

## COURSE CAPSULES

### First Semester

#### **PP 5101. General Microbiology: (2)**

General introduction. Evolution of microorganisms. Classification. Sub cellular structure. Nutrition and growth. Microbial genetics and physiology. Overview of general methodology in microbiology. Prokaryotic diversity, Ecophysiology and habitat. Microbial ecology and environmental activities. Microorganisms and industry. Control of microorganisms.

#### **PP 5102. Plant Pathology (2)**

Concepts of diseases in plant, Pathogenesis. Molecular biology of plant infection. Inoculum and disease severity. Host parasite relations. Environment and disease development. Defense mechanisms. Disease Management.

#### **PP 5103. Insect Morphology (3)**

The external structure of insects: exoskeleton, metamerism, body regions, and the appendages: antennae, mouthparts, legs, wings and abdominal appendages. Maintenance systems: enteron; circulatory, respiratory, and reproductive systems; Control systems: nervous system; sensory receptors; endocrine system and exocrine glands.

#### **PP 5104. Insect Physiology (2)**

The functions of insect structures. Life processes and metamorphosis of insects. Physiology of moulting and body wall: formation of chemical properties of cuticle. Consequences of the possession of exoskeleton. Digestion, nutrition and metabolics. Respiration in terrestrial and aquatic insects. The blood constituents, circulation; homeostasis. Excretion. Senses: Chemoreception; mechanoreception; tactile senses; sensitivity to gravity, pressure, movement; hearing and sound production. Vision. Physiology of reproduction. Mating process and methods of sperm transfer; impregnation; oviposition; sex determination. Muscle action: strength and activity; energy source. Body temperature and humidity. Coordination: nervous and endocrine systems. Insect hormones, pheromones and defensive secretions.

#### **PP 5105. Clinical Plant Pathology (2)**

Clinical procedures and diagnostic techniques, Specialized techniques for identification and study of disease causing agents and plant diseases. Analysis of field problems. Field assignments and reports.

#### **PP 5106. Pesticide Toxicology (2)**

Principles and methods used in toxicology of pesticides. Chemical composition of insecticides and fungicides and their effects in plant and animal tissues. Toxicity to fauna and flora including domesticated animals and wildlife. Acute and chronic toxicity in humans.

#### **PP 5107. Pesticide Technology (1)**

Importance and need of pesticide legislations; Pesticide legislation, Registration of pesticides, FAO international code of conduct. Pesticide legislation in developed countries. Pesticide formulations; Application techniques, equipments. Safety procedures in pesticide management.

#### **PP 5108. Methods in Microbiology and Microbial Technology. (3)**

Safety in microbiology. Culture methods of bacteria, fungi, algae & protozoa, microbial consortia and communities. Biochemical and molecular approaches to measurements of biomass density, diversity and phylogeny. Microorganisms and recombinant DNA technology. Plasmids and phages as cloning vectors, Cloning procedures, cDNA and genomic libraries; construction and screening, DNA probes and labeling techniques, Colony and plaque hybridization methods, Solution hybridization, Yeast two hybrid systems and

phage displays, Polymerase chain reaction and its applications in microbiology, Bacterial transformation methods, Expression of mammalian genes in bacteria, Use of Agrobacterium vectors An integrated discussion of recent genetic, biochemical and engineering approaches to microbial processing from Antibiotic, Biomass and Citric acid to Zymomonas.

**PP 5109. Molecular Microbiology (2)**

Macromolecular Synthesis and Processing: DNA, RNA, and Protein Synthesis. Protein molecules. Macromolecular interactions, Biological membranes and bacterial cell wall. Membrane transport, Mode of action of antibiotics. Bacterial two component signal transfer systems, Growth, Physiology and metabolic regulation in Bacteria, Quorum sensing, Microbial stress responses. Biofilms-structure, phenotypic changes and distribution. Bacterial Genetics: Genetic material, DNA Exchange and transformation, Repair. Transposons, Regulation of Prokaryotic Gene Expression. Bacteriophage Genetics.

**PP 5110. Microbial Genomics (2)**

Introduction to genome and structural and functional genomics, Structural diversity of microbial genomes, Techniques essential to determine genome biodata, Construction of physical and genetic maps for microbial genomes, High resolution maps and linkage maps (gene encyclopedia), chromosome walking, Identification/mapping of genes, Genomic fingerprinting, Genome sequencing strategies, bioinformatics and genome analysis, Mutational studies and functional assays at phenotypic and gene expression level.

**PP 5151. Plant Molecular Biology (2)**

Introduction to plant molecular biology, Structure, regulation and function of plant genes and multi gene families, Signal Transduction, Control of plant developmental and physiological processes at molecular level, Scope for genetic manipulation of different plant processes, Current perspectives.

**PP 5152. Indigenous Technology for Plant Protection (2)**

Evolution of monoculture farming systems from chena to date. Kandyan forest garden systems. Hazards of modern agriculture. Ecological concepts of traditional agriculture. Plant protection as a holistic process in ecological farming for higher sustainability. Concept of spiritual, ecological and biodynamic farming for minimal pest damage. Survey of traditional herbal pest management techniques used in Sri Lanka. Case studies of spiritual and biodynamic pest management techniques used in Sri Lanka. Nawakekulama, Organic farming Biodynamic sowing and planting calendar, Kem and religious methods for prevention of pest infestations in plants and farm animals.

( Field trip). Methodology to test indigenous knowledge.

**PP 5153. Soil borne Pathogens and Root Diseases (2)**

Population dynamics of soil borne pathogens, Rhizosphere influence on pathogens, effects of soil environment on root diseases of crops of economic importance. Disease management.

**PP 5154. Epidemiology (2)**

Epidemiology, disease assessment and crop losses, pathogen factors in epiphytotics, Analysis and forecasting of epidemics, Control of plant diseases, Pesticides and their mode of action, use and abuse of pesticides.

**PP 5155. Immunology (2)**

General introduction to mammalian immune system. Barriers to infection. Evolution. Complement system. Biological effect of complement. Antibodies and their receptors. Antibody effect or functions. T cell receptors. Major histocompatibility complex. Antibody formation and generation of diversity. Antigen recognition and Antigen presentation. B-cell and T-cell interaction. Immunochemical techniques: Estimation of antibody-Antigen antibody interactions in solution. Immunoassay with solid phase antigen. Identification and quantitative assessment. Electrophoresis, SDS-PAGE, Single radial Immunodiffusion SRID, Immunoblotting, Immunoassay of antigens. Monoclonal Antibodies, Engineering Ab.Cellular techniques: Separation of leukocytes based on physical, biological parameters and antibody coating. Immunohisto-chemistry.

**PP 5156. Integrated Pest Management in the Tropics (pass/fail course)**

This practical training program is designed to provide the students the basic idea behind area-wide IPM, understand how to develop a site survey and IPM plan, improve plant health through cultural strategies, monitor pest populations, maintain records and determine when pesticide use is appropriate in an integrated approach.

**PP 5158. Methods of Invertebrate Ecology (2)**

Methods of invertebrate sampling, handling, rearing; Assessment methods of insect populations; Modeling of invertebrate populations; Methods in insect behaviour studies; Assessment methods of bio-control agents; Host specificity testing; Assessment methods of non-target effects of bio-control agents; Assessment of parasitism; Assessment of host parasitoid synchronization; current research in invertebrate ecology.

**PP 5196. Practicum in Molecular and Applied Microbiology (2)**

Practicum in Molecular and Applied Microbiology covers essential techniques in Molecular Microbiology including, culturing of microorganisms, extraction of nucleic acids, analysis of DNA and RNA, quantification of nucleic acids, PCR and different versions of standard PCR (PCR-RFLP, RT-PCR), nucleic acid hybridization techniques (DNA blotting, Southern hybridization, RFLP, colony blots), transformation, electroporation, preparation of competent bacterial cells, cloning of DNA, selection of recombinant clones

**PP 5197. Practicum in Plant Protection Technology (2)**

Practicum in Plant Protection Technology includes a series of practicals and field visits; curation of adult and immature insects; curation of insects damaged plant specimens; preparation of a life cycle of a selected insect pest species; Preparation of a digital image collection on insect damages on crop plants; Preparation of microscopic slides (dissected mouth parts) and parasitoids for taxonomic studies; Pesticide appliances (operation); General techniques in plant pathology; identification of plant pathogenic microbes; Field visits to selected research stations and to vegetable farming areas.

**PP 5198. Directed Study (5)**

Candidates will conduct a research project on a selected topic recommended by the advisor. The student will receive an adequate training on proposal writing, research hypothesis, literature survey, research methodology, data collection, data analysis, report writing and presentation.

**PP 5199. Seminar (1)**

**Second Semester**

**PP 5201. Insect Systematics and Identification (2)**

The species concept. Diversity of insect world. Principles of nomenclature and classification, Diagnostic and special features of major taxa of Superclass Hexapoda, Use and construction of identification keys, Procedures adopted in identification of insects up to species level. Use of chemotaxonomy and morphometric studies in subspecies level identification.

**PP 5202. Insect Ecology and Behaviour (2)**

Principles of ecology and analysis of the insect environment. Effect of climate and abundance and distribution of insect populations. Biotic factors in the environment, Intraspecific and interspecific competition. Models of growth and stability of insect populations, Life table studies, Use of population dynamics strategies in insect pest control. Forms of insect behaviour. Functional aspects of behaviour and feeding, flight and defensive behaviour, Physiology of behaviour of social and non-social insects, Mating behaviour, Photoperiodism and insect behaviour, Communication in insects, hormonal and Pheromonal control of insect behaviour, Manipulation of ecological factors and insect behavior in insect pest management

**PP 5203. Nematology (2)**

The morphology, taxonomy, ecology and symptomology of nematodes, parasitic on cultivated crops. Biological, cultural, chemical and non-chemical management of nematodes in plantation crops, vegetables and other crop production systems. Field sampling, damage estimation. mapping and forecasting of nematode incidences for effective management. Research applications in nematology

**PP 5204. Biological Control of Agricultural Pests (2)**

Historical landmarks of Biological control; Scope of Biological control; Concept of natural regulation. Ecological interactions in a biocontrol system; Approaches of Biological control: Classical biological control, conservation, and augmentation & release. Taxonomy of entomophagous insects, Predator-Prey systems and Host-parasitoid systems. Microbial control. Research trends in biological control.

**PP 5206. Integrated Pest Management (2)**

History of IPM, Economics Injury level and pest status, Assessment of Pest population and crop losses, Natural regulation of Pest populations, IPM components (Cultural control, Physical and mechanical control, Regulatory control, Biological control, Host Plant Resistance, Sterile Insect Techniques and Chemical control). IPM for different cropping systems, Research Extension and Farmer training, Institutional Aspects of IPM.

**PP 5207. Plant Resistance to Insect Pests (2)**

Insect Plant Interaction, Host Plant Selection by phytophagous insects, Mechanisms of resistance, Factors affecting expression of resistance, Implementation of Host-plant resistance program, Role of vector resistance in virus disease control in plants, current trends in host plant resistance.

**PP 5208. Molecular Diagnostics for Plant Protection (2)**

Importance of using molecular techniques for the identification of pathogens and pests; field collection of plant and animal specimens for DNA work; DNA and RNA extraction techniques from plants, insects and microorganisms; DNA probes and their use in identification of pathogens and pests, PCR as a diagnostic tool; PCR and Non-PCR based diagnostic techniques to identify plant pathogens and pests; RAPDS, AFLP, SSCP, SSR. Use of special gel electrophoretic techniques for diagnostics TGGE & DGGE Sources of probes and primers for diagnostics; Nuclear DNA, CpDNA, mtDNA, rDNA, RAPDS & SSRs. Screening for genetic diversity among plant pathogens and insect pests using molecular tools. Molecular taxonomy, phylogenetics and data analysis, Case studies.

**PP 5209. Post Harvest Protection (2)**

Causes of postharvest losses, Economic importance, Identification of insect pests and diseases. Bionomics of organisms that cause postharvest losses including higher animals. Cross infestations, secondary pests, (fungus feeders, scavengers). Microorganisms infecting durable and perishable products, Mechanisms of deterioration of the produce. Management of post harvest pests and diseases in Sri Lanka, Control measures, Clean products, drying, cold storage, pest proof buildings and sealable containers, storage hygiene, avoidance of mechanical damage and other disease producing situations, removing surface wetness, Chemical methods including fumigation.

**PP 5210. Acarology (2)**

External morphology of acarina; segmentation and body regions; integument; mouthparts; legs. Internal anatomy. General biology: life cycles; feeding habits and habitats. Classification and identification of acarina. Collection, preservation and preparation of mites for studies, Description of economically important species of ticks and mites. Control of phytophagous mites and exoparasitic ticks and mites.

**PP 5211. Microorganisms with medical importance (2)**

Microbial pathogens of man. Bacterial pathogens, viruses including HIV as human pathogens. Laboratory Diagnostic tests, procedures and techniques for identification of human pathogens, Opportunistic infections, Laboratory requirements and proper lab practice in a medical microbiology lab, Antibiotics and other chemotherapeutic agents, Mode of action of antibiotics. Microbial resistance to drugs, mechanisms of acquired resistance, Prevention of drug resistance, common Immunizations. Recombinant vaccines and drug design.

**PP 5212. Aquatic Microbiology and Water Quality. (2)**

Water microbiology aquatic microorganisms. Quality parameters of drinking water. Quality standards and other indicator microorganisms. Quality tests. Common pollutants of drinking water and disease associated with them. Pollution and impact of pollution of waterways and reservoirs. Purification of drinking water and assessment of

efficacy. Wastewater management. Taxonomy & Physiology of Marine Microorganisms. Distribution and metabolic activities of various marine microbes in Open Ocean, coastal areas and artificial environments such as harbors. Deep sea habitats. High-pressure laboratory techniques. Biofilms. Diseases caused by marine microorganisms in seaweeds, fish and algae.

**PP 5213. Industrial Microbiology and Biotechnology (2)**

Microorganisms in food, their application in agriculture, industry, environment and health sector. Bioreactors. Biogas production and utilization. Survey of application of Microbiology in biotechnology emphasizing the microbial pesticides, biofertilizer, efficient microorganisms, the operation of fermentation systems and pharmaceutical industry (recombinant pharmaceuticals). Case studies of down stream separation & purification protocols on an industrial scale. Protein engineering and Enzyme biotechnology.

**PP 5214. Molecular Plant - Microbial Interactions (2)**

Molecular Biology of Plant Microbe systems. : Beneficial interactions such as legume-Rhizobia symbiosis, Non-legume N fixing endosymbiosis. PGPR, Mycorrhiza, Endophytes, Epiphytes etc. Pathogenic systems. Bacterial pathogens. Molecular approaches to achieve durable disease resistance. Virulence factors and pathogenesis. Modulators of resistance and susceptibility. Cell to cell interaction. Microbial hormones in Plant development. Signal transduction.- Bacterial type III effectors . Regulation of plant defense reactions. Recognition of plants by microbes. Plant virus interactions. Cellular dynamics of interactions. Coordinated expression of plant and mycorrhizal genes and their fate in plant. Molecular basis of plant response to microbial invasion, plant pathogen co-evolution.

**PP 5251. Insect Toxins and Insect Transmission of Plant Disease (2)**

Studies on the chemical and biological effects of insects feeding on plants and the transmission of plant disease by insects.

**PP 5252. Molecular Virology (2)**

Introduction to Molecular Virology, Plant viruses and virus-like agents, Investigation, biochemistry and physiology of virus diseases, symptomatology, transmission, isolation and identification of plant viruses and virus-like agents, Principles of electron microscopy and serology, Specific diseases of important crops and control. Genomes of plant viruses, replication strategies, cell to cell transport, molecular methods for detection and identification of viruses, molecular strategies to achieve viral resistance, benefits of viruses in biotechnology.

**PP 5253. Insect Pests and Diseases of Forests (2)**

Introduction to pathological stress of forest trees, major grouping of leaf, stem and root diseases, rust, wilt and wound disease, -decay and discoloration, disease diagnosis and management and tree surgery, Introduction to insect pest damages in forest, factors affecting abundance of forest insects, bionomics of insect pests of common forest trees in the tropics, assessment of pest population and extent of their damages in forest, management of forest insect pests.

**PP 5254. Disease Management in Floricultural Crops (2)**

Introduction to disease problems in floriculture industry, Pathology, dissemination and principles of disease management in indoor and outdoor floricultural plants, Diagnosis and treatments, Recent developments in disease management in floricultural crops.

**PP 5255. Insect Pathology and Microbial Control of Pests (2)**

Types of diseases, recognition and pathology, isolation of insect pathogenic microbes, maintenance of cultures, testing against pest species, uses in IPM programs, production and formulation of microbial insecticides, problems of insect pathogens in beneficial insects (silk worm, honey bees).

**PP 5256. Techniques and Strategies in Plant Molecular Biology (3)**

Arabidopsis methods in plant science, Advanced PCR strategies and PCR primer design, Sources of information for plant scientists on the web, Computer based molecular sequence analysis and image analysis, Techniques to isolate and characterize novel plant genes, Localization techniques to study gene and protein expression in plants, methods in functional genomics.

**PP 5257. Crop Protection in the Tropics (2)**

Prevalence and assessment of damages caused by insect pests, diseases and weeds in tropical environments, Management strategies for insect pests, diseases and weeds in tropics: cultural, biological, chemical, physical and mechanical, genetic, regulatory and traditional methods; Case studies in insect pests, diseases and weed management; Farmer education on eco-friendly pest and crop management; Pesticide management problems in the tropics, emergence of resistance; Quarantine aspects of insect pests, diseases and weeds in the tropics.

**PP 5259. Insect Pest Management in Horticultural Crops (2)**

Concepts of pest management; Conventional and traditional pest management strategies; Integrated pest management; Ecological pest management. Bionomics and management of insects attacking horticultural crops: common polyphagous insects, aphids, whitefly, thrips, and fruit fly. Bionomics and management of insects attacking fruit crops; mango, pineapple, banana, papaya, rambutan, strawberry and other minor crops. Bionomics and management of insects attacking vegetables: crucifers, legumes, cucurbits and leafy vegetables.

**PP 5260 Advances in Plant Protection Methods for Plantation Crops and Forest Species (1)**

Plantation crop protection: overview, need and significance, historical developments, economics in pest control; Overview of insect pest species of tea, rubber, coconut and sugarcane; Overview of insect pests of economically-significant forest tree species; Pest population monitoring techniques; Pest control techniques in plantation crops and forests: Biological control; pheromonal control, chemical control, host plant resistance; Future trends in crop protection in plantation crops and forest tree species; Diseases of economic-significance in Tea, Rubber, Coconut and Sugarcane plantations (i.e. causal organisms, symptoms/signs, damage, disease identification); Diseases/disorders of forest trees; Integrated disease management with special reference to non-chemical methods; Impact of climate change on population dynamics of pathogens/microorganisms and disease development; Genetic and management improvements to tolerate/resist the effects of pathogens.