

COURSE OBJECTIVE:-

- The primary objective of the program is to impart quality education in the subject of Zoology as a basic science and its applied branches to the students . The Department is having the following objectives:
- To provide quality education in a branch of Biological sciences i.e Zoology with different specializations.
- To facilitate Higher education & research in zoology.
- To provide quality education offering skill based programs and motivate the students for self employment in applied branches of Zoology.
- To inculcate the spirit of resource conservation and love for nature
- To conduct field studies and different projects of local and global interests.
- To provides opportunities for professional and personal development through curricular and co-curricular activities.
- Provide consultancy and organize extension activities.

Programme Outcomes (M.Sc. Zoology)

- The programme also works across related majors within the M.Sc zoology
- Distinguish between the Structure, Function, Behaviour and evolution of different animals
- For instance if you major in zoology, you can also still take courses from across the other complementary.
- Master of Science majors of conservation biology and ecology, giving you an in-depth knowledge of those most closely related programmes
- Apply the wide range of subject based skills to various fields that provide a base for future career in disciplines such as Health Sciences, Agriculture, Environmental Management, Biotechnology , Publishing ,Teaching and Research
- Perform, Assess and implement practical techniques and procedure to solve biological problems and analyse and quantify data collected during any project.
- Understand the applications of Biological techniques to various fields of biology.
- When you graduate with a Master of Science (Zoology) you will have learned how to work at a high level of academic achievement.
- Work to deadlines under pressure and communicate effectively.

Program Specific Outcomes (M.Sc. Zoology)

- Understand Nature, environment natural resources and their conservation, Classification & Behaviour of different animals, Human genetics, Cytology and Evolution.
- Apply the wide range of subject based skills to various fields that provide a base for future career in disciplines such as Health Sciences, Agriculture, Environmental Management, Biotechnology, Publishing ,Teaching and Research.
- Distinguish between the Structure, Function, Behaviour and evolution of different animals.
- Perform, Assess and implement practical techniques and procedure to solve biological problems and analyse and quantify data collected during any project.
- Understand the applications of Biological techniques to various fields of biology

Biosystematics, Taxonomy and Evolution

COURSE OBJECTIVE:-

This paper is aimed to introducing the students for the salient features of Taxonomy and Evolution.

Syllabus:

- UNIT – I** Definition and basic concepts of biosystematics taxonomy and classification,. History of Classification, Trends in biosystematics: Chemotaxonomy cytotaxonomy and molecular taxonomy, Dimensions of speciation and taxonomic characters. Species concepts: species category, different species concepts, subspecies and other infra-specific categories. Theories of biological classification: hierarchy of categories.
- UNIT – II** Taxonomic Character- Different kinds. Origin of reproductive isolation, biological mechanism of genetic incompatibility. Taxonomic procedures: Taxonomic collections , preservation curation, process of identification. Taxonomic keys, different types of keys, their merits and demerits.International code of Zoological Nomenclature (ICZN): Operative principles, interpretation and application of important rules: Formation of Scientific names of various Taxa.
- UNIT – III** Taxonomic categories. Evaluation of biodiversity indices. Evaluation of Shannon . Weiner Index. Evaluation of Dominance Index.Similarity and Dissimilarity Index.
- UNIT – IV** Concepts of evolution and theories of organic evolution. Neo Darwinism and population genetics: A- Hardy-Weinberg law of genetic equilibrium. B. A detailed account of destabilizing forces: i- Natural selection, ii- Mutation iii- Genetic Drift iv- Migration v- Meiotic Drive. Trends in Evolution Molecular Evolution a) Gene evolution b) Evolution of gene families c) Assessment of molecular variation
- UNIT – V** Origin of higher categories Phylogenetic gradualism and punctuated equilibrium. Major trends in the origin of higher categories.Micro and macro evolution. Molecular population genetics Pattern of changes in nucleotide and amino acid sequence. Ecological significance of molecular variations (genetic polymorphism) Genetic & Speciation Phylogenetic and biological concept of species.Patterns and mechanism of reproductive isolation.Modes of speciation (allopatry&sympatry) Origin and Evolution & Economically important microbes and animals.

COURSE OUTCOMES :

- 1 Classify animals on the basis of their relation to other animals by body structure,external characters, development and DNA
- 2 Apply the International rules of Nomenclature to give a scientific name to animals which are found during research..
- 3 Understand the gradual development and evolutionary history of different kinds of living organisms from earlier forms over several generations
- 4 Understand and demonstrate the internal anatomy of various animals,biodiversity and related indices

Structure & Function of Invertebrates

COURSE OBJECTIVE:-

This paper is aimed to introducing the students for structure & function of Invertebrate.

Syllabus:

- UNIT – I** Origin of metazoa Organization of Coelom – Acoelomates, Pseudo coelomates, Coelomates. Locomotion- Amoeboid, Flageller and Ciliary movement in protozoa, Hydrostatic movements in Coelenterata, Annelida and Echinodermata
- UNIT – II** Nutrition and Digestion, Patterns of Feeding and digestion in lower metazoa, Mollusca, Echinodermata, Filter feeding in polychaeta. Respiration- Organs of respiration : Gills, lungs and trachea, Respiratory pigments. Mechanism of respiration.
- UNIT – III** Excretion in lower invertebrates. Excretion in higher invertebrates.Mechanism of Osmoregulation.
- UNIT – IV** Nervous Systema. Primitive Nervous systems:-Coelentrata and Echinodermata.b.Advanced nervoussystem :- Annelida, Arthropoda(Crustacea and Insecta) and Mollusca (Cephalopoda)
- UNIT – V**
1. Invertebrate larval forms and their evolutionary significance
 - a. Trematoda and Cestoda
 - b. Larval forms of Crustacea
 - c. Larval forms of Mollusca
 - d. Larval forms of Echinodermata.
 2. Structure affinities and life history of the following minor Phyla
 - a. Rotifera
 - b. Entoprocta
 - c. Phoronida
 - d. Ectoprocta

COURSE OUTCOMES:-

- 1 Understand the structure and organization of invertebrate animals.
- 2 Explain modifications in various functions of animals during transition from invertebrates to vertebrates.
- 3 Discuss the evolutionary significance of larval forms of invertebrates.
- 4 Identify invertebrates and homology, analogy and modifications of mouthparts in relation to feeding habits.

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Quantitative Biology, Biodiversity and Wildlife

COURSE OBJECTIVE:-

This paper is aimed to Quantitative Biology, Biodiversity and Wildlife

Syllabus:

- UNIT – I** Quantitative biology, Distribution of the data in biology- mean, mode and median, Measures of dispersion : range, mean deviation, IQD , standard deviation and coefficient of variation, Chi square test, Normal distribution, Experimental designing and sample theory
- UNIT – II** Probability distribution, properties and probability theory, Completely randomized design and randomized block design, Analysis of variance, Co-relation- types of correlation, Karl Pearson, coefficient correlation, Regression
- UNIT – III** Biodiversity - concept and principal of biodiversity, causes for the loss of biodiversity. Biodiversity conservation methods , Medicinal uses of forest plant
- UNIT – IV** Wildlife of India, types of wildlife - Values of wildlife, positive and negative, Wildlife protection Act, Conservation of wildlife in India, Endangered and threatened species
- UNIT – V** Wildlife and conservation - National Parks and Sanctuaries, Project Tiger, Project GirLion and Crocodile breeding project, Wildlife in M.P. with references to Reptiles Birds and mammals, Biospheres reserves.

COURSE OUTCOMES:-

1. To understand quantitative approaches and technologies involved in research.
2. To identify diversity of fauna on earth and implement conservation measures to save diversity
3. To understand importance of wildlife and conservation measures, National parks and Sanctuaries.
4. Analyse biological data mathematically and statistically

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Bimolecular and Structural Biology

COURSE OBJECTIVE:-

This paper is aimed to introduce molecular biology viz Amino acid, DNA, RNA and Enzyme.

Syllabus:

- UNIT – I** Chemical Foundation of biology - pH, pK, acids bases, buffers, weak bonds. Free energy, resonance, isomerisation. Acid soluble pool of living tissues, amino acids, monosaccharides, oligosaccharides, nucleotides, peptides. Nanoparticles Biomaterials
- UNIT - II** Primary, Secondary, tertiary and quaternary structures of proteins, protein folding and denaturation; DNA & RNA: Double helical structure of DNA, Structure of RNA, role of RNA in gene expression; DNA replication, recombination and repair; Functional importance of lipid storage and membrane lipids Membrane channels and pumps
- UNIT – III** Basic concepts of metabolism: Coupled and interconnecting reactions of metabolism cellular energy recourses and ATP synthesis; Glycolysis and Gluconeogenesis; Citric acid cycle; Oxidative phosphorylation: Protein and its regulation; Fatty acid metabolism: Synthesis and degradation of fatty acids
- UNIT – IV** RNA synthesis and splicing; Biosynthesis of amino acids; Biosynthesis of nucleotides; Biosynthesis of membrane lipids and steroids; Protein synthesis
- UNIT – V** Enzymes: Terminologies, classification and basics of enzyme kinetics; Mechanism of enzyme catalysis; Regulation of enzyme reaction; Concept of free energy and thermodynamic principals in biology; Energy rich bonds, compound and biological energy transducers.

COURSE OUTCOMES:-

- 1 To explain Biomaterial, Nanoparticles and their importance.
- 2 To understand biological reactions, structure of protein, carbohydrates fats, nucleic acids and their metabolism.
- 3 To develop a knowledge of enzymes and mechanism of their action in various biological reactions.
- 4 To understand the process of gene expression & protein synthesis.

PRACTICAL:- (Paper I & II) Lab-I

- [1] Study of Invertebrate museum specimen & study of their taxonomic character.
- [2] Study of Invertebrate slide & identify their structure.
- [3] Identify the nervous system of different invertebrates: (a) Pila (b) Sepia (c) Praw (d) Earthworm.
- [4] Determination of O₂ Consumption in insect (Respiration)
- [5] Limnological study of pond water.
- [6] Study the larval forms of crustacean.
- [7] Study of polytene chromosomes in chironomid larva & drosophila larva.
- [8] Aristotle lantern in echinus
- [9] Histological study by microtomy.
- [10] Genetic experiment by checker board (Mendel's law).

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PRACTICAL:- (Paper III & IV) Lab-II

- [1] Calculate the standard deviation in given gastropods shells.
- [2] Determination of P_H value in different solution.
- [3] Preparation of buffers
- [4] Qualitative test for carbohydrate, protein, lipid.
- [5] Separation of amino acid & sugar using paper chromatography.
- [6] Experiment on determination of dissolved oxygen in water.
- [7] To determine the turbidity of given water sample.
- [8] To determine dissolved solids of a given water sample.
- [9] To determine biological oxygen demand (BOD) of given sample of water.
- [10] Study of phytoplankton and zooplanktons in pond ecosystem.

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General and Comparative Animal Physiology and Endocrinology

COURSE OBJECTIVE:-

This paper is aimed to introducing the students for comparative Animal Physiology & Endocrinology

Syllabus:

- UNIT – I** Respiratory pigments through different phylogenetic groups; Transport of oxygen and carbon dioxide in blood and body fluids; Regulation of respiration; Physiology of impulse transmission through nerves and synapses; Autonomic nervous system, neurotransmitters and their physiological functions
- UNIT – II** Patterns of nitrogen excretion in different animal groups; Comparative physiology of digestion; Osmoregulation in different animal groups; Thermoregulation in homeotherms, poikilotherms and hibernation; Physiology of pregnancy, placental hormones, pregnancy diagnosis tests, parturition and breast and lactation
- UNIT – III** Comparative study of mechanoreception; Comparative study of photoreception; Comparative study of phonoreception; Comparative study of chemoreception; Comparative study of equilibrium reception.
- UNIT – IV** Bioluminescence as means of communication among animals; Pheromones and other similar chemicals as means of communication among animals; Chromatophores and regulation of their function among animals; Hormones, their classification and chemical nature; Mechanisms of hormone action
- UNIT – V** Phylogeny of endocrine glands (pituitary, pancreas, adrenal, thyroid); Ontogeny of endocrine glands; Neuroendocrine system; Hormone receptors. signal transduction mechanisms; Hormones and reproduction - a. Seasonal breeders, b. Continuous breeders.

COURSE OUTCOMES:-

- 1 Understand all physiological processes of vertebrates & analyse them biochemically
- 2 Correlate the comparative physiology of the systems and understand their regulation & control
- 3 Compare the structure, functions and regulation of the receptor organs of vertebrates
- 4 Understand the structure, function and regulation of endocrine & neuroendocrine glands,

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Population Ecology and Environmental Physiology

COURSE OBJECTIVE:-

This paper is aimed to introducing the students for Population Ecology & Environmental Physiology

Syllabus:

- UNIT – I** Populations and their characters; Demography: Life tables, generation time, reproductive value. Population growth: Growth of organisms with non-overlapping generations, stochastic and time lag models of population growth, stable age distribution. Population regulation: Extrinsic and intrinsic mechanisms.
- UNIT – II** Adaptations: Levels of adaptations, significance of body size. Aquatic environments: Fresh water, marine, shores and estuarine environments. Eco-physiological adaptations to fresh water environments. Eco-physiological adaptations to marine environments; Ecophysiological adaptations to terrestrial environments.
- UNIT – III** Environmental limiting factors; Inter and intra-specific relationship; Predatory- prey relationship, predator dynamics, optimal foraging theory (patch choice, diet choice, prey selectivity, foraging time); Mutualism, evolution of plant pollinator interaction.
- UNIT – IV** Environmental pollution and human health. Conservation management of natural resources; Environmental impact assessment. Sustainable development.
- UNIT – V** Concept of homeostasis; Endothermic and physiological mechanism of regulation of the body temperature; Physiological response to oxygen deficient stress; Physiological response to body exercise; Meditation, yoga and their effects.

COURSE OUTCOMES:-

1. Understand population and its characters and regulation.
2. Correlate physiological adaptations to environment and pollution, control measures for environmental degradation as well as risk factors to human health.
3. Understand limiting factors, predator-prey relationships and physiological responses of the body to environment.
4. Demonstrate the methods of relaxation of Stress and body by Yoga, Meditation, Asana & Pranayam

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Tools and Techniques In Biology

COURSE OBJECTIVE:-

This paper is aimed to Tools & techniques in Biology.

Syllabus:

- UNIT – I** Microscopy, principle & applications - Light microscope and phase contrast microscope, Fluorescence microscope, Electron microscope; Confocal microscopy. General Principle and applications of – Colorimeter, Spectrophotometer, Ultra centrifuge, Flame photometer, Beer and Lambert’s law. Microbiological technique- Media Preparation and sterilization, Inoculation and growth monitoring. Microbial assays. Microbial identification (cytological staining methods for bacterial and fungal strains) Use of fermentors.
- UNIT – II** Computer aided techniques for data presentation data analysis, statistical techniques. Cryotechniques - Cryopreservation of cells, tissues, organs and organism, Cryosurgery, Cryotomy, Freeze fracture and freeze drying; Separation techniques- Chromatography, principle type and applicants. Electrophoresis, Principles, types and applications PAGE and agarose gel electrophoresis. Organelle separation by centrifugation.
- UNIT – III** Radioisotope and main isotope techniques in biology- a. Sample preparation for radioactive counting, b. Autoradiography. Immunological techniques- Immunodiffusion (Single & Double), Immunoelectrophoresis. Techniques- immune detection, Immunocyto / histochemistry Immunoblotting, immunodetection, immunofluorescence. Surgical techniques- Organ ablation (eg. Ovariectomy, adrenalectomy), Perfusion techniques, Stereotaxy Indwelling catheters Biosensors.
- UNIT – IV** Histological techniques- Principles of tissue fixation, Microtomy, Staining, Mounting Histochemistry Cell culture techniques- Design and functioning of tissue culture laboratory, Culture media, essential components and Preparation Cell viability testing.
- UNIT – V** Cytological techniques- Mitotic and meiotic chromosome preparations from insects and vertebrates- Chromosome banding techniques (G.C.Q. R. banding), Flowcytometry. Molecular cytological techniques- In site hybridization (radio labelled and non-radio labelled methods) FISH, Restriction banding, Molecular biology techniques - Southern hybridization, Northern hybridization, DNA Sequencing, Polymerase chain reaction (PCR).

COURSE OUTCOMES:-

1. Explain Microscopy, Colorimetry, Chromatography principle, process, applications and working of related instruments.
2. Demonstrate Microbiological, Cytological, Histological, Molecular biological techniques.
3. Apply and demonstrate Immunological Surgical Immunodetection and Cell culture techniques.
4. Understand Cryopreservation, Radioisotope and Isotope techniques and applications of all the techniques in biology.

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Molecular Cell Biology and Genetics

COURSE OBJECTIVE:-

This paper is aimed to introduce molecular cell Biology viz Amino acid, DNA, RNA, protein and Enzyme

Syllabus:

- UNIT – I** Biomembrane- Molecular composition arrangement and functional consequences, Transport across cell membrane diffusion active transport, pumps uniports, symports and antiports, Micro filaments and microtubules structure and dynamics, Cell movements intracellular transport, role of kinesin and dynein
- UNIT – II** Cell Cell signaling- Cell surface receptors, Second messenger system, Signaling from plasma membrane to nucleus, Gap junctions and connexin, Integrins
- UNIT – III** Cell. Cell adhesion and communication - Ca⁺⁺ dependant homophilic cell. Cell adhesion, Ca⁺⁺ independant homophilic cell. cell adhesion, Gap junctions and connexin, Genome organization, hierarchy in organization, Chromosomal organization of genes and non-coding DNA.
- UNIT – IV** Sex determination - Sex determination in Drosophila, Sex determination in mammals, Basic concept of dosage compensation, Cytogenetic of human chromosomes, Human genome project (HGP) purpose 2 implicate
- UNIT – V** Genetic Diseases and Genomics - Human gene therapy, Prenatal diagnosis & genetic counseling, Genetic screening, Structural Genomics, Functional Genomics, Gene libraries, Transgenic animals & their applications.

COURSE OUTCOMES:-

- Explain Biomembranes and the processes of Cell-cell signalling and cell-cell adhesion.
- Understand the process of Sex determination and details of Human chromosomes & Human chromosome project.
- Understand gene libraries, Transgenic and Knockout animals.
- Understand various genetic processes and their applications to biological systems

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PRACTICAL:

Laboratory -I

Determination of blood group of own blood.

- [1] WBC counting of given blood sample.
- [2] RBC counting of given blood sample.
- [3] Study of grassland ecosystem (Ecology).
- [4] Ecological adaptation in different animal.
- [5] Study the fresh water ecosystem.

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Laboratory -II

Separation of bimolecular by centrifugation.

- [1] Determine the gram negative bacteria & gram positive bacteria.
- [2] Colorimeter estimation.
- [3] Study of microscopy (Light & electron)
- [4] Separation of amino acid & sugar using paper chromatography.
- [5] Electrophoresis.
- [6] Beer and lambert's law
- [7] Microtomy
- [8] Polymarase chain reaction (PCR)
- [9] Phase contrast microscope.

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Comparative Anatomy of Vertebrates

COURSE OBJECTIVE:-

This paper is aimed to introducing the students for the salient features of Comparative anatomy of all Vertebrates.

Syllabus:

- UNIT - I** Origin of Chordata: Concept of Protochordata Development, structure and functions of integument and its derivatives (glands, scales, feathers and hairs), Respiratory system: Characters of respiratory tissue, external and internal respiration. Comparative account of respiratory organs. Comparative account of Digestive System.
- UNIT – II** Evolution of heart, Evolution of aortic arches and portal systems. Blood circulation in various vertebrates groups. Comparative account of jaw suspensorium and vertebral column.
- UNIT – III** Evolution of urinogenital system in vertebrates. Comparative account of organs of olfactory and taste. Comparative anatomy of brain and spinal cord (CNS). Comparative account of peripheral and autonomous nervous system.
- UNIT – IV** Comparative account of lateral line system. Comparative account of electroreception. Flight adaptations in vertebrates. Aquatic adaptations in birds and mammals.
- UNIT – V** Origin, evolution general organization and affinities of Ostracoderms. General organization, specialized, generalized and degenerated characters of Cyclostomes. Origin, evolution general organization of early Gnathostomes. General account of Elasmobranchi, Holocephali, Dipnoi and Crossoptergii.

COURSE OUTCOMES:-

- Knowledge of Origin, Evolution and general organisation of Chordates.
- Knowledge of Evolution of heart , lungs and urino-genital organs of vertebrates
- Knowledge of comparative anatomy of all systems of vertebrates.
- Knowledge of flight and aquatic adaptations in birds and mammals.

Limnology

COURSE OBJECTIVE:-

This paper is aimed to introducing the students for morphometric analysis and Zonation

Syllabus:

- UNIT – I** Limnology – Definition, historical development and scope of Limnology. Types of freshwater habitats and their ecosystem - (a) Ponds, Streams and rivers. (b) Lakes – Origin and classification. Morphometry – Use of various morphometric parameters and Zonation.
- UNIT – II** Physico – Chemical Characteristics- Light and Temperature- (a) Light as an ecological parameter in freshwater. (b) Temperature- Radiation, Stratification and Heat Budget, Dissolved Solids – Carbonate, Bicarbonates, Phosphate and Nitrate. Physico – Chemical characteristics of freshwater with special reference to different parameters-Turbidity, dissolved gases (Oxygen, Carbon dioxide, Hydrogen Sulphide), Seasonal changes in dissolved gases and pH.
- UNIT – III** Study of Biota- (a) Phytoplankton, Zooplankton and their inter-relationship. (b) Aquatic insects, birds and their environmental significance. Ecological classification of aquatic fauna higher aquatic plants and their significance.
- UNIT – IV** Methods of water quality testing BOD and COD, Sewage – Definition, composition and its treatment. Bioindicators- Aquatic flora and fauna in relation to water quality in an aquatic environment
- UNIT – V** Causes of pollution of Aquatic Resources, their management and conservation. Resource Conservation – Aquatic pollution, control, legislation, regulation on discharge of industrial effluents and domestic wastes in rivers and reservoirs. Use and misuse of inland water

COURSE OUTCOME:-

- Knowledge of morphometry, physico-chemical and biological characteristics of fresh water bodies.
- An understanding of the significance of aquatic flora, fauna, insects, birds and macrophytes in water bodies.
- Knowledge of pollution of rivers, causes and control measures.
- Knowledge of legislation and regulation on discharge of industrial effluents and domestic wastes in rivers and reservoirs.

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**Discipline Specific Elective-I
Ecotoxicology**

COURSE OBJECTIVE:-

This paper is aimed to awareness of Toxicant, heavy metal toxicity and environmental pollution and ecological impact assessment

Syllabus:

- UNIT – I** General principles of Environmental Biology with emphasis on ecosystems. Abiotic and biotic factors of ecosystems. Communities of the environment, their structure & significance. Energy flow in environment: Ecological energetic.
- UNIT – II** Productivity, Production and analysis. Recycling and reuse technologies for solid and liquid wastes and their role in environmental conservation. Remote sensing –basic concepts and applications of remote sensing techniques in environmental conservation. Environmental indicators and their role in environmental balance.
- UNIT – III** Kinds of environmental pollution and their control method. Radioactive compounds and their impact on the environment. Vehicular exhaust pollution causes and remedies. Noise pollution.
- UNIT – IV** Toxicology- Basic concepts, Principles and various types of toxicological agents. Toxicity testing principles, hazards, risks and their control methods. Food toxicants and their control methods. Public Health Hazards due to environmental disasters.
- UNIT – V** Pesticides, types, nature and their effects on environment. Important heavy metals and their role in environment. Agrochemical use and misuse, alternatives. Occupational Health Hazards and their Control.

COURSE OUTCOMES:-

- To develop an understanding of environmental biology, productivity and pollution.
- To develop knowledge of Toxicity of foods, pesticides and agrochemicals among younger.
- To know public health hazards due to natural disasters and occupation..
- To know the process of recycling and reuse technologies of solid and liquid waste.

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**Discipline Specific Elective-I
Animal Behavior and Neurophysiology**

COURSE OBJECTIVE:-

From this paper introduced about the animal behavior and its neurophysiology.

Syllabus:

UNIT – I

1. Introduction:
 - Ethology as a branch of biology.
 - Animal psychology, classification of behavioral patterns, analysis of behavior (ethogram)
2. Reflexes and complex behavior.
3. Perception of the environment: mechanical, electrical, chemical, olfactory, auditory and visual.
4. Evolution and ultimate causation: Inheritance behavior and relationships.

UNIT - II

1. Neural and hormonal control of behavior.
2. Genetic and environmental components in the development of behavior.
3. Motivation: Drive, timing and interaction of drives, physiological basis of motivation, hormones and motivation, aggregation.
4. Communication: Chemical, visual, light and audio, evolution of language (primates).

UNIT - III

1. Ecological aspects of behavior: Habitat selection, food selection, optimal foraging theory, anti-predator defenses, aggression, homing territoriality, dispersal, host parasite relations.
2. Biological rhythms: Circadian and circannual rhythms, orientation and navigation, migration of fishes, turtles and birds.
3. Learning and memory: Conditioning, habituation, insight learning, association learning and reasoning.

UNIT - IV

1. Reproductive behavior. Evolution of sex and reproductive strategies, mating systems, courtship, sexual selection, parental care.
2. Social behavior. aggregations, schooling in fishes, flocking in birds, herding in mammals, group selection, kin selection, altruism, reciprocal altruism, inclusive fitness, social organization in insects and primates.

UNIT - V

1. Thermoregulation: Homoeothermic animals, poikilotherms & Hibernation.
2. Receptor physiology a comparative study - Mechano receptor Photo receptor Phono receptor
3. Chemo receptor Equilibrium receptor Bioluminescence

COURSE OUTCOME:-

- Understand neurophysiology of perception memory, domestic animal and human behaviour.
- Analyse processes at different levels and neurophysiology of sensory processing of animal behaviour.
- Classify behavioral patterns, communication, learning and memory.

Discipline Specific Elective-I Animal Experimentation Ethics & Testing

COURSE OBJECTIVE:-

M.Sc.student are exposed to a variety of advanced methods and principles which they could employ in research.

Syllabus:

UNIT - I Animal Experimentation Ethics CPCSEA guidelines , Institutional Animal Ethical Committee (IAEC) , Institutional Bio-Safety Committee (IBSC) , Experimentation on Animals *in vivo* & *in vitro*, Animal Handling and Animal ethics .

UNIT – II Animal House Building and location of animal house, Maintenance of animals, Experimental Area, Environment, Animal Husbandry, Sanitation & Cleanliness, Record keeping, Safety and biohazards

UNIT – III Animal Testing Toxicity testing and heavy metal toxicity in animal model , Pharmacological testing in animal model , Hematological and Biochemical Analysis , Histopathological Analysis, Receptor mechanism , Types of cell culture , Animal cell culture & Applications of cell culture , Aseptic technique and Preparation of media , Insect cell culture , Animal Behavior and Physiology , Cognition.

UNIT - IV Microscopy and Image Analysis Techniques Bright field; Fluorescence; Confocal , Phase contrast microscope , Electron Microscope , Image Acquisition and Analysis Microscopy and Image analysis.

UNIT - V Analytical Techniques and Instrumentation Colorimetry, Spectrophotometry , Centrifugation Chromatography, HPLC , Electrophoresis, Atomic absorption , Immunological Techniques , Radio-immunoassay (RIA) & IRMA.

COURSE OUTCOMES :-

The goal is to impart Student the knowledge and skills which are contemporary and useful to them. The student will write the standard operating protocols (SOPs) and identify requirement for equipment and reagents.

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Discipline Specific Elective-II
Aquaculture

COURSE OBJECTIVE:-

This paper is aimed to introduce Prawn, Fish, Frog, Pearl Culture, Apiculture, Lac –Culture and Sericulture.

Syllabus:

- UNIT – I** Aquaculture: history, definition, scope & importance. Fishery resources of India in general & Madhya Pradesh in particular. A biotic & biotic factors of water necessary for fish life. Ecological characteristics of lakes & rivers. General ecological characteristics of reservoirs of India.
- UNIT – II** Fish culture :- Mono, Poly, mixed and composite Fish culture. Fresh water prawn culture and its prospects in India. Culture of Mussels, clams, oysters & pearl culture. Sewage fed fish culture, paddy cum fish culture.
- UNIT – III** Fish breeding in natural conditions, bundh breeding, hypophysation & stripping. Transport of live fish & seed. Different types of crafts & gears used for fish catching. Plankton- its definition, culture & identification. Common weeds of fish ponds and methods of their eradication.
- UNIT – IV** Fresh water fish farm engineering: selection of site, construction of fish farm & soil chemistry. Designing, layout & construction of different types of fish ponds. Setting and management of fresh water aquarium. Preservation & processing of fish. By products of fish Industry & their utility.
- UNIT-V** Water pollution, its effects on fisheries and methods of its abatement. Common fish diseases & their control. Biochemical composition and nutritional value of fish. Fisheries economics and Marketing. Fisheries managements and extension.

COURSE OUTCOMES:-

- Develop a knowledge of farming of aquatic organisms for increasing food production and animals beneficial to human.
- Observe culture techniques, farm management and hatchery operations.
- Analyse harvesting and marketing strategies.
- Understand the technique of fish preservation and Water quality monitoring techniques.

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Discipline Specific Elective-II

Gamete Biology Development and Differentiation in Vertebrates

COURSE OBJECTIVE:-

In this paper the student introduced about the morphology of sperm and ovum or its chemical composition etc

Syllabus:

UNIT – I

1. Comparative account of differentiation of gonads in mammals.
2. Spermatogenesis : Morphological basis in rodents. Gamete specific gene expression and genomics
3. Biochemistry of Semen : Semen composition and formation, assessment of sperm function.
4. Fertilization: Prefertilization events Biochemistry of fertilization post fertilization events.

UNIT – II

1. Ovarian follicular growth and differentiation: morphology, endocrinology, molecular biology oogenesis and vitellogenesis, ovulation and ovum transport in mammals
2. Biology of sex determination and sex differentiation a comparative account.
3. Multiple ovulation and embryo transfer technology : in vitro oocyte maturation, super ovulation.

UNIT – III

1. Hormonal regulation of ovulation, pregnancy and parturition.
2. Hormonal regulation of development of mammary gland and lactation.
3. Endocrinology and Physiology of placenta.
4. Cryopreservation of gametes and Embryo.
5. Teratological effects of xenobiotics on gametes.

UNIT – IV

1. Cell commitment and differentiation.
2. Germ cell determinants and germ cell migration.
3. Development of gonads.
4. Melanogenesis.

UNIT – V

1. Creating new cell types, the basic evolutionary mystery.
2. Cell diversification in early Amphibian embryo, totipotency and pluripotency.
3. Embryonic stem cells, renewal by stem cells, epidermis.
4. Connective tissue cell family
5. Haemopoietic stem cells : Blood cells formation, stem cell disorders.

COURSE OUTCOMES:-

- Understand reproductive physiology and development in mammals
- Develop a deep knowledge of the role of endocrine secretion in regulation of reproductive cycle
- Understand the process of differentiation of eggs and sperms before fertilization.
- Develop a knowledge of cryopreservation technique and stem cell disorders.

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Discipline Specific Elective-II

Ipr and Glp

COURSE OBJECTIVE:-

M.Sc.student are exposed to a variety of advanced methods and principles which they could employ in research.

Syllabus:

- UNIT - I** Intellectual Property Right (IPR) Legislative initiatives, Patents Act, Designs Act Trademark Act, Geographical indications of Goods.
- UNIT – II** International Cooperation for improving IP administration WIPO ,EU-India Technology and investment development Programme , Indian Registered Geographical Indications.
- UNIT - III** Good Laboratory Practice Basic concept of GLP, Standard operational procedure (SOP), Working in Laboratory, Sterilization technique , Various routes of injections and sample collection , Safety and biohazards, Record Keeping.
- UNIT - IV** Analytical Techniques and Instrumentation Immunological Techniques , Radio-immunoassay (RIA) & IRMA, Colorimetry, Spectrophotometry , Centrifugation Chromatography, HPLC , Electrophoresis, Atomic absorption .
- UNIT - V** Laboratory Design Toxicology, Pharmacology, Immunology, Zoology, Botany ,Microbiology ,Biotechnology, Animal cell culture and Plant cell culture.

COURSE OUTCOMES:-

The goal is to impart student the knowledge and skills which are contemporary and useful to them. The student will write the standard operating protocols (SOPs) and identify requirement

PRACTICAL for equipment and reagents.

Laboratory -II

- 1.Animal House : Building and location of animal house, Maintenance of animals.
- 2 Experimental Area, Record keeping, Safety and biohazards.
- 3.Animal Testing: Toxicity testing and heavy metal toxicity in animal model.
4. Pharmacological testing in animal model .
- 5.Haematological and Biochemical Analysis
6. Histopathological Analysis,

IPR and GLP

- 1.Good Laboratory Practice: Basic concept of GLP
2. Standard operational procedure (SOP), Safety and biohazards, Record Keeping.
- 3.Working in Laboratory, Sterilization technique , Various routes of injections and sample collection .
- 4 Laboratory Design :Toxicology, Pharmacology, Immunology, Zoology, Botany ,Microbiology, Biotechnology.
- 5.Animal cell culture Laboratory

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PRACTICAL:-

Laboratory –I

- [1] Study of different vertebrate museum specimen.
- [2] Study of different vertebrate slide.
- [3] Study of different scales in fishes.
- [4] Prepare a permanent slide of placoid scale.
- [5] Study of different cranial nerves in elasmobranch fishes.
- [6] Electric organ in torpedo.
- [7] Study of abiotic and biotic factor of grassland (in UTD Campus)
- [8] Study of lateral line in elasmobranch fish.
- [9] Study of histological slide (Prepare by microtomy)
- [10] Productivity in grassland ecosystem.

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PRACTICAL:-

Laboratory -II

- [1] Identification of different teleost fishes.
- [2] Internal ear in elasmobranch fishes.
- [3] Afferent & efferent branchial arteries (Aortic arches)
- [4] Morphometric study of different teleost fishes (fin formula fin ray)
- [5] Cranial nerves in teleost fishes.
- [6] Study of phytoplankton & zooplankton in fresh water ecosystem.
- [7] Study of aquarium.
- [8] Identify the common fish disease.
- [9] Common weeds of fish pond & method of their eradication.
- [10] Paedology of fresh water pond necessary for fish life.

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Discipline Specific Elective-III

Fish Structure and Function

COURSE OBJECTIVE:-

This paper are introduced about origin and evolution of fish ., Fish structure And Function

Syllabus:

UNIT – I

1. Origin and evolution of fishes
2. Classification of fishes as proposed by Berg
3. Fish integument
4. Locomotion

UNIT – II

1. Alimentary canal and digestion
2. Accessary respiratory organs
3. Air bladder and its functions
4. Weberian ossicles their homologies and functions

UNIT – III

1. Excretion and osmoregulation
2. Acoustico-lateral line system
3. Luminous organs
4. Colouration in fishes

UNIT- IV

1. Sound producing organs
2. Deep sea adaptations
3. Hill stream adaptations
4. migration in fishes

UNIT – V

1. Sexual cycle and fecundity
2. parental care in fishes
3. Early development and hatching
4. Poisonous and venomous fishes.

COURSE OUTCOMES:-

- Know the functional anatomy of all organ systems of fish
- Understand migration and adaptations in fishes.
- Observe the phenomenon of Parental care in various fishes and importance of electric organs in fishes.
- Understand the significance of Colouration, luminous and poisonous organs of fish.

Discipline Specific Elective-III Wild Life Conservation

COURSE OBJECTIVE:-

From this paper are study about the values of wild life, its habitat & management also.

Syllabus:

UNIT – I

1. **Wild life -**
 - (a) Values of wild life - positive and negative.
 - (b) Our conservation ethics.
 - (c) Importance of conservation.
 - (d) Causes of depletion.
 - (e) World conservation strategies.
2. **Habitat analysis, Evaluation and management of wild life.**
 - (a) Physical parameters - Topography, Geology, Soil and water.
 - (b) Biological Parameters - food, cover, forage, browse and cover estimation.
 - (c) Standard evaluation procedures - remote sensing and GIS.
3. **Management of habitats -**
 - (a) Setting back succession.
 - (b) Grazing logging.
 - (c) Mechanical treatment.
 - (d) Advancing the successional process.
 - (e) Cover construction.
 - (f) Preservation of general genetic diversity.

UNIT - II

1. **Population estimation.**
 - (a) Population density, Natality, Birth rate, Mortality, fertility schedules and sex ratio computation.
 - (b) Faecal analysis of ungulates and carnivores - Faecal samples, slide preparation, Hair identification, Pug marks and census method.
2. **National Organization.**
 - (a) Indian board of wild life.
 - (b) Bombay Natural History Society.
 - (c) Voluntary organization involed in wild life conservation.
3. **Wild life Legislation - Wild Protection act - 1972, its amendmets and implementation.**

UNIT - III

1. Management planning of wild life in protected areas.
2. Estimation of carrying capacity.
3. Eco tourism / wild life tourism in forests.
4. Concept of climax persistence.
5. Ecology of perturbence.

UNIT – IV

1. Management of excess population & translocation.
2. Bio- telemetry.
3. Care of injured and diseased animal.

4. Quarantine.
5. Common diseases of wild animal.

UNIT – V

1. Protected areas National parks & sanctuaries, Community reserve.
2. Important features of protected areas in India.
3. Tiger conservation - Tiger reserve in M.P, in India.
4. Management challenges in Tiger reserve.

COURSE OUTCOMES:-

- Student able to wild life -Values of wild life, positive and negative.Our conservation ethics , Importance of conservation. Causes of depletion.
- Habitat analysis, Evaluation and management of wild life.
- Physical parameters , biological , parameters and standard evaluation procedures.
- National parks & sanctuaries
- Wild life Legislation - its amendments and implementation.
- To the study of management planning of wild life in protected areas.

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Discipline Specific Elective-III

Entomology

COURSE OBJECTIVE:-

- To introduce the morphology of typical insect
- To study the general anatomy and physiology of insects.

Syllabus:

UNIT - I

1. Insect head types and modification as per their habit and habitat
2. Modification of mouth parts and feeding behavior
3. Structure types and function of antennae
4. Hypothetical wing venation

UNIT - II

1. Structure of cuticle and pigment
2. Sclerotisation and tanning of the cuticle
3. Structure of alimentary canal and Physiology of digestion
4. Malpighian tubules – anatomical organization , Transport

UNIT - III

1. Structure of circulatory system
2. Cellular elements in the haemolymph
3. Cell mediated and humoral immunity
4. Structure of compound eye and Physiology of Vision

UNIT - IV

1. Sound Production in insect
2. Structure and function of endocrine glands
3. Pheromones
4. Embryonic membranous up to the formation of blastoderm

UNIT - V

1. Metamorphosis
2. Insecticide effects on CNS
3. Important pest of Soybean
 - Modern concept of pest management

COURSE OUTCOMES:-

Student will be able to various types of Mouth parts, special Organs & Metamorphosis off insects physiological aspects and modern concept of pest management

PRACTICAL:-

LABORATORY -I

1. Study of museum specimens of different orders and families of insects.

2. Study of permanent slides.
3. Taxonomic identification of insects.
4. Dissection major - Nervous system of grasshopper and cockroach. Reproductive system of cockroach male and female.
5. Study of the following: • Any one sound producing organ. • Identification, classification and description: silverfish, cricket, termite, giant water bug, any one type of butterfly or moth, flesh-fly, potter wasp, long horn beetle or water beetle, dragonfly, damselfly. – use photos
6. Taxonomical identification of egg, larva & pupa.
7. Collection and preservation of insects.

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Discipline Specific Elective-IV
Pisci Culture and Economic Importance of Fishes (Ichthyology)

COURSE OBJECTIVE:-

This is the elective paper this paper introduced about the economic importance of fish.

Syllabus:

UNIT – I

1. Collection of fish seed from natural resources.
2. Dry bundh breeding of carps.
3. Wet bundh breeding of carps.
4. Hypophysation and breeding of Indian major camps.

UNIT – II

1. Drugs useful in induced breeding of fish
2. Types of ponds required for fish culture farms
3. Management of hatcheries, nurseries and rearing ponds
4. Management of stocking ponds

UNIT – III

1. Composite fish culture
2. Prawn culture and pearl industries in India.
3. Fisheries resources of MP
4. Riverine fishries.

UNIT- IV

1. Costal fishries in India
2. Offshore and deep sea fishery's in India
3. Role of fishries in rural development
4. Sewage fed fishries

UNIT- V

1. Methods of fish preservation
2. Marketing of fish in India.
3. Economic importance and by product of fishes
4. Shark liver oil industry in India Transport of live fish & fish seed.

COURSE OUTCOMES:-

Differentiate between natural and induced breeding in fish.

Manage hatcheries and fish farm in future.

Develop technical knowledge of fish preservation and Shark liver oil industry.

Identify fish by morph metric and meristic characters and apply the method in biodiversity oriented research.

Explain and apply genetic engineering in fishery technology.

Discipline Specific Elective-IV Environment & Biodiversity Conservation

COURSE OBJECTIVE:-

From this paper the students were study about the scope of environmental biology and biodiversity.

Syllabus:

UNIT – I

- Basic concept of Environmental Biology Scope and Environmental Science
- Biosphere and Biogeochemical cycles.
- Environmental monitoring and impact assessment.
- Environmental and sustainable development.
- Water conservation, rain water harvesting, water shed management.

UNIT – II

- Cause, effects and remedial measure of Air pollution, Water pollution.
- Noise, radioactive and thermal pollution.
- Agriculture pollution
- Basic concepts of Bioaccumulation.
- Solid waste management.

UNIT – III

- Global warming and disaster management
- Cause of global warming
- mpact of global warming - acid rains and ozone depletion, green house effect.
- Control measures of global warming
- Afforestation (b) reduction in the use of CFCS
- Disaster management -floods, earthquake,
- Cyclones landslides.
- Environmental legislation.

UNIT – IV

Natural Resources:- Forest –

- Use and over exploitation of forests.
- Timber extraction.

Land

- Land degradaton. Landslides.
- Soil-ersion and desertification.

Water

- Use and over utilization of surface and ground water
- Floods. Drought dams- benefits and problems Mineral
- Use and exploitation ,
- Environmental effect of extracting and using mineral resources

Food

- World food problem
- Effects of modern agriculture and overgrazing

Energy

- Conventional and nonconventional energy resources.
- Using of alternate energy sources
- Role of an individual in conservation of natural resources Equitable use of resources for sustainable life

UNIT - V

- Conservation of Biodiversity
 - Biodiversity crisis - habitat degradation poaching of wild life.
 - Socio economic and political causes of loss of biodiversity.
 - In situ and exsitu conservation of biodiversity
 - Value of biodiversity.
 - Hot spots of Biodiversity.
- Field methods of studying diet.
- Examination and recording of stomach contents of a browser, grazer
- carnivore, insectivore and omnivore.
- Examination of faeces.
- Experiments with captive reptiles and mammals in various situations of ambient temperature/isolation.

COURSE OUTCOMES:

- To the study of wild life -Values of wild life, positive and negative. Our conservation ethics , Importance of conservation. Causes of depletion.
- Habitat analysis, Evaluation and management of wild life.
- Physical parameters ,biological , parameters and standard evaluation procedures.
- To the study of protected areas National parks & sanctuaries, community reserve, Important features of protected areas in India, Tiger conservation , Tiger reserve in M.P, in India, management challenges in Tiger reserve.
- Wild life Legislation - Wild Protection act - 1972, its amendments and implementation.
- To the study of management planning of wild life in protected areas.

PRACTICAL: (Paper III & IV)

LABORATORY -I

1. Identification and comments upon wild life animals.
2. Study of endangered species.
3. Study of local birds and their habit habitats.
4. Study of ecosystem.
Distribution of wild life India. (National parks and sanctuaries)
5. Soil and water analysis.
6. Interspecific relationship – Naturalism, Symbiosis, Mutualism, Commensalism, Parasitism, Predation Competition.
7. Field – expedition and project report ucation
8. Practical Record & collection.

LABORATORY-II

- Jar Test (removal of Suspended solid by coagulation e.g. . Use of Alum)
- Case study on Tehri project , Silent valley project , Narmada project , Ecodisaster of deforestation
- Tracing of watershed and their morphological features from toposheets

COURSE CODE: 6SMZO405

- Designing structure for water conservation and harvesting based on field visits
- To perform water ,Energy audit in the house /college building /society /laboratory
- Report on Visit to NGO/Biomedical waste management site/Hazardous waste management /Pollution Control facility of any industry
- Study of local Biodiversity.
- Soil analysis
- Waste water analysis.
- Field – expedition and project report
- Practical Record & collection.

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Discipline Specific Elective-IV
Applied Entomology

COURSE OBJECTIVE:-

To introduce classification of insects up to order level. • To enable learners to categorize insects on the basis of morphological characteristics. To study the modern methods of apiculture, sericulture, lac culture • to familiarize the learners to the economic aspects of apiculture• To study the versatile roles of insects in agriculture.

Syllabus:

UNIT – I

1. Classification according to imms 1. Classification of apterygota upto families.
2. Classification of following insect orders (a) orthoptera (b) hemiptera (c) diptera.
3. Classification of following insect order (a) hymenoptera (b) lepidoptera (c) coleoptera
4. Collection and preservation of insects.

UNIT - II

1. Insect pest-Management strategies and tools
2. Biological control
3. Genetic control
4. Chemical control

UNIT - III

1. Pests of Cotton
2. Pests of sugarcane
3. Pests of paddy
4. Pests of stored food grains
5. Pests of citrus fruits and mango
6. Pests of pulses
7. House hold insect pests

UNIT- IV

1. Insects in relation to forensic science.
2. Insects migration, population fluctuation and factors 40
3. Insects of medical and veterinary importance.
4. Ecological factors affecting the population and development of insects.

UNIT - V

1. Mulberry and non mulberry sericulture
2. Apiculture
3. Lac culture
4. Insects as human food for future

COURSE OUTCOMES:-

Student will be able to classify insect up to their respective orders. Understand the difference in the life cycles of insects.: & various ecological importance of insects.

PRACTICAL:- (Paper III & IV)

LABORATORY-II

(Photographs, Pictures or models should be used to conduct practicals)

1. Study of museum specimens of different orders and families of insects. 2. Study of permanent slides. 3. Taxonomic identification of insects.
2. Observation of permanent slides or photographs of legs of honey bee.
3. Study of Cockroach: Digestive system and nervous system..
4. Study of pest – Stored grains pests, Fruit Pests, House hold Insect pests
5. Identification, classification and description: silverfish, cricket, termite, giant water bug, any one type of butterfly or moth, flesh-fly, potter wasp, long horn beetle or water beetle, dragonfly, damselfly. – use photos
6. Life cycle of lac insect, honey bee, silk moth. • Products – Lac, bee wax, silk. • Equipments used in apiculture, sericulture, lac culture. •
Examples of mimicry, camouflage and concealment e.g. Plain tiger and Danaid egg fly. Stick insect, leaf insect.

COURSE OBJECTIVE:-

To increase the awareness of related taken topic for our project work.

Project Work will be assigned by the Department. Student will work on the project and submit the report. Evaluation of the Project report will be done by an External examiner. Student has to secure at least 100marks in the project work.

PRACTICAL:-

LABORATORY - I (Paper III & IV)

1. Major dissection Nervous system of Walago, Mystus, Labeo, Toreda.
2. Minor dissection of internal ear, accessory , respiratory , organ , pituitary glands , Weberian ossicles . (Virtual dissection through computer aided programme may be done If dissection not allowed)
3. Mounting preparation of permanent slides.
4. Study of different type of scale Through Permanent slide or photographs)
5. Study of crafts and gears used in fisheries
6. Demonstration of induced breeding in fishes (Visual aids)
7. Age determination of fish with the help of scales
8. Water quality assessment of aquaculture (pH, conductivity, TDS, total solid)
9. Taxonomical status of local fishes
10. Demonstration of parental care in fishes (visual aids)through visit to any fish f
11. Spotting of museum specimen slides and bones
12. Practical record , collection.

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LABORATORY -II

- .Systematic identification of freshwater fishes with particular reference to M.P
- .Qualitative zooplankton analysis
- .Nutrient analysis of water
- .. Aquarium design and maintenance
- . Visit to freshwater
- . Estimation of hydro biological parameters- temperature, pH, conductivity, salinity, dissolved oxygen, primary productivity, ammonia, nitrite, nitrate, phosphate, biological oxygen demand, chemical oxygen demand of nursery, rearing, stocking and breeding ponds
- . Demonstration of breeding pools and hatcheries
- . Induced breeding of Indian major carps and catfishes.
- . Identification of eggs, spawn, fry and fingerlings of cultivable fishes of India.
- . Collection and identification of aquatic weeds and aquatic insects.

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