M.Sc. (Ag.) in Plant Pathology

as per ICAR Guidelines

Restructured and Revised

Syllabi of Post-graduate Programme

Courses and Syllabus

of

Plant Pathology

Palli Siksha Bhavana

(Institute of Agriculture)

Visva-Bharati, Sriniketan

Semester-wise course and credits allocation

M.Sc. (Ag.) in Plant Pathology (Revised BSMA syllabus)		
Course Code	**Course Title**	**Credit Hours**
SEM I		
PL PATH 501	Mycology	3(2+1)
PL PATH 505	Principles of Plant Pathology	3(2+1)
PL PATH 507	Principles of Plant Disease Management	3(2+1)
PL PATH 509	Disease Resistance in Plants	2(2+0)
PL PATH 515	Diseases of Field and Medicinal Crops	3(2+1)
SEM II		
PL PATH 502	Plant Virology	3(2+1)
PL PATH 503	Plant Pathogenic Prokaryotes	3(2+1)
PL PATH 506	Techniques in Detection and Diagnosis of Plant Diseases	2(0+2)
PL PATH 513	Biological Control of Plant Diseases	2(1+1)
PL PATH 514	Integrated Disease Management	3(2+1)
PL PATH 516	Diseases of Fruits, Plantation and Ornamental Crops	3(2+1)
PL PATH 517	Diseases of Vegetable and Spices Crops	3(2+1)
SEM III		
PL PATH 504	Plant Nematology	3(2+1)
PL PATH 508	Epidemiology and Forecasting of Plant Diseases	1(1+0)
PL PATH 510	Ecology of Soil-borne Plant Pathogens	2(1+1)
PL PATH 511	Chemicals and Botanicals in Plant Disease Management	3(2+1)
PL PATH 518	Post Harvest Diseases	3(2+1)
SEM IV		
PL PATH 512	Detection and Management of Seed Borne Pathogens	3(2+1)
PL PATH 519	Plant Quarantine and Regulatory Measures	1(1+0)
PL PATH 591	Master's Seminar	1(0+1)
PL PATH 599	Master's Research	30(0+30)

DETAILED COURSE SYLLABI

I. Course Title : Mycology

II. Course Code : PL PATH 501

III. Credit Hours : 2+1

IV. Aim of the course

To study the nomenclature, classification and characters of fungi.

V. Theory

Unit I

Introduction, definition of different terms, basic concepts. Importance of mycology in agriculture, relation of fungi to human affairs. History of mycology. Importance of culture collection and herbarium of fungi. Somatic characters and reproduction in fungi. Modern concept of nomenclature and classification, Classification of kingdom fungi: Stramenopila and Protists.

Unit II

The general characteristics of protists and life cycle in the Phyla Plasmodiophoromycota, Dictyosteliomycota, Acrasiomycota and Myxomycota. Kingdom Stramenopila: characters and life cycles of respective genera under Hypochytriomycota, Oomycota and Labyrinthulomycota.

Unit III

Kingdom fungi: General characters, ultrastructure and life cycle patterns in representative genera under Chytridiomycota, Zygomycota, Ascomycota; Archiascomycetes, Ascomycetous yeasts, Pyrenomycetes, Plectomycetes, Discomycetes, Loculoascomycetes, Erysiphales and anamorphs of ascomycetous fungi.

Unit IV

Basidiomycota; general characters, mode of reproduction, types of basidiocarps and economic importance of Hymenomycetes. Uridinales and Ustilaginales; variability, host specificity and life cycle pattern in rusts and smuts. Mitosporic fungi; status of asexual fungi, their teliomorphic relationships, Molecular characterization of plant pathogenic fungi.

VI. Practical

- Detailed comparative study of different groups of fungi;
- Collection of cultures and live specimens;
- Saccardoan classification and classification based on conidiogenesis;
- Vegetative structures and different types of fruiting bodies produced by slime molds, stramenopiles and true fungi;
- Myxomycotina: Fructification, plasmodiocarp, sporangia, plasmodium and aethalia. Oomycota;
- Somatic and reproductory structures of *Pythium*, *Phytophthora*, downy mildews and *Albugo*, Zygomycetes: Sexual and asexual structures of *Mucor*, *Rhizopus*, General characters of VAM fungi. Ascomycetes; fruiting structures, Erysiphales, and Eurotiales;
- General identification characters of Pyrenomycetes, Discomycetes, Loculo- ascomycetes and Laboulbenio-mycetes, Basidiomycetes; characters, ultrastructures and life cycle patterns in Ustilaginomycetes and Teliomycetes, Deuteromycetes;
- Characters of Hyphomycetes and Coelomycetes and their teliomorphic and anamorphic states, Collection, preservation, culturing and identification of plant parasitic fungi;
- Application of molecular approaches and techniques for identification of fungal pathogens.

VII. Learning outcome

After successful completion of this course, the students would have

• Detailed knowledge about fungi and their biology would help the learners for research in the field of host pathogen interaction and management.

I. **Course Title : Plant Virology**

II. **Course Code : PL PATH 502**

III. **Credit Hours : 2+1**

IV. **Aim of the course**

To acquaint with the structure, virus- vector relationship, biology and managementof plant viruses.

V. **TheoryUnit I**

History and economic significances of plant viruses. General and morphological characters, composition and structure of viruses. Myco-viruses, arbo and baculo viruses, satellite viruses, satellite RNAs, phages, viroids and prions**.** Origin and evolution of viruses and their nomenclature and classification.

Unit II

Genome organization, replication in selected groups of plant viruses and their movement in host. Response of the host to virus infection: biochemical, physiological, and symptomatical changes. Transmission of viruses and virus-vector relationship. Isolation and purification of viruses.

Unit III

Detection and identification of plant viruses by using protein and nucleic acid based diagnostic techniques. Natural (R-genes) and engineering resistance to plant viruses.

Unit IV

Virus epidemiology and ecology (spread of plant viruses in fields, host range and survival). Management of diseases caused by plant viruses.

VI. **Practical**

- Study of symptoms caused by plant viruses (followed by field visit);
- Isolation and biological purification of plant virus cultures;
- Bioassay of virus cultures on indicator plants and host differentials;
- Transmission of plant viruses (Mechanical, graft and vector and study of disease development);
- Plant virus purification (clarification, concentration, centrifugation, high resolution separation and analysis of virions), Electron microscopy for studying viral particlemorphology;
- Antisera production, Detection and diagnosis of plant viruses with serological (ELISA), nucleic acid (Non-PCR–LAMP, Later flow micro array and PCR based techniques);
- Exposure to basic bio-informatic tools for viral genome analysis and their utilization in developing detection protocols and population studies (BLASTn tool, Primer designing software, Bioedit tool, Claustal X/W, MEGA Software).

VII. **Learning outcome**

After successful completion of this course, the students would have

- Detailed knowledge about virus and sub-viral particles would help the learners for research in the field of host pathogen interaction and management.

I. **Course Title : Plant Pathogenic Prokaryotes**

II. **Course Code : PL PATH 503**

III. **Credit Hours : 2+1**

IV. **Aim of the course**

To acquaint with plant pathogenic prokaryote (procarya) and their structure, nutritional requirements, survival and dissemination.

V. **Theory**

Unit I

Prokaryotic cell: History and development of Plant bacteriology, history of plant bacteriology in

India. Evolution of prokaryotic life, Prokaryotic cytoskeletal proteins. Structure of bacterial cell. Structure and composition of Gram negative and Gram positive cell wall; synthesis of peptidoglycan; Surface proteins; Lipopolysaccaride structure; Membrane transport; fimbrae and pili (Type IV pili); Mechanism of flagellar rotatory motor and locomotion, and bacterial movement; Glycocalyx (S-layer; capsule); the bacterial chromosomes and plasmids; Operon and other structures in cytoplasm; Morphological feature of fastidious bacteria, spiroplasmas and Phytoplasmas.

Unit II

Growth and nutritional requirements. Infection mechanism, role of virulence factors in expression of symptoms. Survival and dispersal of phytopathogenic prokaryotes. Taxonomy of phytopathogenic prokarya: Taxonomic ranks hierarchy; Identification, Classification and nomenclature of bacteria, phytoplasma and spiroplasma. The codes of Nomenclature and characteristics. Biochemical and molecular characterization of phytopathogenic prokaryotes.

Unit IV

Variability among phytopathogenic prokarya: general mechanism of variability (mutation); specialized mechanisms of variability (sexual like process in bacteria- conjugation; transformation; transduction); and horizontal gene transfer.

Unit V

Bacteriophages, L form of bacteria, plasmids and bdellovibrios: Structure; Infection of host cells; phage multiplication cycle; Classification of phages, Use of phages in plant pathology/ bacteriology, Lysogenic conversion; H Plasmids and their types, plasmid borne phenotypes. Introduction to bacteriocins. Strategies for management of diseases caused by phytopathogenic prokaryotes.

VI. Practical

- Study of symptoms produced by phytopathogenic prokaryotes;
- Isolation, enumeration, purification, identification and host inoculation of phytopathogenic bacteria;
- Stains and staining methods;
- Biochemical and serological characterization;
- Isolation of genomic DNA plasmid;
- Use of antibacterial chemicals/ antibiotics;
- Isolation of fluorescent *Pseudomonas*;
- Preservation of bacterial cultures;
- Identification of prokaryotic organisms by using 16S rDNA, and other gene sequences;
- Diagnosis and management of important diseases caused by bacteria and mollicutes.

VII. Learning outcome

After successful completion of this course, the students would have

- Detailed knowledge about bacteria and mollicutes would help the learners for research in the field of host pathogen interaction and management.

I. Course Title : Plant Nematology

II. Course Code : PL PATH 504

III. Credit Hours : 2+1

IV. Aim of the course

To project the importance of nematodes in agriculture and impart basic knowledgeon all aspects of plant nematology.

V. TheoryUnit I

Characteristics of Phylum Nematoda and its relationship with other related phyla, history and growth of Nematology; nematode habitats and diversity- plant, animal and human parasites;

useful nematodes; economic importance of nematodes to agriculture, horticulture and forestry.

Unit II

Gross morphology of plant parasitic nematodes; broad classification, nematode biology, physiology and ecology.

Unit III

Types of parasitism; nature of damage and general symptomatology; interaction of plant-parasitic nematodes with other organisms.

Unit IV

Plant nematode relationships, cellular responses to infection by important phytonematodes; physiological specialization among phytonematodes.

Unit V

Principles and practices of nematode management; integrated nematode management.

Unit VI

Emerging nematode problems, Importance of nematodes in international trade andquarantine.

VI. Practical

- Studies on kinds of nematodes- free-living, animal, insect and plant parasites;
- Nematode extraction from soil;
- Extraction of migratory endoparasites, staining for sedentary endoparasites;
- Examination of different life stages of important plant parasitic nematodes, theirsymptoms and histopathology.

VII. Learning outcome

After successful completion of this course, the students would have

- Detailed knowledge about Plant Parasitic nematode, their biology and other aspects would help the learners for research in the field of Phytonematology

I. Course Title : Principles of Plant Pathology

II. Course Code : PL PATH 505

III. Credit Hours : 2+1

IV. Aim of the course

To introduce the subject of Plant Pathology, its concepts and principles.

V. TheoryUnit I

Importance, definitions and concepts of plant diseases, history and growth of plant pathology, biotic and abiotic causes of plant diseases.

Unit II

Growth, reproduction, survival and dispersal of important plant pathogens, role ofenvironment and host nutrition on disease development.

Unit III

Host parasite interaction, recognition concept and infection, symptomatology, disease development-role of enzymes, toXins, growth regulators; defense strategies- oXidative burst; Phenolics, PhytoaleXins, PR proteins, Elicitors. Altered plant metabolism as affected by plant pathogens.

Unit IV

Genetics of resistance; 'R' genes; mechanism of genetic variation in pathogens; molecular basis for resistance; marker-assisted selection; genetic engineering for disease resistance.

VI. Practical

- Basic plant pathological techniques;
- Isolation, inoculation and purification of plant pathogens and proving Koch'spostulates;
- Techniques to study variability in different plant pathogens;
- Purification of enzymes, toXins and their bioassay;
- Estimation of growth regulators, phenols, phytoalexins in resistant and susceptible plants.

VII. Learning outcome

After successful completion of this course, the students would

- Help the learners for proper understating of pathogen behaviour, their interaction with host which in turn allow them for developed resistant cultivars.

I. Course Title : Techniques in Detection and Diagnosis of Plant Diseases

II. Course Code : PL PATH 506

III. Credit Hours : 0+2

IV. Aim of the course

To impart training on various methods/ techniques/ instruments used in the studyof plant diseases/ pathogens.

V. Practical

- Detection of plant pathogens 1. Based on visual symptoms, 2. Biochemical test 3.Using microscopic techniques, 4. Cultural studies; (use of selective media to isolate pathogens). 5. Biological assays (indicator hosts, differential hosts) 6. Serological assays 7. Nucleic acid based techniques (Non-PCR–LAMP, Later flow microarray and PCR based- multiplex, nested, qPCR, immune capture PCR, etc.);
- Phenotypic and genotypic tests for identification of plant pathogens;
- Molecular identification (16S rDNA and 16s-23S rDNA intergenic spacer region sequences-prokaryotic organisms; and eukaryotic organism by ITS region) and whole genome sequencing;
- Volatile compounds profiling by using GC-MS and LC-MS;
- FAME analysis, Fluorescence *in-situ* Hybridization (FISH), Flow Cytometry, Phage display technique, biosensors for detection of plant pathogens;
- Genotypic tools such as genome/ specific gene sequence homology comparison by BLAST(NCBI and EMBL) and electron microscopy techniques of plant virus detection and diagnosis.

VI. Learning outcome

After successful completion of this course, the students would have

- Detailed knowledge regarding different techniques for detection of pathogens. The students also would have detailed knowledge for isolation, inoculation, culturing, preservation, maintenance of microorganisms and handling of different instruments which will help in their employability.

I. Course Title : Principles of Plant Disease Management

II. Course Code : PL PATH 507

III. Credit Hours : 2+1

IV. Aim of the course

To acquaint with different strategies for management of plant diseases.

V. TheoryUnit I

Principles of plant disease management by cultural, physical, biological, chemical, organic amendments and botanicals methods of plant disease control, integrated control measures of plant diseases. Disease resistance and molecular approach for disease management.

Unit II

History of fungicides, bactericides, antibiotics, concepts of pathogen, immobilization, chemical protection and chemotherapy, nature, properties and mode of action of antifungal, antibacterial and antiviral chemicals. Label claim of fungicides.

Unit III

Application of chemicals on foliage, seed and soil, role of stickers, spreaders and other adjuvants, health *vis-a-vis* environmental hazards, residual effects and safety measures

VI. Practical

- Phytopathometry
- Methods of *in-vitro* evaluation of chemicals, antibiotics, bio agents against plantpathogens;
- Field evaluation of chemicals, antibiotics, bio agents against plant pathogens;
- Soil solarisation, methods of soil fumigation under protected cultivation;
- Methods of application of chemicals and bio control agents;
- ED and MIC values, study of structural details of sprayers and dusters;
- Artificial epiphytotic and screening of resistance.

VII. Learning outcome

After successful completion of this course, the students would have

- Acquired knowledge which may help the students for predicting crop loss and disease management through various approaches.

I. Course Title : Epidemiology and Forecasting of Plant Diseases

II. Course Code : PL PATH 508

III. Credit Hours : 1+0

IV. Aim of the course

To acquaint with the principles of epidemiology and its application in diseaseforecasting**.**

V. Theory

Unit I

Epidemic concepts, simple interest and compound interest disease, historical development. Elements of epidemics and their interaction. Structures and patterns of epidemics. Modelling, system approaches and expert systems in plant pathology.

Unit II

Genetics of epidemics. Models for development of plant disease epidemics. Common and natural logarithms, function fitting, area under disease progress curve and correction factors, inoculum dynamics. Population biology of pathogens, temporal and spatial variability in plant pathogens.

Unit III

Epidemiological basis of disease management. Survey, surveillance and vigilance. Remote sensing techniques and image analysis. Crop loss assessment.

Unit IV

Principles and pre-requisites of forecasting, systems and factors affecting various components of forecasting, some early forecasting and procedures based on weatherand inoculum potential, modelling disease growth and disease prediction. Salient features of important forecasting models.

VI. Learning outcome

After successful completion of this course, the students would have

• Detailed knowledge regarding crop losses, environmental factor and disease relationship which may help in disease forecasting and formation of forecasting models.

I. **Course Title : Disease Resistance in Plants**

II. **Course Code : PL PATH 509**

III. **Credit Hours : 2+0**

IV. **Aim of the course**

To acquaint with the disease resistance mechanisms.

V. **Theory**

Unit I

Introduction and historical development, dynamics of pathogenicity, process of infection, variability in plant pathogens, gene centres as sources of resistance, disease resistance terminologies. Disease escape, non-host resistance and disease tolerance.

Unit II

Genetic basis of disease resistance, types of resistance, identification of physiological races of pathogen, disease progression in relation to resistance, stabilizing selection pressure in plant pathogens.

Unit III

Host defence system, morphological and anatomical resistance, pre-formed chemicals in host defence, post infectional chemicals in host defence, phytoalexins, hypersensitivity and its mechanisms. Genetic basis of relationships between pathogen and host, Gene-for-gene concept, protein-for-protein and immunization basis, management of resistance genes. Strategies for gene deployment.

VI. **Learning outcome**

After successful completion of this course, the students would have

• Detailed knowledge regarding the host pathogen interaction in plant diseases resistance and strategies for gene deployment

I. **Course Title : Ecology of Soil Borne Plant Pathogens**

II. **Course Code : PL PATH 510**

III. **Credit Hours : 1+1**

IV. **Aim of the course**

To provide knowledge on soil-plant disease relationship.

V. **Theory**

Unit I

Soil as an environment for plant pathogens, nature and importance of rhizosphere and rhizoplane, host exudates, soil and root inhabiting fungi. Interaction of microorganisms.

Unit II

Types of biocontrol agents. Inoculum potential and density in relation to host andsoil variables, competition, predation, antibiosis and fungistasis. Conducive and suppressive soils**.**

Unit III

Biological control- concepts and potentialities for managing soil borne pathogens. Potential of *Trichoderma* and fluorescent *Pseudomonas* in managing plant diseases.

VI. **Practical**

- Quantification of rhizosphere and rhizoplane microflora with special emphasis onpathogens;

- Pathogenicity test by soil and root inoculation techniques, correlation between inoculum density of test pathogens and disease incidence, demonstration of fungistasis in natural soils;
- Suppression of test soil-borne pathogens by antagonistic microorganisms;
- Isolation and identification of different biocontrol agents;
- Study of various plant morphological structures associated with resistance, testing the effect of root exudates and eXtracts on spore germination and growth of plant pathogens;
- Estimating the phenolic substances, total reducing sugars in susceptible andresistant plants;
- Estimating the rhizosphere and root tissue population of microorganisms (pathogens) in plants.

VII. Learning outcome

After successful completion of this course, the students would have

- Detailed knowledge about pathogen ecology help the learners for proper understanding survival of the soil-borne plant pathogens which help for in developing forecasting modules and disease management.

I. Course Title : Chemicals and Botanicals in Plant Disease Management

II. Course Code : PL PATH 511

III. Credit Hours : 2+1

IV. Aim of the course

To provide knowledge on the concepts, principles and judicious use of chemicalsand botanicals in plant disease management**.**

V. Theory

Unit I

History and development of chemicals; definition of pesticides and related terms;advantages and disadvantages of chemicals and botanicals.

Unit II

Classification of chemicals used in plant disease management and their characteristics.

Unit III

Chemicals in plant disease control, viz., fungicides, bactericides, nematicides,antiviral chemicals and botanicals. Issues related to label claim.

Unit IV

Formulations, mode of action and application of different fungicides; chemotherapyand phytotoxicity of fungicides.

Unit V

Handling, storage and precautions to be taken while using fungicides; compatibility with other agrochemicals, persistence, cost-benefit ratio, factor affecting fungicides. New generation fungicides and composite formulations of pesticides.

Unit VI

Efficacy of different botanicals used and their mode of action. Important botanicals used against diseases. General account of plant protection appliances; environmental pollution,residues and health hazards, fungicidal resistance in plant pathogensand its management.

VI. Practicals

- Acquaintance with formulation of different fungicides and plant protection appliances;
- Formulation of fungicides, bactericides and nematicides;
- *In-vitro* evaluation techniques, preparation of different concentrations of chemicals including botanical pesticides against pathogens;

- Persistence, compatibility with other agro-chemicals;
- Detection of naturally occurring fungicide resistant mutants of pathogen;
- Methods of application of chemicals.

VII. Learning outcome

After successful completion of this course, the students would have

•Detailed knowledge about agricultural chemicals and their proper use against different plant pathogens ecology help the learners for proper

• Detailed knowledge about the use of botanicals against plant pathogens

• This course will also help in employability of the student.

I. Course Title : Detection and Management of Seed Borne Pathogens

II. Course Code : PL PATH 512

III. Credit Hours : 2+1

IV. Aim of the course

To acquaint with seed-borne diseases, their nature, detection, transmission, epidemiology, impacts / losses and management.

V. Theory

Unit I

History and economic importance of seed pathology in seed industry, plant quarantine and SPS under WTO. Morphology and anatomy of typical monocotyledonous and dicotyledonous infected seeds.

Unit II

Recent advances in the establishment and subsequent cause of disease developmentin seed and seedling. Localization and mechanism of seed transmission in relation to seed infection, seed to plant transmission of pathogens.

Unit III

Seed certification and tolerance limits, types of losses caused by seed-borne diseases in true and vegetatively propagated seeds, evolutionary adaptations of crop plants to defend seed invasion by seed-borne pathogens. Epidemiological factors influencing the transmission of seed-borne diseases, forecasting of epidemics through seed-borne infection.

Unit IV

Production of toxic metabolites affecting seed quality and its impact on human, animal and plant health, management of seed-borne pathogens/ diseases and procedure for healthy seed production. Seed health testing, methods for detecting microorganism.

VI. Practical

- Conventional and advanced techniques in the detection and identification of seed- borne fungi, bacteria and viruses;
- Relationship between seed-borne infection and expression of the disease in the field.

VII. Learning outcome

After successful completion of this course, the students would have

• Detailed knowledge about the detection of seed borne pathogens, ecology etc.

• Detailed knowledge for proper management of seed borne diseases

I. **Course Title : Biological Control of Plant Diseases**

II. **Course Code : PL PATH 513**

III. **Credit Hours : 1+1**

IV. **Aim of the course**

To study principles and application of ecofriendly and sustainable managementstrategies of plant diseases.

V. **TheoryUnit I**

Concept of biological control, definitions, importance, principles of plant disease management with bioagents, history of biological control, merits and demerits of biological control.

Unit II

Types of biological interactions, competition: mycoparasitism, exploitation for hypovirulence, rhizosphere colonization, competitive saprophytic ability, antibiosis, induced resistance, mycorrhizal associations, operational mechanisms and its relevance in biological control.

Unit III

Factors governing biological control, role of physical environment, agroecosystem, operational mechanisms and cultural practices in biological control of pathogens, pathogens and antagonists and their relationship, biocontrol agents, comparative approaches to biological control of plant pathogens by resident and introduced antagonists, control of soil-borne and foliar diseases. Compatibility of bioagents with agrochemicals and other antagonistic microbes.

Unit IV

Commercial production of antagonists, their delivery systems, application and monitoring, biological control in IDM, IPM and organic farming system, biopesticides available in market. Quality control system of biocontrol agents.

VI. **Practical**

- Isolation, characterization and maintenance of antagonists, methods of study of antagonism and antibiosis, application of antagonists against pathogen *in-vitro and in vivo* conditions;
- Preparation of different formulations of selected bioagents and their mass production;
- Quality parameters of biocontrol agents;
- One week exposure visit to commercial biocontrol agents production unit.

VII. **Learning outcome**

After successful completion of this course, the students would have

- Detailed knowledge about the bio-control agents, their mass cultivation and formulation.
- Detailed knowledge about their application against plant pathogens which creates employability of the students

I. **Course Title : Integrated Disease Management**

II. **Course Code : PL PATH 514**

III. **Credit Hours : 2+1**

IV. **Aim of the course**

To emphasize the importance and the need of IDM in the management of diseasesof important crops.

V. **TheoryUnit I**

Introduction, definition, concept and tools of disease management, components of integrated disease management- their limitations and implications.

Unit II

Development of IDM-basic principles, biological, chemical and cultural disease management.

Unit III

IDM in important crops- rice, wheat, cotton, sugarcane, chickpea, rapeseed and mustard, pearl millet, pulses, vegetable crops, fruit, plantation and spice crops.

VI. Practical

- Application of physical, biological and cultural methods;
- Use of chemical and bio-control agents, their compatibility and integration in IDM. Demonstration of IDM and multiple disease management in crops of regional importance as project work.

VII. Learning outcome

After successful completion of this course, the students would have

- Detailed knowledge about integrated plant disease management.
- Detailed knowledge about need based sustainable management practices which increase the opportunity of employability in the field of plant health advisory.

I. Course Title : Diseases of Field and Medicinal Crops

II. Course Code : PL PATH 515

III. Credit Hours : 2+1

IV. Theory

Unit I

Diseases of Cereal crops- Rice, wheat, barley, pearl millet, sorghum and maize.

Unit II

Diseases of Pulse crops- Gram, urdbean, mungbean, lentil, pigeonpea, soybean and cowpea.

Unit III

Diseases of Oilseed crops- Rapeseed and mustard, sesame, linseed, sunflower, safflower, groundnut, castor.

Unit IV

Diseases of Cash crops- Cotton, sugarcane, tobacco.

Unit V

Diseases of Fodder legume crops- Berseem, oats, guar, lucerne.

Unit VI

Medicinal crops- *Plantago*, liquorice, mulathi, rosagrass, sacred basil, mentha, ashwagandha, *Aloe vera*.

V. Practical

- Detailed study of symptoms and host parasite relationship of important diseasesof above mentioned crops;
- Collection and dry preservation of diseased specimens of important crops.

VI. Learning outcome

- Help the learners for identify the diseases through symptoms in field, their proper management as well as identification of causal agents by microscopic study. It also provides a thorough knowledge about the diseases and their management of medicinal plants.

I. **Course Title : Diseases of Fruits, Plantation and Ornamental Crops**

II. **Course Code : PL PATH 516**

III. **Credit Hours : 2+1**

IV. **Aim of the course**

To acquaint with diseases of fruits, plantation, ornamental plants and their management.

V. **Theory**

Unit I

Introduction, symptoms and etiology of different fruit diseases. Factors affecting disease development in fruits like apple, pear, peach, cherry, strawberry, citrus, mango, grapes, guava, ber, banana, pineapple, papaya, pomegranate, custard apple, Jackfruit and their management.

Unit II

Symptoms, mode of perpetuation of diseases of plantation crops such as tea, coffee, rubber and coconut and their management.

Unit III

Symptoms and life cycle of pathogens. Factors affecting disease development of ornamental plants such as roses, gladiolus, carnation, gerbera, orchids, marigold, chrysanthemum and their management.

VI. **Practical**

- Detailed study of symptoms and host parasite relationship of representative diseases of plantation crops;
- Collection and dry preservation of diseased specimens of important crops.

VII. **Learning outcome**

- Help the learners for identify the diseases through symptoms in Fruits, Plantation and Ornamental crops, their proper management as well as identification of causal agents by microscopic study.

I. **Course Title : Diseases of Vegetable and Spices Crops**

II. **Course Code : PL PATH 517**

III. **Credit Hours : 2+1**

IV. **Aim of the course**

To impart knowledge about symptoms, epidemiology of different diseases of vegetables and spices and their management.

V. **Theory**

Unit I

Nature, prevalence, factors affecting disease development of tuber, bulb, leafy vegetable, crucifers, cucurbits and solanaceaous vegetables. Diseases of crops underprotected cultivation.

Unit II

Symptoms and management of diseases of different root, tuber, bulb, leafy vegetables, crucifers, cucurbits and solanaceaous vegetable crops.

Unit III

Symptoms, epidemiology and management of diseases of different spice crops such as black pepper, cumin, coriander, turmeric, fennel, fenugreek and ginger. Biotechnological approaches in developing disease resistant transgenics.

VI. **Practical**

- Detailed study of symptoms and host pathogen interaction of important diseases of vegetable and spice crops.

VII. Learning outcome

- Help the learners for identify the diseases through symptoms in Vegetable and Spices Crops, their proper management as well as identification of causal agents by microscopic study.

I. Course Title : Post-Harvest Diseases

II. Course Code : PL PATH 518

III. Credit Hours : 2+1

IV. Aim of the course

To acquaint with the post-harvest diseases of agricultural produce and their eco-friendly management.

V. Theory

Unit I

Concept of post-harvest diseases, definitions, importance with reference to management and health, principles of plant disease management as pre-harvest and post-harvest, Types of post-harvest problems both by biotic and abiotic factors. Role of physical environment, agro- ecosystem leading to quiescent infection, operational mechanisms and cultural practices in perpetuation of pathogens, pathogens and antagonist and their relationship, role of biocontrol agents and chemicals in controlling post-harvest diseases, comparative approaches to controlof plant pathogens by resident and introduced antagonists.

Unit III

Integrated approaches in controlling diseases and improving the shelf life of produce using nutritional, bio-control agents and other agents, control of aflatoxigenic and mycotoXigenic fungi, application and monitoring for health hazards.

Unit IV

Study of symptoms, toxicosis of various pathogens, knowledge of CodeX Alimentarious for each product and commodity. Physical and biological agents/ practices responsible for development/ prevention of post-harvest diseases- traditional and improved practices.

VI. Practical

- Isolation, characterization and maintenance of post-harvest pathogens, application of antagonists against pathogens *in vivo* condition;
- Comparative efficacy of different fungicides and bio-agents;
- Study of different post-harvest disease symptoms on cereals, pulses, oilseed, commercial crops, vegetables, fruits and flowers;
- Visit to cold storage.

VII. Learning outcome

- Detailed knowledge about post harvest pathogens, ecology etc. help the learners for proper post harvest disease management. This course will also increase the opportunity for employability in the field of food processing.

I. **Course Title : Plant Quarantine and Regulations**

II. **Course Code : PL PATH 519**

III. **Credit Hours : 1+0**

IV. **Aim of the course**

To acquaint the learners about the principles and the role of plant quarantine incontainmentof pests and diseases, plant quarantine regulations and set-up.

V. **Theory**

Unit I

Historical development in plant quarantine, Definitions of pest, and transgenics as per Govt.notification; Organizational set up of plant quarantine in India. relative importance; quarantine
– domestic and international. Quarantine restrictions in the movement of agriculturalproduce, seeds and planting material; case historiesof exotic pests/ diseases and their status.

Unit II

Acts related to registration of pesticides and transgenics. History of quarantine legislations, Salient features of PQ Order 2003. Environmental Acts, Industrial registration; APEDA, Import and EXport of bio-control agents. Identification of pest/ disease free areas; contamination of food with toXigens, microorganisms and their elimination; Symptomatic diagnosis and other techniques to detect pest/ pathogen infestations; VHT and other safer techniques of disinfestation/ salvaging of infected material.

Unit IV

WTO regulations; non-tariff barriers; Pest risk analysis, good laboratory practices for pesticide laboratories; pesticide industry; Sanitary and Phytosanitary measures. Visit to plant quarantine station and PEQ facilities.

VI. **Learning outcome**

- Detailed knowledge about national and international quarantine regulations, exotic pest and diseases, diagnosis and different techniques to detect pest/ pathogen infestations. This course also enhances the job opportunity and employability.