squamous epithelial cells. salivary glands of Drosophila larvae or Chironomous larvae. ➤ Clear knowledge on Human pedigree construction for a family data. ➤ Understand the hereditary disorders with the aid of chromosome and karyotyping (Klienfelter's syndrome, Turner's syndrome, Down's syndrome) |

Optional Papers

| Sl.No | Nature of Course | Title of the subject/course | Course outcome |
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| 1 | Optional I | AQUACULTURE | <ul style="list-style-type: none"> ➤ Learn the scope and importance of aquaculture at national and international level. ➤ Know the methods for construct the pond and different fish culture systems. ➤ Know the economic importance of fishes. ➤ Understand the hybridization technique and sex reversal process of fishes. ➤ Learn the method for the preparation of artificial fish feed and their storage technique. ➤ Know the preparation and maintenance of live feed culture. ➤ Understand the diseases diagnosis and management of fishes. ➤ Imbibe the post harvest process and marketing of fishes. |
| 2 | Optional II | LZOEB-POULTRY FARMING | <ul style="list-style-type: none"> ➤ Learn the poultry farm management practices ➤ Know the disease diagnosis and prophylactic measures. ➤ Understand the poultry feed preparation and feed management. ➤ Enable to know the post harvest technology and value added poultry products |
| 3 | Optional III | FISHERY BIOLOGY | <ul style="list-style-type: none"> ➤ Understand the life history of fishes, classification, morphometry and taxonomy of fishes. ➤ Know the growth performance of fishes and the spawning season of fishes. ➤ Learn the inland estuarine management strategies. |

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| | | | <ul style="list-style-type: none"> ➤ Enable to address the problems in fish grafting technology ➤ Understand the post harvest process of fish. |
| 4 | Optional IV | ECONOMIC ENTOMOLOGY | <ul style="list-style-type: none"> ➤ Enable to formulate the holistic package for pests and disease management for field crops. ➤ Learn to know beneficial, harmful aspects of insects and their management. |

SEMESTER – IV

| Sl.No | Nature of Course | Title of the subject/course | Course outcome |
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| | CORE PAPER XIII: | EVOLUTION | <ul style="list-style-type: none"> ➤ Understand the Emergence of evolutionary theories ➤ Role of gene in evolution ➤ Knowledge about the molecular phylogeny, Amino acid sequences ➤ Understanding the concept of population genetics |
| | CORE PAPER XIV- | BIostatISTICS AND COMPUTER APPLICATION | <ul style="list-style-type: none"> ➤ Learn the sampling pattern, collection, maintenance and analysis of data. ➤ Enable to construct the experimental design before starting the experiments. ➤ Know the needs and handling of statistical package with the aid of computer. ➤ Acquire the knowledge on computer operations and database management by using statistical software packages. |

ELECTIVE PAPER

| Sl.No | Nature of Course | Title of the subject/course | Course outcome |
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| 1 | ELECTIVE PAPER III | COMPUTATIONAL BIOLOGY (E-PATHSALA -2) | <ul style="list-style-type: none"> ➤ Understand the various biological and chemical databases. ➤ Learn the sequence analysis and multiple sequence alignment. ➤ Know about the Pharmacophore generation and Molecular Modelling. |

Practical

| Sl.No | Nature of Course | Title of the subject/course | Course outcome |
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| 1 | CORE PRACTICAL VII | EVOLUTION & BIOSTATISTICS AND COMPUTER APPLICATION | <ul style="list-style-type: none"> ➤ Understand the structural peculiarities and adaptive characteristic of organisms. ➤ Acquire Knowledge on the identification and taxonomy of microbes. ➤ Learn the antibiotic and enzymatic assay of microbes. ➤ Understand the physiological functions of animals (Osmoregulation, excretion and respiration etc.) |