

Department of Plant Pathology

M.Sc. Programme

<i>Course No.</i>	<i>Title of the course</i>	<i>Credits</i>
1 st Semester		
PL.PATH-501	Mycology	2+1
PL.PATH-502	Plant Virology	2+1
PL.PATH-503	Plant Bacteriology	2+1
PL.PATH-504	Principles of Plant Pathology	2+0
PL.PATH-505	Detection and Diagnosis of Plant Diseases	0+2
PL.PATH-506	Diseases for Horticultural Crops	2+1
2 nd Semester		
PL.PATH-551	Principles of Plant Disease Management	2+1
PL.PATH-552	Disease of Field, Medicinal & Ornamental Crops	2+1
PL.PATH-553	Seed Health Technology	2+1
3 rd Semester		
PL.PATH-601	Seed Health Technology	2+1
PL.PATH-602	Chemicals in Plant Disease Management	2+1
PL.PATH-603	Ecology of Soil Born Plant Pathogens	2+1
PL.PATH-604	Disease Resistance in Plants	2+1
PL.PATH-605	Insects Vectors of Plant Virus and other Pathogens	2+1
PL.PATH-606	Biological Control of Plant Disease	2+1
PL.PATH-607	Integrated Disease Management	2+1
PL.PATH-608	Mushroom Production Technology	2+1
PL.PATH-609	Epidemiology and Forecasting of Plant Disease	2+1
PL.PATH-610	Post Harvest Disease	2+1
PL.PATH-649	Seminar –I	1+0
4 th Semester		
PL.PATH-651	Plant Quarantine	1+0
PL.PATH-699	Seminar-II	1+0

PL.PATH	Master's Research	
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Ph.D Programm

<i>Course No.</i>	<i>Title of the course</i>	<i>Credits</i>
1 st semester		
PL.PATH -701	Advanced Mycology	2+1
PL.PATH -702	Advanced Virology	2+1
PL.PATH -703	Advanced Bacteriology	2+1
PL.PATH -704	Molecular Basis of Host Pathogen Interaction	2+1
2 nd semester		
PL.PATH -751	Principles and Procedures of Certification	1+0
PL.PATH -752	Plant Biosecurity and Biosafety	2+0
PL.PATH -799	Seminar-I	1+0
3 rd semester		
PL.PATH -849	Seminar-II	1+0
4 th semester		
	Nil	
5 th semester		
	Nil	
6 th semester		
PL.PATH -999	Seminar-III	1+0
PL.PATH-1000	Doctoral Research	0+45

PL. PATH- 501

Mycology

2+1

Theory :

UNIT – 1: Introduction, definition of different terms, basic concepts.

UNIT – II: Importance of mycology in Agriculture, relation of fungi to human affairs in history of mycology.

UNIT – III: Concept of nomenclature and classification, fungal biodiversity reproduction in fungi. Fungal evaluation and basic life cycle patterns.

UNIT – IV: The comparative morphology, ultrastructure, characteristics of different groups of fungi upto generic level; (a) Myxomycota and (b) Eumycota- i) Mastgomycotina , ii) Zygomycotina, iii) Ascomycotina, iv) Basidiomycotina, v) Duteromycotina Lichens types and importance fungal genetics and variability in fungi Mycorrhizal symbiosis.

Practical: Detailed comparative study of different groups of fungi, collection, Identification and preservation of specimens, Isolation and Identification of Plant Pathogenic fungi.

PL. PATH- 502

Plant Virology

2+1

Theory :

UNIT – I: History of Plant viruses, composition and structure of viruses.

UNIT – II: Symptomatology of important plant viral diseases, transmission, chemical and physical properties, host virus interaction , virus vector relationship.

UNIT – III: Virus nomenclature and classification, genome organization, replication and movement of viruses.

UNIT – IV: Isolation and purification, electron microscopy, protein and nucleic acid based diagnostics.

UNIT – V: Mycoviruses, Phytoplasma, arbo and baculoviruses, satellite viruses, satellite RNAs, phages, viroids, prions. Principles of the working of electron microscope and ultra-microtome.

UNIT – VI: Origin and evaluation, Mechanism of resistance, genetic engineering, ecology and management of plant viruses.

Practical : Study of symptoms caused by viruses, transmission assay of viruses, Physical properties, purification, method of raising antisera, serological test, electron microscopy and ultratomy, PCR.

PL. PATH – 503

Plant Bacteriology

2+1

Theory :

UNIT – I: History and introduction to phytopathogenic procarya viz. bacteria, MLOs, spiroplasmas and other fastidious procarya, Importance of phytopathegenic bacteria.

UNIT – II: Evaluation, classification and nomenclature of phytopathegenic procarya and important diseases caused by them.

UNIT – III: Growth, nutrition requirements, reproduction, preservation of bacterial cultures and variability among phytopathogenic procarya.

UNIT – IV: General biology of bacteriophages from bacteria plasmids and bdellovirios .

UNIT – V: Procaryotic inhibitors and their mode of action against Phytopathogenic bacteria.

UNIT – VI: Survival and dissemination of phytopathogenic bacteria.

Practical : Isolation purification, identification and host inoculation of phytopathogenic bacteria, staining methods, biochemical and serological characterization. Isolation of plasmid and use of antibacterial chemicals/ antibiotics.

PL. PATH-504

Principles of Plant Pathology

2+0

Theory :

UNIT – I :Importance, definitions and concepts of diseases, history and growth of plant pathology, biotic and abiotic causes of plant diseases.

Practical: In vitro and in vivo evaluation of chemicals against plant pathogens, ED and MIC values, study of structural details of sprayers and dusters.

PL. PATH- 552 Disease of Field Medicinal and Ornamental Crops 2+1

Theory :

UNIT – I: Diseases of general; crops, wheat, barley, rice, maize.

UNIT II: Diseases of pulse crops, gram, urdbean, mungbean, lentil, pigeonpea, soybean.

UNIT – III: Diseases of Oil seed crops, rapeseed and mustard, sesame, linseed, sunflower, ground nut, castor.

UNIT –IV: Disease of Cash crops, cotton, sugarcane, jute, mesta.

UNIT – V:Ornamental crops - Rose, Gladiolus, carnation marigold, chrysanthemum Orchid, Tube rose, Dahlia, Zarbera, China rose.

UNIT – VI: Medicinal crops-rosagrass sacred basil, menthe, ashwagandha, Aloe vera, Chirata, Kalmegh, Sarpaghandha, Centalla, bach, Senna, Safed musli.

Practical : Detailed study of symptoms and host parasite relationship of important diseases of above mentioned crops. Collection and dry preservation of diseased specimens of important crops.

PL. PATH- 601 Seed Health Technology

2+1

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 seed.

UNIT II: Recent advances in the establishment and subsequent cause of disease development in 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 vegetative propagated seeds, evolutionary adaptations of crop plant to defined seed invasion by seed borne pathogens. Epidemiological factors influencing the transmission of seed borne disease, 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 pathogen/diseases and procedure for healthy seed production, seed health testing, methods for detecting microorganism.

Practical : Conventional and advance technique 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.

PL. PATH-602 Chemicals in Plant Disease Management 2+1

Theory :

UNIT – I: History and development of chemicals, definition of pesticides and related terms, advantages and disadvantages of chemicals.

UNIT – II: Classification of chemicals used in plant disease control and their characteristics.

UNIT – III: Chemicals in plant disease control, viz. fungicides, bactericides, nematocides, antiviral chemicals and botanical.

UNIT – IV: Formulations, mode of action and application of different fungicides, Chemotherapy and phytotoxicity of fungicides.

UNIT – V: Handling, storage and precautions to be taken while using fungicides, compatibility with other agrochemicals, persistence and cost- benefit ratio factor affecting fungicides.

UNIT – V: General account of plant protection appliances, environmental pollution, residues and health hazards, fungicidal resistance in plant pathogens and its managements.

Practical : Acquaintance with formulation of different fungicides and plant protection appliances. Formulation of fungicides, bactericides and nematicides , in vitro evaluation in techniques, preparation of different concentrations of chemicals including botanical pesticides best on active ingredients against pathogens, persistence, compatibility with other agro chemicals, detection of naturally occurring fungicides resistance mutants of pathogen, methods of application of chemicals.

PL. PATH -603 Ecology of Soil Borne Plant Pathogens 2+1

Theory :

UNIT – I : Soil as an environment for plant pathogens, nature and importance of rhizosphere and rhizoplane, host exudates, soil and root inhabiting fungi, Types of biocontrol agents.

UNIT – II: Inoculum potential and density in relation to host and soil variables, competitions, predation, antibiosis and fungistasis.

UNIT – III: Suppressive soils, biological control, concepts and potentialities for managing soil borne pathogens.

Practical : Quantification of rhizosphere and rhizoplane microflora with special emphasis on pathogens, 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.

Pl. PATH – 604 Disease Resistance in Plants 2+ 1

Theory :

UNIT – I: Introduction and historical development. Dynamic of pathogenicity, process of infection, variability in plant pathogens, gene centres as sources of resistance, disease resistance terminology.

UNIT – II: Disease escapes, disease tolerance, types of resistance, identification of physiological races of pathogens, disease progression in relation to resistance, stabilizing selection pressure in plant pathogen.

UNIT – III: Host defence system, morphological and anatomical resistance, performed chemicals in host defence, post inflectional chemicals in host defence, phytoalexins, hypersensitivity and its mechanism.

UNIT – IV: Gene-for-gene concept, protein-for-protein and immunization basis. Management of resistance genes. Strategies for gene deployment.

PL. PATH – 605 Insects Vectors of Plant Viruses and other Pathogens 2+1

Theory :

UNIT – I: History of development in the area of insects as vectors of plant pathogens. Important insect vectors and their characteristics, mouth parts and feeding processes of important insect vectors. Efficiency of transmission.

UNIT – II: Transmission of plant viruses and fungal pathogens. Relation between viruses and their vectors.

UNIT – III: Transmission of plant viruses by aphids, whiteflies. Mealy bugs and thrips.

UNIT – IV: Transmission of mycoplasma and bacteria by leaf hoppers and plant hoppers.

UNIT – V: Transmission of plant viruses by psyllids, beetles and mites, Epidemiology and management of insect transmitted disease through vector management.

Practical : Identification of common vector of plant pathogens-aphids, leafhoppers, whiteflies, thrips, beetles, nematodes, culturing and handling of vectors demonstration of virus transmission through vectors-aphid, leafhoppers and whiteflies.

PL. PATH- 515 Biological Control of Plant Disease

2+1

Theory :

UNIT – I: Concept of biological control, definitions, importance, principles of plant disease management with bio-agents , history of biological control, merits and demerits of biological control.

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

UNIT – III: Factors governing biological control, roll of physical environment, agroecosystem, operational mechanisms and cultural practices in biological control of 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 different bioagents.

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

Practical : Isolation, characterization and maintenance of antagonists, methods of study of antagonism and antibiosis, application of antagonists against pathogen *in vitro* and *in vivo* condition study of cfu /g.

PL. PATH– 607 Integrated Disease Management

2+1

Theory :

UNIT – I: Introduction, definition, concepts 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, musterd, kharif pulses, vegetables crops and fruits crops.

Practical : Application of biological, cultural, chemical and biocontrol agents, their compatibility and integration in IDM, Demonstration of IDM in certain crops as project works.

PL. PATH – 608 Musroom Production Technology

2+1

Theory :

UNIT – I: Historical development of mushroom cultivation and present status, taxonomy, classification, food, medicinal value, uses of mushroom, edible and poisonous mushroom.

UNIT – II: Life cycle of cultivated mushrooms, reproduction and strain improvement maintenance of pure culture, preparation of spawn and facilities required for establishing commercial spawn lab.

UNIT – III: Preparation of substrate for mushroom cultivation, long, short and indoor composting methods, formulate for different composts and their computation , qualities and testing of compost, use of spent mushroom compost/substrate.

UNIT – IV: Facilities for setting up mushroom farm for seasonal and environmentally control cultivation, requirement and maintenance of temperature, relative humidity, CO₂ ventilation in cropping rooms, cultivation trechnology of *Agaricus bisporus*, *pleurotus sp.* *Calocybe indica*, *lentinus edodes* and *Ganoderma luicidum*.

UNIT – V: Insects pests, disease and abnormalities of cultivated mushroom and their management, post harvest processing and value addition, economics of mushroom cultivation, biotechnology and mushroom cultivation.

Practical : Preparation of spawn, compost, spawning , casing, harvesting and post harvest handling of edible mushroom, identification of various pathogens, competitors of various mushroom.

PL. PATH-518 Epidemiology and Forcasting of Plant Disease 2+1

Theory :

UNIT – I: Epidemic concept and historical development, pathometry and crop growth stages epidemic growth and analysis.

UNIT – II: Common and natural logarithms function, fitting area under disease progress curve and correction factors, inoculum dynamics, population biology of pathogens, temporal spatial variability in plant pathogens.

UNIT – III: Survey, surveillance and vigilance, crop loss assessment and models.

UNIT – IV: Principles and pre-requisites of forecasting, systems and factors affecting various components of forecasting, some early forecasting procedures based on weather and inoculum potential modeling disease growth and disease prediction.

Practical : Measuring diseases, spore dispersal and trapping, weather recording, survey, multiplication of inoculum, computerized data analysis, function, fitting, model preparation and validation.

PL. PATH – 610 Post Harvest Disease 2+ 1

Theory :

UNIT- I: Concepts of post harvest diseases, definitions, importance with reference to environment and health, principles of plant disease management as pre-harvest and post harvest, merits and demerits of biological / phytoextracts in controlling post-harvest diseases .

UNIT – II: Types of post harvest problems both by biotic and abiotic causes, rhizosphere colonization, competitive ability, antibiosis, induced resistance, microbial associations, concept, operational mechanisms and its relevance in control.

UNIT – III: Factors governing post harvest problems both as biotic, role of physical environments, agro-eco-system leading to quiescent infection, operational mechanism and cultural practices in perpetuation in pathogens, pathogens and antagonist and their relationship, role of biocontrol agents and chemicals in controlling post harvest diseases, comparative approaches to control of plant pathogens by residence and introduced antagonists. Isolation, characterization and maintenance of pathogens, role of different storage.

UNIT – IV: Integrated approach in controlling disease and improving the shelf life of produce, control of aflatoxigenic and mycotoxigenic fungi, application and monitoring for any health hazard knowledge of Codex Alimentarius for each product and commodity.

Practical : Isolation, characterization and maintenance of pathogens, role of different storage condition of disease development, application of antagonists against pathogens *in vivo* and *in vitro* conditions. Comparative efficacy of different, chemicals, fungicides phytoextracts and bioagent.

Theory :

UNIT – I: Definitions of pest, pesticides and tangencies as per Govt. notification, relative importance, quarantine domestic and international. Quarantine restriction in the involvement of agriculture produce, seeds and planting material, case histories of exotic pests/ diseases and their status.

UNIT – II: Plant protection organization in India, Acts related to registration of pesticides and tangencies. History of quarantine legislations, PQ order 2003. Environmental Acts. Industrial registration, APEDA, Import and Export of biocontrol agents.

UNIT – III: Identification of pest/ disease free areas, contamination of food with toxigens, microorganisms and their elimination. Symptomatic diagnosis and other techniques to detect pest /pathogen infestation, VII'I' and other safer techniques of disinfestations / 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 measure.

PL. PATH - 601

Advanced Mycology

2 + 1

Theory :

UNIT – I: General introduction, historical development and advances in mycology.

UNIT. – II: Recent taxonomic criteria, morphological criteria for classification, Serological, Chemical (chemotaxonomy), Molecular and Numerical (Computer based assessment) taxonomy.

UNIT – III: Interaction between groups: Phylogeny, Micro condition, conidiogenesis and sporulating structures of fungi imperfect. Morphology and reproduction of representative plant pathogenic genera from different groups of fungi, Sexual reproduction in different groups of fungi.

UNIT – IV: Population biology, pathogenic variability / vegetative compatibility.

UNIT – V: Heterokaryosis and parasexual cycle. Sex hormones in fungi. Pleomorphism and speciation in fungi. Mechanism of nuclear inheritance. Mechanism of extra nuclear inheritance. Biodegradation.

Practical : Study of conidiogenesis – phialides, prospores, arthospores, Study of fruit bodies in Ascomycotina. Identification of fungi upto species level. Study of hyphal anastomosis. Morphology of representative plant pathogenic genera from different groups of fungi.

PL. PATH - 701

Advance Virology

2+1

Theory :

UNIT – I: Mechanism of virus transmission by vectors, virus-vector relationship, bimodal transmission and taxonomy of vectors and viruses, vector specificity for classes of virus, virus replication, assembly and architecture, ultra structural changes due to virus infection, variations, mutation and virus strain.

UNIT – II: Immunoglobulin structures and functions of various domains, methods of immunodiagnosis, hibridoma technology and use of monoclonal antibodies in identification of viruses and their strains, Polymerase Chain Reaction.

UNIT – III: Genenome organization, replication, transcription and translational strategies of Para retroviruses and Gemini viruses satellite viruses and satellite RNA genome organization in Tobamo-, poty-, bromo, cummo, ilar and tospoviruses.

UNIT – IV:Gene expression and regulation, viral promoters, molecular mechanism of host virus interactions, virus induced gene molecular mechanism of vector transmission. Symptom expression, viroids and prions.

UNIT – V: Genetic engineering with plant viruses, viral suppressors, a RNA dynamics, resistance genes. Viruses potential as vectors, genetically engineered resistance, transgenic plants.

UNIT – VI: Techniques and application of tissue culture. Origin evolution and interrelationship with animal viruses.

Practical : Purification of virus(es), SDS-PAGE for molecular weight determination, production of polyclonal antiserum, purification of IgG and conjugate preparation, serological techniques (i) DAC – ELISA (ii) DAS – ELISA (iii) DIBA (iv) Western blots (v) (ab) 2- ELISA, vector transmission (one each with aphid, leafhopper and whitefly), methods for collecting vectors and their maintenance, nucleic acid isolation , DOT-blot, southern hybridization , probe preparation and autoradiography, PCR application and viral genome cloning, sequencing annotation of genes.

PL. PATH- 603

Advanced Bacteriology

2+1

Theory :

UNIT – I: Current approaches for the characterization and identification of phytopathogenic bacteria. Ultrastructures and biology of bacteria.

UNIT – II: Current trends in taxonomy of phytopathogenic procarya.

UNIT – III: Role of enzyme, toxin, expolysaccharide, polypeptide signals in disease development. Mechanism of wilt (*Ralstonia solanacearum*), development, mechanism of soft rot (*Erwinia spp.*) development, mechanism of grown gall formation (*Agrobacterium tumifaciens*)

UNIT – VI: Host- bacterial pathogen interaction, quorum-sensing phenomenon, Type III secretion system, HR / SR reactions, R-genes. Avr-genes, hrp genes, Effector protein.

UNIT- V: Molecular variability among phytopathogenic procarya and possible host defense mechanism(s). Genetic engineering for management of bacterial plant pathogens-gene silencing, RNA technology.

UNIT- VI: Epidemiology in relation to bacterial plant pathogens. Development of diagnostic kit.

UNIT – VII: Benicial pokaryotes- Endophytes, PGPR, phylloplane bacteria and their role in disease management. Endosymbionts for host defence.

practical : Pathogenic studies and race identification; plasmid profiling of bacteria, fatty acid profiling of bacteria, RAPD profiling of bacteria and variability status, Endospore, Flagiler staining, test for secondary metabolite production, cyanides, EPS, siderophore, specific detection of phytopathogenic bacteria using species / pathovar specific primers. Basic techniques in diagnostic kit development, molecular tools to identify photoendosymbionts.

PL. PATH – 704

Molecular Basis of Host- Pathogen Interaction

2+1

Theory :

UNIT – I: Importance and role of biotechnological tools in plant pathology-Basic concepts and principles to study host pathogen relationship.

UNIT – II: Molecular basis of host- pathogen interaction – fungi, bacteria and viruses; recognition system, signal transduction.

UNIT – III: Induction of defense- pathogenesis related proteins, HR, reactive oxygen species, phytoalexins and systemic acquired resistance, programmed Cell Death, Viral induce gene silencing.

UNIT- IV: Molecular basis of gene for gene hypothesis; R-gene expression and transcription profiling, mapping and cloning of resistance genes and marker-aided selection, pyramiding of R-genes.

UNIT – V: Biotechnology and disease management; development of disease resistance plants using genetic engineering approaches, different methods of gene transfer, biosafety issues related to GM crops.

Practical : Protein, DNA and RNA isolation, plasmid extraction, PCR analysis, DNA and Protein electrophoresis, bacterial transformation.

PL. PATH – 751 Principles and Procedures of Certification 1+0

Theory :

UNIT – I: Introduction to certification, International scenario of certification and role of ISTA, EPPO, OECD etc. in certification and quality control.

UNIT – II: Case studies of certification system, of USA and Europe, National regularity mechanism and certification system including seed certification standards. National status of seed health in seed certification. Methods of testing genetic identity, physical purity, germination percentage seed health etc.

UNIT – III: Fixing tolerance limit for diseases and insect pests in certification and quality control programmes. Methods used in certification of seeds vegetative propagules and *in vitro* cultures. Accreditation of seed testing laboratories. Role of seed / planting material health certification in national and international trade.

PL. PATH – 752 Plant Biosrcurity and Diversity 2 +0

Theory :

UNIT – I: History of biosecurity, Concept of biosecurity, Components of biosecurity, Quarantine, Invasive Alien species, Biowarfare, Emerging / resurgence of pests and diseases.

UNIT – II: National regularity Mechanism and International agreements /Convention viz., Agreement of Application of Sanitary and phtosanitary (SPS) Measures / World Trade Organization (WTO), Convention on biological Diversity (CBD), International Standard for phtosanitary Measures, pest risk analysis, risk assessment models, pest information system, early warning and forecasting system, use sof Global Positioning system (GPS) and Geographic Information System (GIS) for plant biosecurity, pest / disease and epidemic management, strategies for combating risks and costs associated with agroterrorism event, mitigation planning, integrated approach for biosecurity.

UNIT – III: Biosafety, policies and regulatory mechanism, Cartagena Protocol on Biosafety and its implications, Issues related to release of genetically modified crops.
