

SEMESTER IV

ELECTIVE COURSE A. : ENTOMOLOGY

ZY4A ET 01 MORPHOLOGY AND TAXONOMY

ZY 4A ET 02 ANATOMY AND PHYSIOLOGY

ZY 4A ET 03 APPLIED ENTOMOLOGY

ZY4 A E P04. PRACTICAL – I. MORPHOLOGY, ANATOMY & TAXONOMY.

ZY4 A E P05. PRACTICAL-II. INSECT PHYSIOLOGY & APPLIED ENTOMOLOGY.

ELECTIVE A. : ENTOMOLOGY

Objectives:

- To introduce the insect diversity and its significance
- To study the economic and medical importance of insects
- To learn about the pests of crops and vectors of diseases and their control measures
- To provide skills for scientific study of insects
- To develop research aptitude among students by introducing frontier areas of entomology

ZY 4A ET01 MORPHOLOGY AND TAXONOMY

90 Hours (5 hrs/week)

Credit -4

Module I. Introduction

4 hrs

Scope and importance of insects, Origin and evolution of insects (including theories), Fossil insects.

Module II. Insect Morphology

26 hrs

Segmentation and division of the body: General morphology of head (Opisthognathus, Prognathus, Hypognathus). Head segmentation; Head skeleton; Tentorium; Modifications in head capsule; Cephalic appendages; Antennae – Structure functions and types, Mouth parts – various modifications, feeding mechanisms.

General morphology of thorax (thoracic segmentation, thoracic skeleton and thoracic appendages); Wings – Structure, Venation, Wing articulation, Wing coupling apparatus, Wing modifications.

Legs-structure and adaptive radiation of legs, Locomotion; Morphology of abdomen and its appendages. External genitalia-structure and diversity of male and female genitalia. eg. Grasshopper, *Drosophila*, Cockroach, Dragonfly.

Sense Organs – Structure and classification of sense organs (Hair organs, Plate organs, Campaniform organs, Compound eyes and vision.); Light and Sound Producing Organs – Structure of light producing organs, Production of light, Stridulatory organs in various insects.

Module III. Insect Classification

36 hrs

Methods of Insect collection and preservation, Use of keys, kinds of keys, their merits and demerits. Classification of insects up to families; General characters, Biology and habits of different orders of insects (special emphasis on economically important insects). Vectors of human diseases (Diptera, Anoplura and Siphonoptera).

Module IV. Social Organisation and Behaviour

16 hrs

Social organisation and behaviour with reference to Termites, Ants and Honey Bees; Study of Gall forming insects (features, Gall formation, Types of Galls – open and Closed, Common Gall pests, adaptations for Gall making habits. Economic importance); Leaf mining insects – features forms of leaf mines, feeding habits. Ecological aspects of leaf mining; Communication – Acoustic, Visual, Tactile and chemical methods; Adaptations of parasitic and predatory insects; Study of aquatic insects (factors influencing the aquatic life, food capture – modifications, anchorage, locomotion, respiration, oviposition and adaptations of swimming forms.

Module V. Insect Development

8 hrs

Egg, structure and adaptations; General pattern of embryonic development; Polyembryony; Parthenogenesis; Paedogenesis; Metamorphosis; Diapause.

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ZY4A ET 02ANATOMY AND PHYSIOLOGY

90 Hours (5hrs/week)

Credit - 4

Module I. Integumentary System

4 hrs.

Anatomy and histology, Moulting and sclerotisation, Role of hormones.

Module II. Digestive System

10 hrs.

Anatomy and histology of gut. Modifications of gut (filter chamber).

Physiology of digestion of wood, keratin, wax and silk. Extra intestinal digestion. Role of microbe in digestion. Assimilation.

Module III. Circulatory System

8 hrs.

Anatomy and histology of dorsal vessel, dorsal and ventral diaphragms and accessory pulsatile organs. Composition and cellular elements in haemolymph; functions. Course of circulation and control of heart beat.

Module IV. Respiratory System

10 hrs.

Anatomy and histology of trachea, tracheole, spiracles and air- sacs.

Modifications of respiratory system-cutaneous respiration, diffusion, ventilation, control of ventilation, cyclic release of CO₂, respiratory pigments.

Module V. Muscular System

8 hrs.

Histo-morphology of muscles, skeletal muscles and visceral muscles.

Neuromuscular junctions. Excitations of muscle fibres, role of fast and slow axons.

Module VI. Fat Body and Intermediary Metabolism

6 hrs.

Structure of fat body, Role of fat body in storage of reserves.

Intermediary metabolism-Glycolysis, Glycerol phosphate shuttle, Trehalose-biosynthesis

Module VII. Excretory System

14 hrs.

Anatomy and histology of Malpighian tubules (Hemiptera, Coleoptera, Lepidoptera). Nephro-rectal complex and labial glands. Physiology of excretion.

Absorption of water and ions, reabsorption of essential materials. Synthesis of uric acid, formation of excreta.

Module VIII. Nervous System

14 hrs.

Anatomy and histology of brain, ganglia and nerves. Physiology-reception and transmission of stimuli, production and conduction of nerve impulses.

Anatomy and histology of mechanoreceptors, photoreceptors and chemoreceptors. Sound production and light production.

Module IX. Endocrine System

12 hrs.

Histomorphology of neurosecretory cells and endocrine glands (corpora cardiaca, corpora allata and prothoracic glands). Hormones and their functions.

Types of pheromones and behavioural patterns. Pheromonal communications-allelochemicals; allomones, kairomones and synomones.

Module X. Reproductive System

4 hrs.

Reproductive system in male insects, Reproductive system in female insects.

REFERENCES

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- Beament, J.W.L. , Treherne, J.E. and V.b. Wigglesworth. 1972. *Advances in Insect Physiology*. Academic Trust London
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ZY 4A ET 03 APPLIED ENTOMOLOGY

90 Hours (5hrs/week)

Credit- 4

Module I. Insect Pests

8 hrs

Kinds of pests (major and minor) – Key pests, sporadic pests, endemic pests, exotic pests, epidemic and pandemic pests, seasonal pests, occasional pests, regular pests, persistent pests. Causes of pest outbreak. Pest resurgence and replacement (secondary pest outbreak). Causes and management of resurgence and replacement. Forecasting pest outbreaks and surveillance (Short term and long term forecasting); forecasting based on observations – climatic and empirical factors.

Types of damage caused by insect pest to crops (Injury by chewing, piercing, sucking insects, internal feeders, subterranean insects, to stored products and indirect effect of feeding).

Module II. Insect Pests of Crops

16 hrs

Life history, nature of damage and control measures of major pests of paddy, coconut, cotton, sugar cane, mango, cashew, pulses, coffee, tea, banana, pepper, cardamom, turmeric and ginger, tapioca, rubber, vegetables, stored products; Locusts –life history and migration, damage and methods of control; Termites – life history, damage and control measures.

Module III. Basic Principles of Insect Control

16 hrs

Prophylactic methods. Curative methods- Cultural methods; Mechanical methods; Physical methods; Legal methods.

Biological control- History, ecological basis and agents of biological control – Parasites, Parasitoids, Predators; The practice of biological control (Conservation and enhancement, importation and colonisation, mass culture and release of natural enemies); Economic dimensions of biological control; merits and demerits; Important biological control projects undertaken in India against insect pests and weeds. Autocidal control – Sterile male technique and other methods, Chemo sterilants, methods of sterilisation, application advantages and disadvantages. Examples; Pheromonal control – Mode of application, pest management with pheromones. Advantages and disadvantages. Examples; Insect growth regulators (IGRS), Insect growth hormones and mimics (brief account).

Insect repellents – Definition, features of good repellents, types, applications in pest management, advantages and disadvantages, examples. Insect anti feedants – definition, applications, advantages, disadvantages, examples.

Microbial control of crop pests by employing bacteria virus and fungi. Mode of action, applications and examples; Insect attractants – definition, types, application in pest management. Advantages and disadvantages and examples.

Pest management – concepts, definition, characteristics, pest management strategies and techniques Integrated pest management – definition, IPM in agro ecosystem, Preventive practice, therapeutic practice, guidelines for developing IPM. IPM of rice; Ecological backlash and its management (resistance of population to pest management tactics, Pest population resurgence and replacement, genetic physical and biochemical mechanisms, microbial and environmental degradation of pesticides.

Module IV. Chemical Control

12 hrs

Insecticide formulations, Insecticide appliances and applications; Classification of insecticides – based on mode of entry, mode of action, chemical nature, toxicity.

Chemistry and mode of action of insecticides; Inorganic compounds as insecticides - Arsenic, fluoride and sulphur compounds; Synthetic organic insecticides - Organochlorine compounds (DDT, BHC, Endosulfan – heptachlor, dieldrin).

Organo phosphorous insecticides – monocrotophos, tetra ethyl pyrophosphate, parathion, carbamates – carbaryl, carbofuran.

Botanical insecticides – chemical properties, mode of action and toxicity. (nicotine, rotenone, pyrethrum and neem; Ethnobotanical traditions. Synthetic pyrethroids – definition, uses as insecticides, mode of action (pyrethrin, allethrin).

Fumigants – definition, examples, methods of fumigation, hazards, precautions, advantages; Insecticide synergists – definition, types of synergism, mode of action and examples; Pesticide impact on wildlife and human health.

Module V. Vectors of Domestic Animals and Man **10 hrs**

Insect vectors of human diseases belonging to diptera, anoplura, Syphonoptera (self study systematic and biology); Identification, nature of attack, and control measures of insect pest of domestic animals – cattle, sheep and goat, fowl, dog. Acarina – Morphology, biology and control measures.

Module VI. Mode of Transmission and Epidemiology of Vector Borne Diseases **10 hrs**

Malaria, Filariasis, Yellow Fever, Dengu Fever, West Nile Disease, Chickungunia, Encephalitis, Kala-azar, Plague, Typhus, Kyasanur Forest Disease, Scabies – control of vectors. Vector control measures.

Module VII. Beneficial Insects **10 hrs**

Biology and rearing of Honey bees, Silk worm, lac insect; Insects of forensic importance – crime detection using entomological science. Examples of forensically important insects; DNA techniques in forensic entomology.

Module VIII. Insect Host Interactions **8 hrs**

Selection of hosts (plants and animals); Evolution of phytophagy and haematophagy in insects; Insect host resistance; Insect pollinator – plant interaction. Modern findings.

REFERENCES

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ZY 4A EP04 PRACTICAL – I MORPHOLOGY,ANATOMY AND TAXONOMY**90 hours. (5 hrs./week)****Credit- 2**

Study of mouthparts in insects (Grasshopper,plantbug,mosquito,honeybee, house fly) Study of different types of antennae, genitalia and legs.

Sting apparatus –honeybee

Wings and wing venation in insects of 5

orders. Study of sexual dimorphism in insects

Preparation of dichotomous keys with reference to various insect orders

Dissection of alimentary canal and associated glands of different insects (plant bug,honey bee,oryctes, grasshopper.

Dissection of nervous system in different insects (plantbug,honeybee,oryctes,grasshopper)

Dissection of reproductive system in insects (cockroach,oryctes ,grasshopper, Plant bug)

Dissection of stomatogastric nervous system –cockroach

Collection and preservation of insects (students are required to submit an insect collection belonging to 50 families-dry collection,wet collection, whole mounts and slides) at the time of practical examination.

Field Study Report:

Visit to two institutions engaged in entomology research and different ecological niches other than local area for collection of insects. The field study is for 3-4 days. Report the study conducted and submit a 10 page write up/ print out giving the dates, daywise itinerary, methodology, results and references. Include photographs of the activities. Group and individual assignments shall be preferred.

ZY 4A EP 05 PRACTICAL – II INSECT PHYSIOLOGY AND APPLIED ENTOMOLOGY**90 Hours (5 Hours/week)****Credit-2**

Survey of digestive enzymes –amylase,invertase,protease and lipase in different parts of the gut in cockroach,grasshopper, dragonfly

Dye transport by Malpighian tubule using dyes

Identification of free aminoacids (at least 3) in haemolymph by paper chromatography. Haemocytes –staining and identification.

Collection and identification of insect pests of different crop plants,fruit trees,vegetables and stored products

Collection and identification of insect vectors of man and domestic animals.

Collection and preservation of economically important insects, their life stages, products, damaged parts.

Collection and identification of insect damages to crop plants. Insecticide appliances.

Determination of LC₅₀ using probit analysis.

Collection – Students are expected to submit a collection consisting of insect pest of different crops, stored products, domestic animals and man. Useful insects, their life stages and products, parasites and predators

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SEMESTER IV

ELECTIVE COURSE B : FISHERY SCIENCE

ZY4B ET 01 ICHTHYOLOGY

ZY4B ET02 FISHERY RESOURCES & MANAGEMENT

ZY4B ET03 FISHERY TECHNOLOGY

ZY4B EP04 PRACTICAL –I. TAXONOMY, ANATOMY, PHYSIOLOGY
& PATHOLOGY

ZY4B EP05 PRACTICAL-II . FISHERY BIOLOGY & TECHNOLOGY

ELECTIVE B - FISHERY SCIENCE**Objectives:**

- To learn fish diversity, fish habitats, and fishery resources
- To impart knowledge regarding fish biology
- To understand the various aspects of inland and marine fisheries
- To equip the students with the techniques of aquaculture and fish processing
- To provide professional entrepreneurship skills in fishery science

ZY4B ET01 ICHTHYOLOGY**90 Hours (5hrs./week)****Credit:4****Module 1. Taxonomy, Evolution and Distribution****10 hrs.**

Origin and evolution of fishes, Classical taxonomy – morphometrics, meristics. Methods employed in phylogenetic studies and fish identification, fish barcoding. Classification up to orders. Biogeographical distribution of fishes.

Module II. Body Form and Locomotion**10 hrs.**

Body shape, body musculature. Swimming and non-swimming locomotion and buoyancy regulation-propulsive systems, hydrodynamic analyses, swimming modes, fish bio-modelling, bioenergetics, strategies for buoyancy regulation. Fins- types, structure, modifications and functions. Theories of origin of median and paired fins. Integument and Exoskeleton. Colouration-chromatophore pigments and colouration. Physiology of colour change.

Module III. Food and Feeding**6 hrs.**

Structure of alimentary canal. Food, feeding habits and adaptations. Physiology of digestion and absorption.

Module IV. Blood Vascular System and Defense Mechanisms**10 hrs.**

Circulatory system - modifications in blood circulation in relation to air breathing. Defense mechanism-immune system, cells and tissues of the fish immune system, modulators of fish immune responses, humoral and cell mediated immune defense, fish antibody molecules and their effector functions.

Module V. Respiratory System**6 hrs.**

Gill structure and Physiology of gill respiration. Accessory respiratory organs and mechanism of air breathing in fishes. Swim bladder, structure and function. Weberian ossicle.

Module VI. Excretory System**4 hrs.**

Structure and functions of kidney. Nitrogenous products and patterns of their excretion.

Module VII. Nervous System and Sense Organs**10 hrs.**

Structure and functions of central and peripheral nervous systems. Structure and functions of sense organs.- visual, chemoreception, statocoustic, mechanoreceptors, thermoreceptors, and electroreceptors.

Module VIII. Specialized Characters**6 hrs.**

Sound production and detection, Acoustic communication. Electric organs, Luminescent organs, Venomous fishes.

Module IX. Endocrine System and Reproduction**10 hrs.**

Functions of the endocrine organs and tissues-Pituitary, Thyroid, Gonad, Adrenals, Corpuscles of Stannous, Endocrine pancreas, Ultimobranchial. Sexuality, hermaphroditism, (gonochorism), Modes of reproduction

– oviparity, aplacentalviviparity and placental viviparity. Reproductive cycles and Breedingbehaviour.Nest building and parental care.Hormonal and environmental regulation of reproduction.

Module X. Ecology of Fishes

8 hrs.

Adaptations to special conditions of life – deep sea, cave, hill-stream fishes.Aestivation and hibernation.Migrations and orientation.Homing and territorial recognition.Schooling.

ModuleXI. Fish Pathology

10 hrs.

Fish diseases and their causes.Viral diseases.Bacterial infections.Fungal infections.Protozandiseases.Helminth parasite infections.Crustacean parasite infections.Ulcers and tumours.Prophylactic and therapeutic measures.

REFERENCE

Aline, W. 1980. *Fish Diseases*. Springer,Berlin, Germany.

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ZY4B ET02 FISHERY RESOURCES AND MANAGEMENT**90 Hours (5hrs. /week)****Credit - 4****Module I. Inland Fishery Resources****15 hrs.**

Freshwater and brackish water fishery resources – Pond, Lakes, Tanks, Estuaries, brackish water lagoons, wetlands and mangroves. Major riverine fisheries in India. Peninsular rivers and its fishery diversity with special reference to endemic species in Kerala. Reservoir fisheries – classification of reservoirs. Methods of enhancement of productivity. Reservoir fisheries of Kerala. Estuarine fisheries – Status and potential of estuarine fisheries, Backwaters of Kerala. Scope of Inland fisheries in Kerala.

Module II. Problems and Management of Inland Fishery**20 hrs.**

Approaches to management of Inland fisheries resources for sustainable development – Activities of FIRMA and Matsyafed. Management challenges of riverine fisheries and fishes. Management of estuarine fisheries. Biodiversity and Management of inland waters with special reference to Vembanad lake and Sasthamkotta lake. Mangrove ecosystem – Degradation and its problems on coastal fisheries. Invasive species and its effect on fish diseases. Derelict water bodies – problems and management aspects. Protection and restoration of fish movements – different types of fish passes and enhancement of fish migration. Effects of dams on riverine fisheries. Sand mining and its impact on fisheries.

Module III. Marine Fishery Resources and Oceanography**15 hrs.**

Coastal Resources: coastal biological resources - finfish, shellfish, seaweeds, sea grasses. Ecological subdivisions of the sea-continental shelf, continental slope, ocean base. Physicochemical properties of sea water-salinity, pH, temperature, light penetration, pressure, dissolved gases, minerals, nutrients and their cycles. Plankton and productivity. Mud banks - formation and significance. Exclusive Economic Zone (EEZ). Indian Antarctica expedition.

Module IV. Climatic Factors and Fishery**10hrs.**

Critically important climatic factors (temperature, rainfall and wind pattern / monsoon influencing aquatic (inland and marine) productivity and production. Remotely sensed SST, Chlorophyll and Wind pattern features of Indian seas used in locating Potential Fish Zones (PFZ). Influence of rainfall intensity, its seasonal and annual variations on fish migration, breeding.

Module V. Marine Biodiversity and Conservation**15hrs.**

Marine biodiversity and its threats. Endangered Species, IUCN, Criteria, Red Data Book. Coral Reefs and their sustainability and conservation. Conservation and Restoration of marine protected areas-Marine parks. Coastal Tourism.

Module VI. Remote Sensing and GIS for Fisheries Management**15 hrs.**

Basic terms and Concepts- Electromagnetic radiation and its properties, atmospheric interactions, target interactions. Sensor platforms – boats, balloons, air-crafts and satellites, Sensor systems – global acquisition systems and sequential acquisition system. Environmental satellites – The Landsat series, NOAA & IRS; Digital image processing and interpretation; Elements of GIS, Application of remote sensing and GIS to fisheries and aquaculture planning and development. Study of satellite information, interpretation of Satellite pictures for resource management, case studies in remote sensing and GIS application.

REFERENCES

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ZY4B ET03 FISHERY TECHNOLOGY**90 Hours (5hrs./week)****Credit - 4****Module I. Introduction****3hrs.**

Major Fishing nations of the world, Major fishing regions.

Module II. Methods of Fishing**15 hrs.**

Crafts and gears used for fishing in inland and marine waters. Gears–Types of gears-design, operation and efficiency. Destructive and prohibited fishing practices. Recent advances in fishing methods. Fishing using electricity, light. Bycatch reduction devices : Definition, types of bycatch reduction devices and the principles of operation. Fish finders (echo sounders and sonar) and their use. Turtle Excluder Devices: Definition, Types of TEDs. Advanced communication Systems – VHF, SSB, Inmarsat system. Vessel Monitoring Systems (VMS): Importance, uses, role in fisheries management. Satellite navigation system: GPS : Components of GPS, working, functions, hand held GPS, important applications of GPS in fisheries and aquaculture. Fishing harbours: Classification, facilities, layout of a typical fishing harbour.

Module III. Freshwater Culture Fisheries**22 hrs.**

Methods of culture and cultivable fishes (Carps, Catfishes, Murrels, Prawn). Fish food organisms (Algae, Artemia, Zooplankton). Induced breeding of fishes through hypophysation with special reference to Indian major carps. Management of freshwater fish farm - survey of site, layout, soil, water quality requirements. Soil and water quality management in aquaculture. Pond Fertilization- different kinds of fertilizers and manures, Bio-fertilizers, use of treated sewage for pond fertilization. Aquatic weed management. Algal bloom control, Eutrophication, Waste water treatment practices. Role of microorganisms in fish production, microbial load and algal blooms.

Fish seed collection and Preservation technology - natural collection, bundh breeding, induced breeding, cryopreservation of gametes. - transport of eggs, fry, fingerlings and adults.

Nutrition of aquatic animals - nutritional requirements of commercially important finfish and shellfish, dietary requirements of larvae and brooders, feed types, manufacture and ingredients, , use of attractants and growth stimulants in fish feeds, alternative protein sources in aquaculture diets, feeding techniques, role of probiotics in nutrition.

Role of genetics in aquaculture– gynogenesis, androgenesis, triploidy, tetraploidy, hybridization, sex reversal and breeding, production of transgenic fish, impact of GMOs on aquatic biodiversity.

Methods of culture of Indian major carps (Rohu, Catla and Mrigla), exotic carps (common carp, grass carp and silver carp) and Tilapia. Culture of air breathing fishes (*Heteropneustes fossilis*, *Clarius batrachus*, *Channasps*, and *Anabas testudineus*). Sewage – fed culture of carps, Tilapia and air breathing fishes. Integrated fish culture (Paddy – cum-fish, fish –cum-duck and fish-cum pig). Composite fish culture.

Module IV. Sustainable Aquaculture**8hrs.**

Present scenario and problems: Trends in global and Indian aquaculture; Different farming systems; intensive systems and constraints.

Environmental degradation and disease outbreaks. Organic farming; integrated farming; responsible aquaculture; rotational aquaculture; bioremediation; role of biotechnology. Economic viability: export vs. domestic marketing, value addition.

Module V. Brackishwater Culture and Mariculture**8 hrs.**

Methods of culture of Mugilids, *Chanoschanos*, milk fish, mullets, crabs, shrimps. Methods of prawn culture- Traditional (Bheries, Pokkali), modern. Culture of pearl oyster, edible oyster and sea mussels.

Module VI. Preservation and Fishery Byproducts 10 hrs.

Post-mortem change and rigor mortis in fish. Assessment of freshness in fish-physical, chemical and microbial evaluation of freshness. Fish spoilage- bacterial and chemical. Fish preservation- handling and cleaning of fresh fish, chilling, freezing, quick freezing, use of chemicals and antibiotics, irradiation, salting, drying, freeze drying, smoking, canning and pickling. Traditional fishery by-products- fish meal and fish oil-preparation and uses. Processing wastes-prawn heads, chitin, Chitosan, Fish protein concentrate(FPC) preparation and Uses of shells, isinglass, glue, guano, fins and leathers. Packaging, storage and transport of fish products.

Module VII. Quality Control in Processing Industry and Fishery Export 6 hrs.

Quality factors of food, tests for quality. Plant sanitation and hygiene. Standards for quality of by-products- Indian and international. Water analysis. Inspection system. Prospects for augmenting fishery exports.

Module VIII. Fisheries Education (Self study) 5 hrs.

Objectives and functions of Institutes: Central Institute of Fisheries Education (CIFE, Bombay), Central Inland Capture Fisheries Research Institute (Barrackpore), Central Marine Fisheries Research Institute (CMFRI, Kochi), Central Institute of Fisheries, Nautical and Engineering Training (CIFNET, Kochi), Central Institute of fisheries Technology (CIFT, Kochi), National Institute of oceanography (NIO, Dona Paula and Kochi).

Module IX. Statistical Methods 9 hrs.

Fisheries statistics-scope and objectives. Fish population-population structure and estimation. Population dynamics, recruitment. Stock assessments. Estimation of yield and optimum yield. Length- weight relationship.

Module X. Aquarium Management 4 hrs.

Aquaria and their uses. Setting up and maintenance of an aquarium. Ornamental fishes. Setting up of marine aquaria. Selection of compatible species, breeding of aquarium fishes.

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**ZY4B EP04 PRACTICAL 1 ANATOMY, TAXONOMY, PHYSIOLOGY
AND PATHOLOGY**

90 Hours (5 hrs/week)

Credit - 2

Anatomy

Study of anatomy of a teleost (Cat fish/Carp). External features and gills.

Dissection and display of Viscera, Digestive system, urinogenitalsystem. Branchial blood vessels. Brain and cranial nerves. Dissection of swim bladder, weberianossicles. Skeleton-skull and vertebrae.

Dissection of air-breathing organs and their blood supply of *Anabas*, *Clarius*, *Saccobranchnus* and *Channa*.

Study of the anatomy of elasmobranchs. Dissection of branchial blood vessels. Brain and cranial nerves. Dissection of internal ear. Preparation of stained mounts of Ampulla of Lorenzini, otolith, scales and gill filaments

Taxonomy

Study of distinguishing features (morphometric and merisitic).

Identification and classifications of at least 20 species (5 marine, both bony and cartilaginous, 5 fresh water, 5 cultivable, 5 aquarium fishes) using manuals.

Identification and classification of distinguishing features of commercially important crustaceans (3 prawns).

Physiology

Determination of the rate of ammonia and urea excretion in fish. Determination of the haemoglobin content in fish blood. Identification of blood cells of a teleost.

Study of the effect of epinephrine, NaCl and KCl on fish chromatophores.

Pathology

Identification of common external and internal parasites of fish

Identification of any 4 fish diseases.

ZY4B EP 05 PRACTICAL II FISHERY BIOLOGY AND TECHNOLOGY

Fishery Biology

Study of feeding habits of fish through qualitative and quantitative analysis of gut contents of herbivore, carnivore and omnivore species.

Study of the scale, vertebra and otolith for determination of age. Determination of gonadosomatic index.

Estimation of fecundity.

Measurement of ova diameter.

Length-weight relationship.

Study of the principal stages in the life history of prawn.

Methodology of induced breeding of fish through hypophysation. Dissection, collection and preservation of pituitary gland. Preparation of pituitary extract.

Dosage and technique of injecting pituitary extract (demonstration)

Fishery Technology

Estimation of total protein and identification of amino acids in fish muscle(two directional chromatography).

Extraction and estimation of liver and body oil from commercially important fishes.

Fishing crafts and gears-identification of various components of a mechanized fishing craft from actual specimen/model/drawing.

Study of principal types of fishing gears from actual specimen/model/drawing.

Identification of fishing gear materials:twines, ropes, floats,sinkers,buoys and anchors. Identification of fishery by-products.

Collection and identification of aquatic weeds and aquatic insects.

Formulation and preparation of artificial fish food for Indian major carps and Prawns.

Fish spoilage

Estimation of trimethyl amine

Field work and study tour:

Three to four days tour to study various fishery activities at selected centres/sites; visit to a fish seed production farm. Freshwater/Brackish water aquaculture.Fishing operations, fish landing, packing, transport. Fish preservation and processing chain. Boat building yard and net making plant. NIO, CIFT, CIFNET, CIMFRI *etc.* Report the study conducted and submit a 10 page write up/ print out giving the dates, daywise itinerary, methodology, results and references. Include photographs of the activity.

Group and individual assignments shall be preferred.

Each student should submit:

A collection of 15 Fishes/Crustaceans (5 Freshwater, 5 Marine, 5 Aquarium fishes).

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SEMESTER IV

ELECTIVE COURSE C. : ENVIRONMENTAL SCIENCE

ZY4C ET 01 ENVIRONMENTAL SCIENCE: CONCEPTS AND APPROACHES

ZY4C ET02 ENVIRONMENTAL POLLUTION AND TOXICOLOGY

ZY4C ET03 ENVIRONMENTAL MANAGEMENT AND DEVELOPMENT

ZY4C EP04 ENVIRONMENTAL SCIENCE: PRACTICAL –I

ZY4C EP05 ENVIRONMENTAL SCIENCE PRACTICAL-II

ELECTIVE C : ENVIRONMENTAL SCIENCE

Objectives:

- To provide a broad and deep understanding on environment and influence of man on environment
- To equip the students to use various tools and techniques for the study of environment
- To enable the learner to understand, think and evolve strategies for management and conservation of environment for sustaining life on earth
- To take up further studies and research in the field

ZY4C ET 01 ENVIRONMENTAL SCIENCE: CONCEPTS AND APPROACHES

90 Hrs. (5hrs./week)

Credit- 4

Module 1. Introduction to Environmental Science

2 hrs

Definition, Principle and Scope of environmental Science- its relation to other sciences.

Prerequisite: Basic concept of ecosystem, abiotic and biotic factors.

Module II. Earth System and Biosphere

4 hrs

Concept of life and life supporting systems. The origin and structure of earth, primary differentiation and formation of core, mantle, crust, atmosphere and hydrosphere.

Prerequisite: Biomes and distribution of life on earth.

Module III. The Physical Environment

22 hrs

Lithosphere - Weathering and soil formation, - soil colloids, adsorption and exchange of anions and cations, role of microbes in soil, types of soil, soil profile, classification of rocks, folds, faults and dykes and other geological formations and their environmental significance. Geomorphological processes-plate tectonics, sea floor spreading, mountain building, evolution of continents and structural deformation.

Atmosphere -Physico-chemical characteristics, divisions, composition and significance of atmospheric components.

Hydrosphere -Visible and invisible hydrosphere, Range of aquatic habitats, water cycles between earth and the atmosphere, Global water balance, ice sheets, origin and composition of sea water, sea level changes, River basins and watershed. Physico-chemical characteristics of water- diffusion of oxygen from the atmosphere to surface waters. Influence of pH, turbidity and light on aquatic life.

Prerequisite: Physical and chemical properties of soil, Biomes and distribution of life on earth.

Module IV. Weather and Climate

12 hrs

Definitions and scope of climatology, weather and climate, components of climate system, earth's thermal environment, earth intercepts solar radiation, seasonal variation in intercepted solar radiation, air temperature in relation to altitude, global circulation of air masses, wind and earth's rotation on ocean currents, influence of temperature on moisture content of air, global pattern of precipitation, influence of topography on regional pattern of precipitation. classification of climate-Koepfen's classification and Thornthwaite's scheme, climatic types and zones.

Global climatic phenomena-*El Nino* and *La Nina*, causes and factors of climate change. Effect of climate change on ecosystems and human welfare. Organisms and microclimate.

Module V. Climate of India

4 hrs

Climatic regions of India, tropical monsoon climate-onset, rain bearing systems, break in the monsoon, retreat of monsoon. Monsoon in Kerala, oceanic and continental influence.

Module VI. Landscape Ecology**12 hrs**

Land and Landscape processes; Hierarchy: ecosystems to land units; ecological principles at work with Landscapes ; Human dimensions and Land Use in agro-ecosystems, urban ecosystems, rangelands, riparian and wetland systems, coastal and estuarine systems. Concept of ecological land degradation desertification, water logging, salinisation and soil erosion. Ecological assessment of landscape for vegetation and habitats. Integrated analytical techniques- land suitability analysis and carrying capacity studies; Use of soil survey, aerial photos, topographic maps and other resource data in landscape management; case studies on corridor selection problems.

Module VII. Biodiversity and Conservation**20 hrs**

Biodiversity-concepts and patterns. Types of biodiversity-wild biodiversity, agro-biodiversity, domesticated biodiversity. Values of biodiversity, ecosystem functions and biodiversity, mobile links and valuating ecosystem services. Drivers of biodiversity loss.

Tools and techniques for biodiversity estimation- biodiversity indices.

Strategies for biodiversity conservation- *In-situ* conservation: sanctuaries, biospheres reserves, national parks, nature reserves, preservation plots. *Ex-situ* conservation: botanical gardens, zoos, aquaria, homestead garden; herbarium; *In-vitro* Conservation: germplasm and gene bank; tissue culture: pollen and spore bank, DNA bank. GEF-World Bank initiatives. Biodiversity hotspots and their characteristics, global distribution.

CBD, IPRs, National and international programmes for biodiversity conservation. CITES and TRAFFIC. Indian Biodiversity Act 2002 and laws, National Board of Biodiversity, State Board of Biodiversity. Ecosystem people and traditional conservation strategies; People's participation in conservation-PFM, community reserve and People's Biodiversity Register (PBR). Biodiversity Management Committee (BMC). Wildlife values and eco-tourism, wildlife distribution in India, problems in wildlife protection-Policies and programmes. Threatened animals of India.

Module VIII. Biological Invasions**10 hrs**

Introduction Elton's hypothesis – Invasion patterns and process biological attributes for invasion: Reproductive potential, Allelopathy Phenotypic plasticity, fitness to the new environment. Hypotheses for invasion success: Natural enemy hypothesis evolution of invasiveness hypothesis, empty niche hypothesis, novel weapon hypothesis, disturbance hypothesis and Propagule pressure hypothesis. Invasive alien species of India (plants and animals). Databases of biological invasions. Impacts and management of invasions: impacts of exotics on biodiversity, productivity, nutrient cycling.

Management: Bio-control programmes, mechanical and chemical control Positive utilization Quarantine and EIA of biological invasion.

Module IX. Evolutionary Ecology**4 hrs**

Darwin's ecology and evolution, Evolutionary trees, natural selection and environment, molecular evolution, speciation and extinction.

REFERENCES

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ZY4C ET02 ENVIRONMENTAL POLLUTION AND TOXICOLOGY**90 Hrs (5hrs/week)****Credit - 4****Module I. Introduction****3 hrs.**

Brief history of human civilization, industrialization and urbanization. Definition of pollution. Different types of pollution- Air, Water and soil and their local, regional and global aspects.

Module II. Air Pollution**12 hrs.**

Sources and classification of air pollution ; particulates and gaseous pollutants in the atmosphere. Primary and secondary pollutants. Effects of air pollutants on human health, animals, vegetation, materials and structures.

Air pollution monitoring - methods, air quality standards; ISI, EPA.

Sampling and measurement of particulate matters (SPM) - gaseous pollutants, CO₂, CO, NO_x, SO₂, H₂S, oxidants, ozone and hydrogen fluoride.

Control of gaseous emission: adsorption by liquids, adsorption by solids, combustion and condensation. Control of SO₂, NO_x, CO, CO₂ and hydrocarbons.

Pre requisites: GHGs, climate change, carbon foot print and carbon trade

Module III. Water Pollution**15 hrs.**

Sources of water pollution-Domestic (municipal sewage), industrial and agricultural. Health effects of water pollution. Water borne and water related diseases. Effects of water pollution on aquatic system. Water quality standard for potability - Pollution parameters, BOD, COD, Coliform bacteria.

Treatment of water for potable purpose (mixing, sedimentation, coagulation, filtration and disinfection) Primary and secondary treatment. Sludge disposal. Biological treatment: Kinetics of Biological growth - activated sludge treatment - trickling filters - anaerobic digestion, combined aerobic and anaerobic treatment process, aerobic process.

Advanced waste water treatment - removal of dissolved organics and inorganic - precipitation, iron exchange, reverse osmosis, electro dialysis, adsorption and oxidation.

Removal of nutrients. Removal of heavy metals - overall waste water treatment for sewage water. Water pollution treatment using constructed wetlands Bioremediation; traditional water purification techniques.

Module IV. Soil Pollution**10 hrs.**

Sources of soil pollution; - agricultural, industrial and domestic. Hazardous waste compounds, formulations and classes of substances, chemical classification of hazardous waste.

Soil factors affected by pollution – physico-chemical and biological impacts. Case studies on soil pollution in wetland and Highland soils in Kerala. Control of soil pollution. Soil quality parameters and test methods.

Module V. Solid Waste Management**15 hrs.**

Municipal solid wastes (MSW) - quantities and characteristics, waste collection and transport, waste processing and resources recovery and recycling. Aerobic and anaerobic systems-composting, vermicomposting; Biodigesters (Biogas plants); incineration, pyrolysis, plasma pyrolysis; sanitary land fills and open dumping yards. Management of plastic and e-waste. Better management strategies (any two model case studies). Treatment process for unsegregated waste, fixation of hazardous solid waste prior to disposal, hazardous waste in land fill.

Hazardous waste (Management and Handling) Rules 1989 - the Manufacture Storage and Import of Hazardous Chemicals Rules 1989 - Biomedical Waste (Management and Handling) Rules 1998 - Plastic Act 1999. Extended producer responsibility.

Module V. Noise, Thermal and Oil Pollution

7 hrs.

Properties of sound and noise. Effects of noise on People and ecosystem. Basic principles of noise control. National and International Standards. Assessment and measurement of sound.

Thermal Pollution-causes and consequences

Oil pollution – causes and consequences (any two case studies).

Module VI. Radiation Pollution

8 hrs.

Radiation pollution- Definition, Radioactivity, Radionuclide, Radiation emissions, sources, Radioactive decay and buildup. Biological effects of radiation. Radioactive pollution impacts on ecosystem. Nuclear reactor disasters (Any two case studies), safety standards.

Module VII. Toxicology

20 hrs.

Definition, scope and history of toxicology, Acute and chronic toxicity, selective toxicity, dose, synergism and antagonism.

Dose – Response relationships – Graded response, quantal response, Time action curves, Threshold Limit value (TLV); LC₅₀; Margin of safety; Toxicity curves; Cumulative toxicity and LD₅₀ and CTF. Toxic chemicals in the Environment – Biochemical aspects of As, Cd, Pb, Hg, Cu, O₃, PAN, pesticides, MIC and other carcinogens. Bio accumulation and biomagnification.

Occupational toxicology- hazardous chemicals, disorders from chemical exposure at work, assessment of occupational hazards.

Toxicity testing; Bioassay – Definition, purpose, criteria for selection of test organism, methodology, estimation of LC₅₀, Limitation and importance of bioassay, acute toxicity (single); sub acute toxicity; chronic toxicity; teratogenicity, carcinogenicity and mutagenicity.

Bio-monitoring of toxic chemicals - objectives, programs and parameters, concepts of bio indicators. Bio-transformation of Xenobiotics (Selective Toxicity).

REFERENCES

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ZY4C ET03 ENVIRONMENTAL MANAGEMENT AND DEVELOPMENT

90Hrs (5hrs/week)**Credit - 4****Module I. Environmental Management****20 hrs.**

Basic principles: Management of physical, social, and economic environment. Concepts and scope of environmental planning, regional planning and management. Cost-benefit analysis and Resource economics. Environmental modeling- simulation modeling, input-output modeling, Linear programming, Software and resource management.

Tool box for environmental management – An over view of Ecological foot prints, SEA, Ecological Economics, conflict resolution strategies. Eco funds.

Environmental auditing and standards Eco labeling and certification, accreditation – need, objectives and benefits; Corporate social responsibility and Corporate environmental responsibility, ISO standards for environmental management systems (EMS) ISO 14000, 14001 and 26001; OHSAS 18001.

Module II Ecosystem Management**20 hrs.**

An overview Population, Resources and ecosystem management Exponential growth in human numbers and the implications.

Major management concepts and methodologies The five basic laws of Ecology and their relevance for ecosystems management; paradigm shifts in the management of Ecosystems- influence of economics in ecology.

Management practices for various ecosystems: grasslands, forests, mountains, wetlands and coastal areas. Environmental planning and management of – waste lands, reclaimed lands, mining areas, human settlements, industrial lands and agricultural lands.

Eco restoration/remediation; local knowledge and management systems; environmentally sound management of Biotechnologies; the common property resources and their management.

Module III. Environmental Impact Assessment (EIA)**20 hrs**

Introduction- Definition, history, Aim, principles, concept and scope. Baseline data collection, Methods and steps - Adhoc method, checklist method, matrices, Map overlays method, network method, index method.

Impact assessment and impact evaluation-EIA Processes, Stages, EIA Statement Environment management plan- Risk assessment and disaster management programme. National Policy on EIA and Regulatory Framework: Environmental Impact Assessment Notification 2006 and Coastal Zone Notification 1991; Environmental Clearance Process in India; Legislative requirements (discharge requirements and area restrictions); Environmental Appraisal procedure for mining, industrial , thermal power, nuclear power and multipurpose river valley projects; Central and state pollution control boards for environmental protection. EIA case studies. Life Cycle Assessment (LCA) and its significance.

Module IV. Remote Sensing and GIS***15 hrs.**

Principles and concepts of Remote Sensing, Electromagnetic spectrum; spectral characteristics of surface features (rocks, soils, vegetations, water). Space Imaging Landsat, SPOT, IRS, NOAA, Seasat, ERS, RADARSAT, INSAT. Satellites and their sensors, geometry and radiometry, Digital Image Processing: Principles, Image Rectification and restoration, Image enhancement and Mosaicing. Image classification. Supervised, Unsupervised, Ground truth data and training set manipulation, Classification accuracy assessment. Geographical Information System (GIS): Basic principles and terminologies, Raster and vector data, Map projection, Topology creation, Overlay analysis, Data structure and Digital cartography; Software used in GIS Surveying: Leveling, Triangulation, Geodetic survey; Global Positioning System (GPS) Basic principles, Applications to environmental studies.

Module V. Environment Vs Development

5 hrs

Dominance of Man on earth. Limits of growth. Industrial revolution and resource utilization, environmental consequences. Modern agriculture and green Revolution- environmental impacts. Conflicts of interest - environment and development. Tragedy of the commons.

Module VI. Sustainable Development

10 hrs

Our common future and the idea of Sustainable Development - concepts and dimensions. Basic needs-Imperatives relating to sustainable development. Johannesburg Conference 2002 and follow up Conference on sustainable development. Securing Sustainable futures Millennium Development Goals and Strategies (MDG & S); the earth charter; need and scope for evolving participatory, community based environmental management strategies. Education for sustainability. Building sustainable societies and lifestyles. Ecological Foot Print analysis and its significance. Environmental concerns in traditional societies, Gandhian environmentalism.

*** Note:**

Students and faculty can avail of the facility RS & GIS Division of School of Environmental Sciences of the MG University for technical support and guidance for Module IV.

REFERENCES

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Web Resources

- www.moef.gov.in (of Ministry of Environment and Forests, Govt. of India)
- www.millenniumassessment.org. (for Millennium Ecosystem Assessment Synthesis Reports) www.unep.org

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ZY4C EP04 ENVIRONMENTAL SCIENCE: PRACTICAL –I

90 Hours (5 hrs/week)

Credit - 2

Soil texture using micrometry from two different sites. Determination of moisture content.

Determination of soil pH from at least three different locations and correlate it with the soil type. Determination of Chloride, Calcium, Magnesium, Potassium and Phosphorous.

Determination of Calcium Carbonate in Egg shell- (Three different types of egg; calculate the mean value and the standard deviation, and compare it with the standard values).

Estimation of primary productivity in two different aquatic ecosystems and interpretation of the results. Compare the results of Dark and Light bottle method and Chlorophyll method.

Identification of trophic levels from gut analysis (Fish or insect)

Study of biodiversity in Forest/Grass land and Pond/River and report the species richness, abundance and animal interactions. Calculate frequency, abundance, evenness and diversity indices (*This can be done as part of the three / four day field study compulsory for this elective*).

ZY4C EP05. ENVIRONMENTAL SCIENCE PRACTICAL-II

90 Hours(5 hrs/week)

Credit -2

Water Quality Analysis:

a. Determination pH, Electrical conductivity, Alkalinity, Salinity, Hardness, Nitrate, Phosphate and Silica

b. Determination of total dissolved salts (TDS)

Toxicity Analysis of Water: For Chlorine, H₂ S, Ammonia, Copper and

Chromium Estimation of BOD and COD of polluted water

Determination of LC₅₀ for fish (pesticide) using Probit analysis (use of appropriate software is suggested to find out the value)

Study of histo-pathological changes in any two of the tissues (Liver/ Kidney/ Gonad) using CCl₄ or NH₃ (five stained permanent slides [normal and affected] to be submitted for the examination).

Isolation and Enumeration of microorganisms in soil (TBC or

TMC). Bacteriological quality testing of water and wastewater.

(a). Presumptive coliform test

(b). Confirmatory coliform test

Field Study Report: (Three /four days)

Visit to Institutions engaged in environment /conservation research; a sanctuary/national park and an industrial /polluted area. Report the study conducted and submit a 10 page write up/ print out giving the dates, daywise itinerary, methodology, results and references. Include photographs of the activity. Group and individual assignments shall be preferred.

(The activity suggested in Practical -I can be clubbed with this field study).

SEMESTER IV

ELECTIVE COURSE D: MEDICAL MICROBIOLOGY

ZY4D ET 01	GENERAL MICROBIOLOGY & PARASITOLOGY
ZY4D ET02	BACTERIOLOGY, VIROLOGY & MYCOLOGY
ZY4D ET03	CLINICAL MICROBIOLOGY
ZY4D EP04	PRACTICAL –I. GENERAL MICROBIOLOGY & PARASITOLOGY
ZY4D EP05	PRACTICAL-II . CLINICAL MICROBIOLOGY

ELECTIVE D.: MEDICAL MICROBIOLOGY

Objectives:

To introduce the diversity of microbial world

To learn various pathogens, parasites and related diseases of man

To familiarise with various tools and techniques in the study of microbes and to manage a microbial laboratory

To provide skills and competency in the field of clinical microbiology

ZY4D ET01 GENERAL MICROBIOLOGY AND PARASITOLOGY

90 Hours (5hrs/week)

Credit-4

Module 1. Historical Introduction to Microbiology

3 hrs.

History, scope, relevance and future of microbiology.

Module II . Nomenclature and Identification of Bacteria

12 hrs.

Identification and nomenclature of bacteria - common biochemical tests for the identification.

Serological identification. Classification of bacteria and salient features according to Bergey's manual of determinative Bacteriology. Microbial diversity in different ecosystems (halophiles, mesophiles, thermophiles, acidophiles, alkalophiles, barophiles and other extremophiles). Identification and classification using molecular techniques.

Module III. Sterilization and Control of Microbial Growth

20 hrs.

Control of microorganisms by physical methods: heat, filtration and radiation; Sterilization equipments: Hot air oven and Pasteurization, Tyndallization.

Autoclaves- principles, precautions and applications; Filtration- types and methods Sterilization by radiation.

Chemical methods: phenolics, alcohols, halogens, heavy metals, quaternary ammonium compounds, aldehydes and sterilizing gases; Disinfectants and their mechanisms of action.

Evaluation of antimicrobial agent effectiveness. Antibiotics- types, mechanism of action.

Determination of MIC and MBC

Antibiotic sensitivity tests, antibiogram.

Antimicrobial agents (bacterial, viral and fungal).

Module IV. Microbial Growth and Cultivation of Bacteria

10 hrs.

Growth and nutritional requirements of bacteria. Autotrophs, heterotrophs - enrichment culture - growth curve - Kinetics of Growth - Mathematical expression of exponential growth phase; Measurement of growth and growth yields - Culture media, culture methods; Batch Culture - Synchronous growth - Techniques of pure culture.

Module V. Study of Morphology of Bacteria

20 hrs.

Microscopy, different types of microscopy.

Morphology and arrangement of bacteria, ultrastructure of bacteria. Cellular components of bacteria - sporulation and its mechanics.

Staining: Principle and Methods. Simple Staining and Differential staining, Common differential staining - Gram staining, Acid-fast staining (Ziehl-Neelson Method), Staining of Specific Structures, Spore staining (Schaeffer-Fulton Method), Capsule staining, staining of volutin granules, Negative staining.

Examination of bacterial motility.

Epidemiology of bacterial infections, Guidelines for the collection, Transport, Processing analysis, isolation of bacterial pathogens and reporting of cultures from specimens for bacterial infections.

Module VI. Microbiology of Water, Milk and Food Substances

5hrs.

Microbial contamination of water- types, sources, threats. Microbial contamination of milk. Food poisoning. Major food borne diseases. Methods of detection of microbial contamination of food, water and milk. Microbial standards of drinking water.

Module VII. Parasites and Vectors

20 hrs.

Study of Parasites- parasitism, types, origin and theories.

Structure and life cycle of the following parasites and pathogenesis of diseases caused: Also study their laboratory diagnosis, treatment and prevention, antiparasitic agents and susceptibility test (of each). Protozoan parasites- *Entamoeba histolytica*, *Plasmodium* sp., *Lieshmania*, *Trypanosoma*, *Trichomonas*, *Giardia*.

Taenia; Trematodes: *Schistosoma*; *Paragonimus*;

Helminthes – *Ascaris lumbricoides*, Hook Worm, Pin worm, Filarial Parasites.

Arthropod vectors of medical importance: definition, types, importance. Major vector borne diseases and their pathogens.

A brief study of the following insects, the major diseases they transmit, epidemiology of such diseases, control and preventive measures:

Mosquito, Sand fly, House fly, Tse-Tse fly, Fleas, Louse, Bed bug, Ticks, Mites

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Davis, D. and E. Ginsberg, 1990. *Microbiology* (4 edn.). Harper and Row Publishers, Singapore.

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Ketchum P.A. 1988. *Microbiology -Concepts and Applications*. Oakland University Press.

NZ. Markell, E.K., Voge, M and D.T. John. 2002. *Medical Parasitology*. W.B. Saunders,

Philadelphia. Prescott M.C, J.P. Hardley and D.A. Clean. 2001. *Microbiology*. ASM, USA

Ross, N.E. and J.D. McLaren (eds). 1986. *Pathophysiological Responses to Parasites*. British Society for parasitology, London.

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ZY4DET02BACTERIOLOGY, VIROLOGY AND MYCOLOGY

90 Hours (5hrs/week)

Credits- 4

Module I. Pathogenesis

5 hrs.

Mechanism of pathogenesis- bacterial and viral.
Prophylaxis of communicable diseases.

Module II. Pathogenic Bacteria

25 hrs.

Study of important properties, pathogenicity and laboratory identification of: *Staphylococci, Streptococci, Pneumococcus, Corynebacterium diphtheriae, Bacillus anthracis, Clostridium Neisseria, E.coli, Proteus, Klebsiella, Shigella* and *Salmonella. Vibrio, Pseudomonas, Haemophilus, Brucella.*
Study of important properties, pathogenicity and laboratory identification of: *Mycobacterium, Treponema, Leptospira, Yersinia, Bordetella, Mycoplasma, Actinomycetes, Rickettsiae* and *Chlamydiae* A brief study of bacteria viz. *Borrelia, Listeria, Campylobacter, Helicobacter* and *Legionella.*

Module III. Bacterial Infections of Human Body

15 hrs.

Bacterial infections of respiratory tract, Bacterial infections of gastro intestinal tract and food poisoning, Bacterial urinary tract infections, Bacterial infections of genital tract and reproductive organs, Bacterial infections of central nervous system, Skin and soft tissue infections, Bone and joint infections, Eye ear and sinus infections, Cardiovascular infections, Tissue samples for culture, Anaerobic infections, Zoonotic infections.
Infections associated with immunodeficiency and immune suppression, Pyrexia of unknown origin.

Module IV. Virology

20 hrs.

Study of properties of viruses viz., Alpha virus, Pox, Herpes Virus, Adeno, Orthomyxo virus, Paramyxo virus and Papova. Pathogenesis and laboratory diagnosis of diseases caused by these viruses.
Study of properties of viruses viz. Polio, Influenza, Rabies, and Rubella viruses, Hepatitis viruses, HIV and AIDS.
Pathogenesis of these viral diseases
Oncogenic viruses, Slow viruses and Prion diseases Immunology of viral infections

Module V. Control of Viruses and Emerging Viruses

5 hrs.

Control of viral infections through vaccines, interferons and chemotherapeutic agents.
Structure, genomic organization, pathogenesis and control of Human immunodeficiency virus. Emerging viruses

Module VI. Bacteriophages

10 hrs.

Structure and life cycle patterns of T-even phages; one step growth curve and burst size; Bacteriophage typing; Structure of Cyanophages, Mycophages.
General principles of phage-bacterium interaction and growth cycle studies of RNA and DNA phages. The biochemistry of phages infected bacterium. Phage genetics.

Module VII. Mycology

10 hrs.

Introduction, Classification of fungi, General techniques used in mycology. Cultivation of fungi, Staining of fungi.
Mycosis in man-Classification, pathogenesis and clinical findings in various superficial, cutaneous and systemic fungal infections. Opportunistic mycoses;
Immuno compromised situation and mycological infections; emerging diseases.
Antifungal agents (specific to disease to included in course) and their susceptibility test.

REFERENCES

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- Belsche, R.B., 1991. *Text Book of Human Virology* (2nd edn.). Mosby, St.Louis.
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ZY4D ET03 CLINICAL MICROBIOLOGY

90 Hours (5hrs./week)

Credit-4

Module I. Introduction

5hrs.

History of development of Medical Microbiology, Contributions made by eminent scientists. Safety in Clinical Microbiology laboratory. Good laboratory practices. Microbiological safety cabinets- Types. WHO safe code of practice for a clinical microbiology laboratory.

Module II. Epidemiology

15hrs.

Factors predisposing to microbial pathogenicity Infections. Sources of infections. Mode of transmission of infections, nosocomial infections, opportunistic infections, Normal microflora of human body. Identification of pathogens- cultural, biochemical, serological and molecular methods.

Module III. Laboratory Procedures for Microbiology

30hrs.

Collection, transport, processing and microbiological examination of Blood, Sputum, stool, urine, Cerebrospinal fluid, genital specimens, throat and mouth specimens, nasopharyngeal swabs and aspirates, ear discharges, eye specimens, pus from wounds, abscesses, burns and sinuses, and effusions.

Module IV. Diagnosis of Viral Diseases

10hrs .

Laboratory Diagnosis of Viral diseases
Specimens for viral diagnosis, Viral isolation and growth, Cell culture for viral detection
Detection of viral proteins, Detection of viral genetic material, Viral serology

Module V. Diagnosis of Fungal Diseases

10hrs.

Laboratory diagnosis of fungal diseases.
Diagnostic procedures, Superficial, Cutaneous and Systemic mycosis.

Module VI. Laboratory Studies of Parasites

15hrs.

Laboratory methods for diagnosis of parasitic infections.
Identification of animal parasites, Collection of specimens for the detection of parasites
Intestinal protozoans, Blood protozoans, intestinal helminthes, blood helminthes

Module VII. Handling of Laboratory Animals

5hrs.

Care and management of laboratory animals. Legal requirements for animal experiments. General aspects of organization of animal experiments- Preparation of animals, common experimental procedures, Humane methods of killing animals. Handling of common laboratory animals: Rabbit, guinea-pig, mouse and rat.

REFERENCES

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**ZY4D EP04 PRACTICAL I - GENERAL MICROBIOLOGY,
PARASITOLOGY AND MYCOLOGY**

90 hours (5 hrs./week)

Credit - 2

Preparation of stains and various staining methods
Simple Staining, gram's staining, Acid fast staining, Albert's staining
Sterilization-various Techniques: Autoclave, Hot air oven; Laminar flow chamber
Disposal of contaminated materials and Laboratory
refuse. Preparation of Antibiotic disc
Antibiotic sensitivity test-Kirby Bauer test and Tube dilution
Method Estimation of MIC
Test for Beta Lactamase.
Testing of disinfectants
Bacteriological test for water, air and
food. Examination of faeces for:
Amoeba and cyst
Eggs, larva and adult helminthes
Examination of blood for plasmodium and
Filariasis. Collection of Specimen for Fungi
Preparation of special medium.
Inoculation, Incubation and Identification of Fungi-*Candida
albicans*. Slide culture Techniques.

**ZY4D EP05 PRACTICAL 2 - BACTERIOLOGY, VIROLOGY AND
CLINICAL MICROBIOLOGY**

90 hours (5 hrs./week)

Credit - 2

Study of Morphological, cultural and Biochemical reactions of following organisms.
Staphylococcus aureus, *Streptococcus Species*, *E.coli*, *Klebsiella*, *Proteus*, *Salmonella
Schigella*, *Pseudomonas*.
Slide agglutination
Anaerobic culture methods; McIntosh Method
Slide Identification
Neisseria gonoerrhoea, *Mycobacterium*, *Tuberculosis*, *Mycobacterium leprae*,
Clostridium botulinum, *C.tetani*.
Viral Haemagglutination
Haemagglutination Inhibition test
Precipitation of serum and preservation for short and long term.
Widal test.
Immunodiffusion.
Various antigen-antibody reactions
Agglutination, Precipitation, Complement fixation, Passive Haemagglutination- latex agglutination test
(RA, ASO, CRP AND TRUST ANTIGEN)
ELISA

Field Study Report: (Three to four days)

1. Visit to Institutions engaged in microbiology/virology research (e.g., Vector Control Research Institute, Cherthala/ Virology Institute, Alapuzha/ Sree Chithra Institute, Thiruvananthapuram) ;
2. hospital with Pathology laboratory (e.g., Government Medical College Hospital), 3. Visit a polluted area and document microbial diversity. Report the study conducted and submit a 10 page write up/ print out giving the dates, daywise itinerary, methodology, results and references. Include photographs of the activity.

Group and individual assignments shall be preferred.

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**MAHATMA GANDHI UNIVERSITY
PRIYADARSHINI HILLS
KOTTAYAM-686560**

**MASTER DEGREE PROGRAMME IN ZOOLOGY
Restructured under credit semester system
(M.Sc. Zoology CSS Programme)
w.e.f. the academic year 2012-2013**

**Members of the Board of Studies in Zoology (PG) 2010-13
Mahatma Gandhi University
Kottayam**

1. **Dr. Shaju Thomas**, Nirmala College, Muvattupuzha (Chairman)
2. **Dr. Jameela Beevi K.S**, Maharaja's College, Ernakulam
3. **Dr. Issac Thomas**, S.B. College, Changanacherry
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6. **Prof. Philomina C.J**, Alphonsa College, Pala
7. **Dr. Gopakumar, P.S**, N.S.S Hindu College, Changanacherry
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10. **Dr. Sunil M.S**, Catholicate College, Pathanamthitta
11. **Prof. Mathew M. Oommen**, University of Kerala, Trivandrum

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Prof. Dr. A.P. Thomas, Director, Advanced Centre of Environmental Studies and Sustainable Development, MG University, Kottayam

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Maharajas College, Ernakulam - Dr. Shyamala M.V, Dr. Rema, L.P.

Marthoma College, Tiruvalla - Prof. Johnson Samuel, Dr. Kurian Mathew Abraham

Nirmala College, Muvattupuzha - Prof. Laly Mathew, Prof. Sasikala K. Joseph,

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