Introductory Microbiology:

Theory

Introduction. Microbial world: History of Agril. Microbiology, Prokaryotic and eukaryotic microbes. Bacteria: cell structure, chemoautotrophy, photo autotrophy, growth. Bacterial nutrition: classification of nutrients Macro elements, Microelements, growth factors, culture media, nutritional classification of microorganisms Bacterial genetics: Genetic recombination- transformation, conjugation and transduction, plasmids, transposon. Role of microbes in soil fertility and crop production: Carbon, Nitrogen, Phosphorus and Sulphur cycles. Biological nitrogen fixation- symbiotic, associative and asymbiotic. Azolla, blue green algae and mycorrhiza. Rhizosphere and phyllosphere. Microbes in human welfare: silage production, biofertilizers, biopesticides, biofuel production and biodegradation of agro-waste. Mushrooms- edible and poisonous types, nutritive values, Culturing and production techniques.

Practical

Introduction to microbiology laboratory and its equipments; Microscope- parts, principles of microscopy, resolving power and numerical aperture. Methods of sterilization. Nutritional media and their preparations. Enumeration of microbial population in soil- bacteria, fungi, actinomycetes. Methods of isolation and purification of microbial cultures. Isolation of *Rhizobium* from legume root nodule. Isolation of *Azotobacter* from soil. Isolation of *Azospirillum* from roots. Isolation of BGA. Staining and microscopic examination of microbes. Simple Staining, Negative staining and Gram Staining. Isolation of P and silicon Solubilizing Microbes, Mycorrhiza, Isolation of cellulose and Pectin degrading microbes for agro waste management

- **Fundamentals of Plant Pathology**

Theory

Introduction: Importance of plant diseases, scope and objectives of Plant Pathology. History of Plant Pathology with special reference to Indian work. Terms and concepts in Plant Pathology. Pathogenesis. Cause and classification of plant diseases. Important plant pathogenic organisms, different groups: fungi, bacteria, fastidious vesicular bacteria, Phytoplasmas, spiroplasmas, viruses, viroids, algae, protozoa, phanerogamic parasites and nematodes with examples of diseases caused by them. Diseases and symptoms due to abiotic causes. Fungi: general characters, definition of fungus, somatic structures, types of fungal thalli, fungal tissues,modifications of thallus, reproduction (asexual and sexual). Nomenclature, Binomial system of nomenclature, rules of nomenclature, classification of fungi. Key to divisions,sub-divisions, orders and classes.Bacteria and mollicutes: general morphological characters. Basic methods of classification and reproduction.Viruses: nature, architecture, multiplication and transmission.Study of phanerogamic plant parasites.Nematodes: General morphology and reproduction, classification, symptoms and nature of damage caused by plant nematodes (Heterodera, Meloidogyne, *Anguina* etc.)Principles and methods of plant disease management.Nature, chemical combination, classification, mode of action and formulations of fungicides and antibiotics.

Practical

Acquaintance with various laboratory equipments and microscopy. Preparation of media,isolation and Koch's postulates. General study of different structures of fungi. Study of symptoms of various plant diseases. Study of representative fungal genera. Staining and identification of plant pathogenic bacteria. Transmission of plant viruses. Study of phanerogamic ant parasites.Study of morphological features and identification of plant parasitic nematodes. Extraction of nematodes from soil. Study of fungicides and

their formulations. Methods of pesticide application and their safe use. Calculation of fungicide sprays concentrations.

➢ Principles of Integrated Disease Management

Theory

IPM: Introduction, history, importance, concepts, principles and tools of IPM. Economic importance of diseases and pest risk analysis. Methods of detection and diagnosis of diseases.Measurment of lossess causes due to diseases. Methods of control: Host plant resistance, cultural, mechanical, physical, legislative, biological and chemical control. Ecological management of crop environment. Introduction to conventional pesticides for the disease management. Survey surveillance and forecasting of plant diseases. Development and validation of IPM module. Implementation and impact of IPM (IPM module for diseases. Safety issues in pesticide uses. Political, social and legal implication of IPM. Case histories of important IPM programmes.

Practical

Methods of diagnosis and detection of various plant diseases, Methods of plant disease measurement, Assessment of crop yield losses, calculations based on economics of IPM, Identification of biocontrol agents,Mass multiplication of *Trichoderma, Pseudomona*s, NPV etc. identification of diseases and their management. Crop (agro-ecosystem) dynamics of selected diseases. Plan & assess preventive strategies (IPM module) and decision making. crop monitoring attacked by diseases . Awareness campaign at farmers' fields.

➢ Biofertilizers, biocontrol agents and biopesticides

Theory

Biofertilizers: Introduction and types and importance of biofertilizers, Biopesticides and bioagents in agriculture and organic farming system, History of biofertilizers production Classification of biofertilizers microorganisms used in biofertilizers production. A study of growth characteristics of various microbes used in biofertilizers production. Nitrogen cycle in Nature. Process of nodule formation ,Role of Nif and Nod gene in Biological Nitrogen fixation, Enzyme nitrogenase and its component, Biochemistry of nitrogen fixation, Cross inoculation groups amongst *Rhizobium*, Methods used for the studying selection of efficient strain of *Rhizobium* .Quality standard for biofertilizers different methods of application of biofertilizers, role of microorganisms in decomposition of organic farm wastes, methods of quality control assessment in respect of biofertilizers, Strategies of Mass multiplication and packing Registration of biofertilizers. Strategies of marking and Registration with CIB of bioagents and biopesticides

Importance of *Trichoderma* spp., *Pseudomona*s spp. and *Bacillus* spp. as a biocontrol agents,Mechanism of disease control by thses organisms bioagents .Types of diseases controlled bioagents formulations, Effectiveness of bioagents against seed borne and soil borne plant pathogens, Mass multiplication and packing , Strategies of marking, and Registration with CIB and organic farming institute

Importance of *Trichogramma*, *Cryptolaemus, Chrysoperla*, NPV and entomofungal pathogens. Establishing insectary for host insects and natural enemies, Mass production of *Verticillium/Beauveria/Metarhzium/Nomuraea/Paecilomyces*/*Hirsutella thompsoni/Trichoderma, / Pseudomonas/Bacillus/Potash Mobilizers/Sulphur oxidizers /organic matter decomposers*

Practical

Equipment, machinery and tools used for biofertilizers,Biopesticides and bioagents production. Preparation of media used for isolation and culturing of biofertilizers : Jensen's agar, NFb medium, Yeast extract manitol agar, BGA-medium, Pikovaskaya's medium ; Isolation of *Rhizobium* from root nodulesIsolation *Azotobacter* from rhizosphere of cereal crops, *Beijernickia, Acetobacter* from soil, *Azospirillium* from roots of graminicious plants, BGA from soil, Mycorrhizae from the roots,PSM sulphur oxidizing microorganisms, ion chealator, potash mobilizers ,organic matter decomposers and their isolation in pure culture form. Estimating the efficiency of *Rhizobium* through pot culture experiments and through nodulation tests in test tubes and Leonard jar.. Preservation of cultures of these organisms. Production of commercial biofertilizers *viz*. *Rhizobium, Azotobacter, Azospirillum* and *Acetobacter* : selection of efficient strains, carriers and their sterilization, mother culture preparation, mass multiplication using shake culture method, mixing of culture and carriers and preparation of packets. Production of carrier based and grain based phosphate solubilizing biofertilizers.

Methods of mass multiplication of BGA and *Azolla*. A large scale production of decomposting cultures. Va-mycorrhiza : growth on Guinea grass roots and observations for root colonization. Preparation of VA-mycorrhizal inoculum. Methods of application of *Rhizobium*, *Azotobacter*, *Azospirillum* and phosphate solubilizing biofertilizers. Methods of application of *Azolla* and blue green algal biofertilizers in paddy farming. Production of compost cultures. Quality control of biofertilizers : ISI standards specified and estimating the viable bacterial count in carrier based biofertilizers. Storage of biofertilizer packets. Visit to biofertilizer plants. Preparation of plan of biofertilizer production unit and proposal of loan. Biopesticide and bioagents : Mass production of *Trichogramma, Cryptolaemus, Crysoperla,*Mass HaNPV, and EPN. Importance of *Verticillium/Beauveria/ Metarhzium/Nomuraea/ Paecilomyces*/*Hirsutella thompsoni/ Trichoderma,/ Pseudomonas/Bacillus/ organic matter decomposers.* Testing of quality parameters and standardization of biopesticides.

- **Diseases of Field and Horticultural Crops and their Management – I**

Theory :

Symptoms, etiology, disease cycle and management of major diseases of following crops:

Field Crops: Rice: blast, brown spot, bacterial blight, sheath blight, false smut, Khaira and tungro; Maize: stalk rots, downy mildew, leaf spots; Sorghum: smuts, grain mold and anthracnose, Bajra: downy mildew and ergot; Finger millet: Blast and leaf spot

Groundnut: early and late leaf spots, wilt.Soybean: Rhizoctonia blight, bacterial spot, seed and seedling rot and mosaic; Pigeonpea: Phytophthora blight, wilt and sterility mosaic; Black & green gram: Cercospora leaf spot and anthracnose, web blight and yellow mosaic; Castor: Phytophthora blight; Tobacco: black shank, black root rot and mosaic.

Horticultural Crops: Guava: wilt and anthracnose; Banana: Panama wilt, bacterial wilt, Sigatoka and bunchy top; Papaya: foot rot, leaf curl and mosaic, Pomegranate: bacterial blight;

Cruciferous vegetables: Alternaria leaf spot and black rot; Brinjal: Phomopsis blight and fruit rot and Sclerotinia blight; Tomato: damping off, wilt, early and late blight, buck eye rot and leaf curl and mosaic; Okra: Yellow Vein Mosaic; Beans: anthracnose and bacterial blight; Ginger: soft rot; Colocasia: Phytophthora blight;

Coconut: wilt and bud rot; Tea: blister blight; Coffee: rust

Practical

Identification and histopathological studies of selected diseases of field and horticultural crops covered in theory. Field visit for the diagnosis of field problems. Collection and preservation of plant diseased specimens for Herbarium;
Note: Students should submit 50 pressed and well-mounted specimens.

- **Diseases of Field and Horticultural Crops and their Management – II**

  Theory

  Symptoms, etiology, disease cycle and management of following diseases:

  Field Crops: Wheat: rusts, loose smut, karnal bunt, powdery mildew, alternaria blight, and ear cockle; Sugarcane: red rot, smut, wilt, grassy shoot, ratoon stunting and Pokkah Boeng; Sunflower: Sclerotinia stem rot and Alternaria blight; Rust, Downy mildew Mustard: Alternaria blight, white rust, downy mildew and Sclerotinia stem rot;Gram: wilt, grey mould and Ascochyta blight;Lentil: rust and wilt;Cotton: anthracnose, vascular wilt, and black arm;Pea: downy mildew, powdery mildew and rust

  Horticultural Crops: Mango: anthracnose, malformation, bacterial blight and powdery mildew; Citrus: canker and gummosis, Grape vine: downy mildew, Powdery mildew and anthracnose; Apple: scab, powdery mildew, fire blight and crown gall; Peach: leaf curl, Strawberry: leaf spot Potato: early and late blight, black scurf, leaf roll, and mosaic;

  Cucurbits: Downy mildew, powdery mildew, wilt; Onion and garlic: purple blotch, and Stemphylium blight; Chillies: anthracnose and fruit rot, wilt and leaf curl; Turmeric: leaf spot, Coriander: stem gall, Marigold: Botrytis blight; Rose: dieback, powdery mildew and black leaf spot.

  Practical

  Identification and histopathological studies of selected diseases of field and horticultural crops covered in theory. Field visit for the diagnosis of field problems. Collection and preservation of plant diseased specimens for herbarium. Note: Students should submit 50 pressed and well-mounted specimens.