

GURU KASHI UNIVERSITY



Master of Science in Agriculture (Plant Pathology) (PATH)

Session:2025-26

Faculty of Agriculture

Graduate Attributes of the Programme: -

Type of learning outcomes	The Learning Outcomes Descriptors
Graduates should be able to demonstrate the acquisition of:	
Learning outcomes that are specific to disciplinary/interdisciplinary areas of learning	To provide knowledge of identification and distribution of all plant pathogenic groups, principle of diseases management, diseases etiology and epidemiology.
Generic learning outcomes	To acquire in depth knowledge on molecular level host-pathogen interactions, development of disease resistance in plants, Phytosanitary measures, of Plant Quarantine at National and International level, Regulations of import /export of plant material, sanitary and phytosanitary issues, quarantine.

Programme Learning outcomes: A Postgraduate Certificate is awarded to students who have demonstrated the achievement of the outcomes located at level 6.0:

Element of the Descriptor	Programme learning outcomes relating to Undergraduate Certificate
The graduates should be able to demonstrate the acquisition of:	
Knowledge and understanding	Comprehend the principles and methodologies used in Plant Pathology.
General, technical and professional skills required to perform and accomplish tasks	Possess deep insight of fungal systematic, fungal structures, their role in identification and recent developments in fungal classification including chemo and molecular taxonomy. Understand genetics and variability among fungi and their economic and industrial importance.
Application of knowledge and skills	Familiarize with various methods/techniques/instruments used in the study of plant diseases/pathogens and to acquaint with seed-borne diseases, their nature, detection, transmission, epidemiology, impacts/ losses and management.
Generic learning outcomes	Develop advanced understanding on characterization, identification of bacteria, pathogenesis, mechanism of disease development and recent approach in bacterial disease management.
Constitutional, humanistic, ethical, and	Development of understating for eco-friendly management of diseases for sustainable agriculture.

moral values																			
Employability and job-ready skills, and entrepreneurship skills and capabilities/qualities and mindset	Develop deep understanding on post-harvest diseases, factors governing post-harvest problems, stages of diseases development, integrated approach in disease management and quality control.																		
Credit requirements	<table> <tr> <th colspan="2">Masters' Programme</th></tr> <tr> <td colspan="2">(i) Course work</td></tr> <tr> <td>Major courses</td><td>20</td></tr> <tr> <td>Minor courses</td><td>08</td></tr> <tr> <td>Supporting courses</td><td>06</td></tr> <tr> <td>Common courses</td><td>05</td></tr> <tr> <td>Seminar</td><td>01</td></tr> <tr> <td>(ii) Thesis Research</td><td>30</td></tr> <tr> <td>Total</td><td>70</td></tr> </table>	Masters' Programme		(i) Course work		Major courses	20	Minor courses	08	Supporting courses	06	Common courses	05	Seminar	01	(ii) Thesis Research	30	Total	70
Masters' Programme																			
(i) Course work																			
Major courses	20																		
Minor courses	08																		
Supporting courses	06																		
Common courses	05																		
Seminar	01																		
(ii) Thesis Research	30																		
Total	70																		
Entry requirements	A student with a Bachelor Degree subject to fulfillment of the eligibility conditions of a programme as specified by the University, shall be eligible for admission to a 2-year PG Programme.																		

Program Structure

Semester I										
Sr. No.	Course Code	Course Title	Type of Course	(Hours Per Week)			No. of Credits	Int.	Ext.	Total Marks
				L	T	P				
1	PATH501	Mycology	Major	2	0	0	2	30	70	100
2	PATH502	Mycology Lab	Major	0	0	2	1	30	70	100
3	PATH503	Principles of Plant Pathology	Major	3	0	0	3	30	70	100
4	STAT501	Agriculture statistics	Supporting	3	0	0	3	30	70	100
5	STAT502	Agriculture statistics Lab	Supporting	0	0	2	1	30	70	100
6	ENTO600	Toxicology of Insecticides	Minor (CBCS) (Choose any one)	2	0	0	2	30	70	100
7	ENTO556	Biological control of insect pest								
8	ENTO601	Toxicology of Insecticides Lab	Minor (CBCS) (Choose any one)	0	0	2	1	30	70	100
9	ENTO557	Biological control of insect pest and weeds Lab								
10	PGC501	Library and Information Services Lab	Common	0	0	2	1	30	70	100
11	PGC502	Agricultural Research, Research Ethics and Rural Development Programmes	Common	1	0	0	1	30	70	100
12	PATH500	Master Research	Research	-	-	-	4	50	0	50
	Total						19	320	630	950

Semester II										
Sr. No.	Course Code	Course Title	Type of Course	(Hours Per Week)			No. of Credits	Int.	Ext.	Total Marks
				L	T	P				
12	PATH551	Plant Pathogenic Prokaryotes	Major	2	0	0	2	30	70	100
13	PATH552	Plant Pathogenic Prokaryotes Lab	Major	0	0	2	1	30	70	100
14	PATH553	Molecular Approaches in Plant Protection	Major	1	0	0	1	30	70	100
15	PATH554	Molecular Approaches in Plant Protection Lab	Major	0	0	2	1	30	70	100
18	PATH555	Plant Quarantine and Regulations	Minor	2	0	0	2	30	70	100
19	PATH556	Seminar	Seminar	-	-	-	1	30	70	100
20	CA551	Fundamentals of Computer Applications Lab	Supporting	-	-	4	2	30	70	100
21	PGC551	Basic Concepts in Laboratory Techniques Lab	Common	0	0	2	1	30	70	100
22	PATH500	Master Research	Research	-	-	-	5	50	0	50
	Total						16	290	560	850

Semester III										
Sr. No.	Course Code	Course Title	Type of Course	(Hours Per Week)			No. of Credits	Int.	Ext.	Total Marks
				L	T	P				
1	PATH600	Biological Control of Plant Diseases	Major	2	0	0	2	30	70	100
2	PATH601	Biological Control of Plant Diseases Lab Lab	Major	0	0	2	1	30	70	100
3	PATH602	Post Harvest Diseases	Major	2	0	0	2	30	70	100
4	PATH603	Post Harvest Diseases Lab	Major	0	0	2	1	30	70	100
5	ENTO558	Host-Plant Resistance to Insects	Minor (CBCS) (Choose any one)	1	0	0	1	30	70	100
6	ENTO663	Insect vectors of plant pathogens								
7	ENTO559	Host-Plant Resistance to Insects Lab	Minor (CBCS) (Choose any one)	0	0	2	1	30	70	100
8	ENTO664	Insect vectors of plant pathogens Lab								
9	PGC600	Technical writing and communication skills Lab	Common	0	0	2	1	30	70	100
10	PATH500	Master Research	Research	-	-	-	10	200	0	200
	Total						19	410	490	900

Semester IV										
Sr. No.	Course Code	Course Title	Type of Course	L	T	P	No. of Credits	Int.	Ext.	Total Marks
1	PATH651	Plant Virology	Major	2	0	0	2	30	70	100
2	PATH652	Plant Virology Lab	Major	0	0	2	1	30	70	100
3	PATH653	Epidemiology and Forecasting of Plant Diseases	Minor	2	0	0	2	30	70	100
4	PGC651	Intellectual Property and its Management in Agriculture	Common	1	0	0	1	30	70	100
5	PATH500	Master Research	Research	-	-	-	13	200	0	200
	Total						17	320	280	600
	Grand total						71			

Semester I**Course Title: Mycology****Course Code: PATH501**

L	T	P	Credits
2	0	0	2

Total Hours-30

Learning Outcomes: After completion of this course, the learner will be able to:

- 1 Acquire basic information regarding nomenclature, historical development and classification of fungi.
- 2 Classify the importance of mycology in agriculture, relation of fungi to human affairs, history of mycology
- 3 Analyze the different structures produced by fungi and their identification
- 4 Demonstrate the comparative morphology, ultrastructure, characters of different groups of fungi up to generic level
- 5 Investigate about the importance of mycorrhiza & lichens, types, fungal genetics and variability in fungi.

Course Contents (Theory)**Unit I****8hours**

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**8hours**

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**7hours**

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**7hours**

Basidiomycota; general characters, mode of reproduction, types of basidiocarps and economic importance of Hymenomycetes. Uredinales 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.

Course Title: Mycology Lab
Course Code: PATH502

L	T	P	Credits
0	0	2	1

Course Contents (Practical)

30 hours

- 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 reproductive 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, Loculoascomycetes and Laboulbeniomyces, 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.

Transaction Mode

Lecture, Seminar, Peer Group Discussion, Self-Learning, Collaborative Learning and Cooperative Learning

Suggested Readings

1. Alexopoulos, C.J., Mims, C.W. and Blackwell, M. 2007. *Introductory Mycology. Fourth edition. Wiley Publishing, Inc., New Delhi. pp. 800.*
2. Harshberger, J.W. 2010. *A Text-Book of Mycology and Plant Pathology. Nabu Press, Charleston, South Carolina. Pp. 780.*
3. Hait, G. 2017. *A Textbook of Mycology, 1st edition. New Central Book Agency (NCBA), Kolkata, West Bengal. Pp. 774.*

Course Title: Principles of Plant Pathology**Course Code: PATH503**

L	T	P	Credits
3	0	0	3

Total Hours -45

Learning Outcomes: After completion of this course, the learner will be able to:

- 1 Examine the importance, terminology and concepts of plant diseases. To study the History and growth of plant pathology.
- 2 Catalogue and Understand the biotic and abiotic causes of plant diseases for the study of Growth, reproduction, survival and dispersal of important plant pathogens.
- 3 Assess the concept of host parasite interaction, recognition concept and infection.
- 4 Recognize the biofertilizers, disease development, role of enzymes, toxins, growth regulators to identify the disease.
- 5 Acquaint about defense strategies and altered plant metabolism as affected by plant pathogens.

Course Content**Unit I****9hours**

Importance, terminology and concepts of plant diseases. History and growth of plant pathology. Biotic and abiotic causes of plant diseases. Growth, reproduction, survival and dispersal of important plant pathogens.

Unit II**9hours**

Role of environment and host nutrition on disease development. Host parasite interaction, recognition concept and infection. Symptomatology, disease development.

Unit III**12hours**

Role of enzymes, toxins, growth regulators. Defense strategies, oxidative burst, phenolics, phytoalexins, PR proteins and elicitors.

Unit IV**15hours**

Altered plant metabolism as affected by plant pathogens. Genetics of resistance, 'R' genes, mechanism of genetic variation in pathogens, molecular basis for resistance, marker-assisted selection and genetic engineering for disease resistance. Disease management strategies.

Transaction Mode

Lecture, Self-Learning, Collaborative Learning and Cooperative Learning

Suggested readings:

1. Agrios, G.N. 2005. *Plant Pathology*. 5th Ed. Academic Press, New York. Pp.952.
2. Heitefuss, R. and Williams, P.H. 1976. *Physiological Plant Pathology*. Springer Verlag, Berlin, New York. Pp. 196.
3. Mehrotra, R.S. and Aggarwal, A. 2003. *Plant Pathology*. 2nd Ed. Oxford & IBH, New Delhi. pp. 846.
4. Singh, R.S. 2002. *Introduction to Principles of Plant Pathology*. Oxford & IBH, New Delhi. pp. 416.

Course Title: Agriculture statistics**Course Code: STAT501**

L	T	P	Credits
3	0	0	3

Total Hours-45

Learning Outcomes: On successful completion of this course, the students will be able to:

- 1 Enumerate statistical principles apply in all the areas of experimental work
- 2 Recognize the requirement at the national level and farm level for agriculture policy making,
- 3 Get familiarize with decision making, agriculture development and estimates agriculture and national income
- 4 Discover the importance of statistics in agriculture, helps to ascertain the volume of crop that needs to be produced based on output and demand of previous year
- 5 Compile knowledge about land utilization and irrigation including the net area sown gross cultivated area, current follow, cultivable waste

Course Content**Unit I****10hours**

Frequency distribution, standard error and deviation, correlation and regression analyses, co-efficient of variation; Hypothesis testing.

Unit II**15hours**

Concept of p-value. Tests of significance-t, F and chi-square (X^2); Data transformation and missing plot techniques.

Unit III**15hours**

Design of experiments and their basic principles, completely randomized, randomized block, split plot, strip-plot, factorial and simple confounding designs.

Unit IV**5hours**

Efficiency of designs; Methods of statistical analysis for cropping systems including intercropping; Pooled analysis.

Course Title: Agriculture statistics Lab**Course Code: STAT502**

L	T	P	Credits
0	0	2	1

Course Content (Practical)**30 hours**

- Correlation analysis. Regression analysis (exponential, power function, quadratic, multi-variate, selection of variables, validation of models, ANOVA and testing of hypothesis).
- Tests of significance (Z-test, t-test, F-test and Chi-square test). Analysis of variance.
- Completely randomized design.
- Randomized block and latin square designs.
- Missing plot and analysis of covariance.
- 23, 24 and 33 simple and confounded experiments.
- Split plot designs. Factorial in split plot designs.

Transaction Mode

Lecture, Seminar, e-Team Teaching, e-Tutoring

Suggested readings:

1. Panse, V.G. and Sukhatme, P.V. 1954. Statistical methods for agricultural workers. Pp. 361.
2. Gupta, S.C. and Kapoor, V.K. 2014. Fundamentals of Mathematical Statistics. Sultan Chand & Sons, New Delhi. pp. 230.
3. Snedecor, G.W. and Cochran, W.G. 1989. Statistical Methods, 8th Edition. Wiley-Blackwell. Pp.524.
4. Rangaswamy, R. 2016. Textbook of Agricultural Statistics. New Age International (P) Ltd. New Delhi. pp. 531.

Course Title: Toxicology of Insecticide**Course Code: ENTO600**

L	T	P	Credits
2	0	0	2

Total Hours-30

Learning Outcomes: After completion of this course, the learner will be able to:

- 1 Recognize the major classes of insecticide and understand their mode of action
- 2 Demonstrate the various processes involved in toxic dynamics of insecticides
- 3 Get awareness regarding the limitations of insecticide use such as resistance and environmental contamination
- 4 Develop a basic understanding on performing insect bioassays
- 5 Get acquaintance with pesticides acts.

Course Content

Unit-I

6 hours

Theory: Definition of toxicology, importance, scope, basic principles of insecticide toxicology and its relationship with other disciplines.

Unit-II

10 hours

Structure and mode of action of organochlorines, organophosphates, carbamates, pyrethroids, neonicotinoids, oxadiazines, phenylpyrozoles, botanicals and new promising compounds etc. Criteria, methods, problems and solutions of bioassay. Evaluation of insecticide toxicity, joint action of insecticides, synergism, potentiation and antagonism. Factors affecting toxicity of insecticides, selectivity and phytotoxicity.

Unit-III

8 hours

Insecticide metabolism, pest resistance to insecticides, mechanisms and types of resistance, Insecticide resistance management and pest resurgence. Insecticide residues, their significance and environmental implications.

Unit-IV

6hours

Insecticide Act, registration and quality control of insecticides, safe use of insecticides, diagnosis and treatment of insecticide poisoning

Course Title: Toxicology of Insecticide Lab
Course Code: ENTO601

L	T	P	Credits
2	0	2	1

Course Content (Practical)

30 hours

- Insecticide formulation and mixtures, quality control of pesticide formulations.
- Working out doses and concentrations of pesticides for laboratory and field evaluation for their bio-efficacy, bioassay techniques, probity analysis, evaluation of insecticide toxicity and joint action.
- Toxicity to beneficial insects.
- Preparation of working standard solutions of pesticides, Sampling, extraction, clean-up
- Estimation of insecticide residues by various methods, calculations and interpretation of data, visit to toxicology laboratories

Transaction Mode

Lecture, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning

Suggested readings

1. Chattopadhyay, S.B. 1985. *Principles and Procedures of Plant Protection*. Oxford & IBH, New Delhi.
2. Gupta, H.C.L. 1999. *Insecticides: Toxicology and Uses*. Agrotech Publ., Udaipur.
3. Ishaaya, I. and Degheele, (Eds.). 1998. *Insecticides with Novel Modes of Action*. Narosa Publ. House, New Delhi.
4. Matsumura, F. 1985. *Toxicology of Insecticides*. Plenum Press, New York.
5. Perry, A.S., Yamamoto, I., Ishaaya, I. and Perry, R. 1998. *Insecticides in Agriculture and Environment*. Narosa Publ. House, New Delhi.
6. Prakash, A. and Rao, J. 1997. *Botanical Pesticides in Agriculture*. Lewis Publ., New York.

Course Title: Bio-control of insect pests**Course Code: ENTO556**

L	T	P	Credits
2	0	0	2

Total Hours-30

Learning Outcomes: After completion of this course, the learner will be able to:

- 1 Comprehend the economic importance of different categories of insects and microbes
- 2 Discover the potential of useful insects and microbes in agricultural pest management
- 3 Learn about evaluating efficacy of various biocontrol agents
- 4 Study of mass production of natural enemies of pest insects
- 5 Acquire knowledge about mass production of microbial strains in biofertilizer and biofertilizers production

Course Content (Theory)

Unit I

08hours

Principles and scope of biological control. Techniques in biological control. Biology and host seeking of predatory and parasitic groups of insects.

Unit II

07hours

Role of insect pathogens and their mode of action. Biological control of weeds using insects. Techniques for mass production of quality biocontrol agents.

Unit III

09hours

Various formulations and economics of bioagents. Field application and evaluation. Analysis of successful biological control projects. Trends and future possibilities of biological control.

Unit IV

06 hours

Importation of natural enemies and quarantine regulations. Biotechnology in biological control. Semiochemicals in biological control.

Course Title: Bio-control of insect pests Lab
Course Code: ENTO2557

L	T	P	Credits
0	0	2	1

Course Content (Practical)

Total Hours-30

- Identification of common natural enemies of crop pests and weed killers.
- Techniques for rearing of natural enemies.
- Visits (only where logistically feasible) to bio- control laboratories to learn rearing and mass production of natural enemies of crop pests and weeds and their laboratory hosts.
- Field collection of parasitoids and predators.
- Hands- on training in culturing and identification of common insect pathogens.
- Quality control and registration standards for biocontrol agents.

Transaction Mode

Lecture, Seminar, e-Tutoring, Dialogue, Peer Group Discussion, Self-Learning

Suggested readings:

1. Prasad, T.V. 2019. *Handbook of Entomology*. New Vishal Publications, New Delhi. 3rd edition. pp. 496.
2. Shields, V.D.C. 2018. *Biological Control of Pest and Vector Insects*. INTECH. Princes Gate Court, London.
3. Jamal, A. 2017. *Biological Control of Insects Pests*. Anmol Publications Pvt. Ltd. pp. 264.

Course Title: Library and Information services Lab
Course Code: PGC501

L	T	P	Credits
0	0	2	1

Total Hours-30

Learning Outcomes: After completion of this course, the learner will be able to:

- 1 Identify library services and availability of resources in order to develop a realistic overall plan for research
- 2 Use general information resources to increase familiarity with the topic and disciplinary vocabulary.
- 3 Learn about the research topic, question or thesis to achieve a manageable focus appropriate to the assignment criteria, available resources, and evidence needed to support thesis
- 4 Identify keywords, synonyms and related terms in order to flexibly
- 5 Effectively search information resources

Course Content

- Introduction to Library and its services; five laws of library science; type of documents;
- Classification and cataloguing; organization of documents;
- Sources of information primary, secondary and tertiary;
- Current awareness and SDI services; tracing information from reference sources;
- Library survey; preparation of bibliography; use of Online Public Access Catalogue;
- Use of CD-ROM databases and other computerized library services, CeRA,
- J-Gate; use of Internet including search engines and its resources; e-resources.

Transaction Mode

- Lecture, Seminar, e-Team Teaching, e-Tutoring

Suggested readings:

1. Gita, S. 2012. *Library and Information Services*. LAP Lambert Academic Publishing. USA. pp. 76.
2. Kishore, A. 2021. *A Conceptual approach to library and information science A complete self study guide. 2nd edition*. AKB Publication. Jaipur. pp. 250.

**Course Title: AGRICULTURAL RESEARCH,
RESEARCH ETHICS AND RURAL
DEVELOPMENT PROGRAMMES**
Course Code: PGC502

L	T	P	Credits
2	0	0	2

Total Hours-30

Learning Outcomes:

On successful completion of this course, the students will be able to:

1. Identify library services and availability of resources in order to develop a realistic overall plan for research
2. Use general information resources to increase familiarity with the topic and disciplinary vocabulary
3. Learn about the research topic, question or thesis to achieve a manageable focus appropriate to the assignment criteria, available resources, and evidence needed to support thesis
4. Identify keywords, synonyms and related terms in order to flexibly

UNIT I

9 hours

History of agriculture in brief; Global agricultural research system: need, scope, opportunities; Role in promoting food security, reducing poverty and protecting the environment; National Agricultural Research Systems (NARS) and Regional Agricultural Research Institutions; Consultative Group on International Agricultural Research (CGIAR): International Agricultural Research Centres (IARC), partnership with NARS, role as a partner in the global agricultural research system, strengthening capacities at national and regional levels; International fellowships for scientific mobility.

UNIT II

7 hours

Research ethics: research integrity, research safety in laboratories, welfare of animals used in research, computer ethics, standards and problems in research ethics.

UNIT III

7 hours

Concept and connotations of rural development, rural development policies and strategies. Rural development programmes: Community Development Programme, Intensive Agricultural District Programme, Special group – Area Specific Programme

UNIT IV

7 hours

Integrated Rural Development Programme (IRDP) Panchayati Raj Institutions, Co-operatives, Voluntary Agencies/ Non-Governmental Organisations. Critical evaluation of rural development policies and programmes. Constraints in implementation of rural policies and programmes.

Transaction Mode

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning

Suggested readings:

1. Bhalla GS and Singh G. 2001. Indian Agriculture - Four Decades of Development. Sage Publ.
2. Punia MS. Manual on International Research and Research Ethics. CCS Haryana Agricultural University, Hisar.
3. Rao BSV. 2007. Rural Development Strategies and Role of Institutions - Issues, Innovations and Initiatives. Mittal Publ.

Course Title: Master Research

Course Code: PATH500

L	T	P	Credits
-	-	-	4

Learning Outcomes: After completion of this course, the learner will be able to:

- 1 Conduct an investigation and solve scientific problems using a range of methods, and apply appropriate and/or theoretical techniques
- 2 Negotiate, plan, design and execute a research-based project,
- 3 Analyse data and provide a written report or thesis on the methodology and outcomes in an appropriate format
- 4 Learn the methodology of planning, layout, data recording, analysis, interpretation and report writing of plant pathology experiments
- 5 Familiarize with indexing databases, citation databases: web of science, scopus, etc.

Semester II**Course Title: Plant Pathogenic Prokaryotes****Course Code: PATH551**

L	T	P	Credits
2	0	0	2

Total Hours-30

Learning Outcomes: After completion of this course, the learner will be able to:

- 1 Assess the basic knowledge on biology, classification and nomenclature, survival, phytopathogenic prokaryotic bacteria.
- 2 Acquire basic information regarding about phytoplasma, bacteriophages and bacteriophages.
- 3 Learn about the identification and preservation of bacterial cultures.
- 4 Gain the insights of understanding of disease distribution, symptomatology, etiology, epidemiology and control.
- 5 Generalize the role of bacteria in agriculture and as biocontrol agents.

Course Content**Unit I****6hours**

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; Lipopolysaccharide structure; Membrane transport; fimbriae and pili (Type IV pili); Mechanism of flagellar rotatory motor and locomotion, and bacterial movement; Glycocalyx (Slime layer; capsule); the bacterial chromosomes and plasmids; Operon and other structures in cytoplasm; Morphological feature of fastidious bacteria, spiroplasmas and Phytoplasmas.

Unit II

9hours Growth and nutritional requirements. Infection mechanism, role of virulence factors in expression of symptoms. Survival and dispersal of phytopathogenic prokaryotes. Taxonomy of phytopathogenic prokaryotes: 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 III**8hours**

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

Unit IV

7hours

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; Plasmids and their types, plasmid borne phenotypes. Introduction to bacteriocins. Strategies for management of diseases caused by phytopathogenic prokaryotes.

Course Title: Plant Pathogenic Prokaryotes Lab
Course Code: PATH552

L	T	P	Credits
0	0	2	1

Course Content (Practical)

30 hours

- 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.

Transaction Mode

Lecture, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning

Suggested readings

1. Goto, M. 1990. *Fundamentals of Plant Bacteriology*. Academic Press, New York. pp. 952.
2. Mount, M.S. and Lacy, G.H. 1982. *Phytopathogenic Prokaryotes*. Vols. I Academic Press, New York. pp. 560.
3. Mondal, K.K. 2011. *Plant Bacteriology*. Kalyani Publishers, Ludhiana, Punjab. pp. 190.

Course Title: Molecular Approaches in Plant Protection

Course Code: PATH553

L	T	P	Credits
1	0	0	1

Total Hours-15

Learning Outcomes: After completion of this course, the learner will be able to:

- 1 Comprehend the basic concepts and principles to study host pathogen relationship
- 2 Indicate about the recognition system and signal transduction of pathogens
- 3 Acquire basic knowledge about induction of defense responses- pathogenesis related proteins, HR, reactive oxygen species, phytoalexins and systemic acquired resistance, programmed cell death, viral induced gene silencing
- 4 Study the importance of biotechnology in disease management
- 5 Realize the biosafety issues related to GM crops

Course Content (Theory)

Unit I

5hours

Recent concepts of molecular biology and techniques used in plant protection. Genes of interest in plant protection. Identification, characterization and isolation of novel genes involved in pest resistance.

Unit II

4hours

Molecular basis of host plant-insect and pathogen interactions. PR-proteins and G-proteins. Molecular characterization of biodiversity-insects and pathogens.

Unit III

3hours

Molecular biology of baculoviruses. Molecular mechanisms of genetically engineered plants for pest resistance and pesticide resistance.

Unit IV

3hours

Improvement of biocontrol agents and useful insects using molecular techniques. Bio-safety related issues.

**Course Title: Molecular Approaches in
Plant Protection**

Course Code: PATH554

L	T	P	Credits
0	0	2	1

Course Content (Practical)

30 hours

- Molecular characterization of pest populations.
- Detection of biotypes/races.
- Establishment of phylogenetic relationships/dendrograms.
- Detection of Cry-gene and estimation of cry-toxin.
- characterization of capsid proteins of insect viruses.
- Detection of disease induced biochemical changes at molecular level.

Transaction Mode

Lecture, Seminar, e-Tutoring, Dialogue, Collaborative Learning and Cooperative Learning

Suggested readings:

1. Marshall, G. 1994. *Molecular Biology in Crop Protection*. Springer, Netherlands. pp. 283.
2. Nagarajan, S. 2013. *Dynamics of Plant Diseases*. Allied Publishers, New Delhi, India. pp. 120.
3. Mehrotra, R.S. 2011. *Plant Pathology*. McGraw Hill Education, New York, United States. pp. 910.

Course Title: Plant Quarantine and Regulations**Course Code: PATH555**

L	T	P	Credits
2	0	0	2

Total Hours-30

Learning Outcomes: After completion of this course, the learner will be able to:

- 1 Obtain knowledge on the principles and the role of plant quarantine at national and international level.
- 2 Absorb about the quarantine restrictions in the movement of agricultural produce, seeds and planting material; case histories of exotic pests/diseases and their status.
- 3 Categorize about plant protection organization in India, acts related to registration of pesticides and transgenics.
- 4 Learn about the history of quarantine legislations, PQ order 2003, environmental acts,
- 5 Formulate Industrial registration; APEDA, import and export of bio-control agents.

Course Content**Unit I****15hours**

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 agricultural produce, seeds and planting material; case histories of exotic pests/ diseases and their status.

Unit II**10hours**

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.

Unit III**8hours**

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 disinfection/ salvaging of infected material.

Unit IV**12hours**

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.

Transaction Mode

e-Team Teaching, e-Tutoring, Lecture, Seminar, Dialogue, Peer Group Discussion

Suggested readings:

1. Kahn, R. 1988. *Plant Protection & Quarantine*. CRC Press, Boca Raton, Florida, United States. Pp. 248.
2. Ebbels, D.L. 2003. *Principles of Plant health & quarantine*. Central Science Laboratory, York, UK. Pp. 228.
3. Mehrotra, R.S. 2011. *Plant Pathology*, McGraw Hill Education, New York, United States. Pp. 910.

Course Title: Fundamentals of Computer Applications Lab
Course Code: CA551

L	T	P	Credits
0	0	4	2

Total Hours-60

Learning Outcomes: After completion of this course, the learner will be able to:

- 1 Learn and understand about basics of MS-Word, Excel, preparation of Graphs
- 2 Read, understand, and interpret material on technology. They will have an appreciation for some of the ideas, issues, and problems involved in writing about technology and in workplace writing.
- 3 Recognize the operating systems, peripheral devices, networking, multimedia and internet
- 4 Familiarize with basic sources and methods of research and documentation on topics in technology, including on-line research.
- 5 Synthesize and integrate material from primary and secondary sources with their own ideas in research papers.

Course Content (Practical)

60 Hours

- Ms-word: creating a document, saving and editing, use of options from tool bars, format, insert and tools(spelling and grammar),
- alignment of text, creating a table, merging cells, column and row width. Ms-excel:
- entering expressions through the formula tool bar and use of inbuilt functions, sum, average, max, min.
- Creating graphs and saving with and without data in Ms-excel.
- Ms-access: creating database, structuring with different types of fields.
- Ms-power point: preparation of slides on power point.
- Internet Browsing: browsing a web page and creating of E-Mail ID. Agri. net (ARIS).

Suggested Readings:

1. Salaria, R.S. 2017. *Computer Fundamentals*. Daryaganj, New Delhi. pp. 486.
2. Manish, S. and Bhatt, A. 2016. *Computers in Agriculture: Fundamentals and Applications*. New India Publishing Agency. New Delhi. pp. 190.

3. *Manjunath, B.E. 2010.Computer Basics.Vasan Publications, Bengaluru, Karnataka. pp. 356.*

Course Title: Credit Seminar

Course Code: PATH556

L	T	P	Credits
-	-	-	1

Learning Outcomes: After completion of this course, the learner will be able to:

- 1 Show competence in identifying relevant information, defining and explaining topics under discussion
- 2 Present the classical and innovative work related to plant pathology subject.
- 3 Reach across diverse disciplines to apply theories, methods and knowledge bases from multiple fields to a single question or problem
- 4 Judge when to speak and how much to say, speak clearly and audibly in a manner appropriate to the subject
- 5 To ask appropriate questions, use evidence to support claims, respond to a range of questions

Course Title: BASIC CONCEPTS IN LABORATORY TECHNIQUES**Course Code: PGC551**

L	T	P	Credits
0	0	2	1

Objective

To acquaint the students about the basics of commonly used techniques in laboratory.

Practical

- Safety measures while in Lab;
- Handling of chemical substances;
- Use of burettes, pipettes, measuring cylinders, flasks, separatory funnel, condensers, micropipettes and vaccumets;
- Washing, drying and sterilization of glassware;
- Drying of solvents/ chemicals;
- Weighing and preparation of solutions of different strengths and their dilution;
- Handling techniques of solutions;
- Preparation of different agro-chemical doses in field and pot applications;
- Preparation of solutions of acids;
- Neutralisation of acid and bases;
- Preparation of buffers of different strengths and pH values;
- Use and handling of microscope, laminar flow, vacuum pumps, viscometer, thermometer, magnetic stirrer, micro-ovens, incubators, sandbath, waterbath, oilbath;
- Electric wiring and earthing;
- Preparation of media and methods of sterilization;
- Seed viability testing, testing of pollen viability;
- Tissue culture of crop plants;
- Description of flowering plants in botanical terms in relation to taxonomy.

Suggested Readings

1. Furr AK. 2000. *CRC Hand Book of Laboratory Safety*. CRC Press.

2. Gabb MH and Latchem WE. 1968. A Handbook of Laboratory Solutions. Chemical Publ. Co.

Course Title: Master Research
Course Code: PATH500

L	T	P	Credits
-	-	-	5

Learning Outcomes: After completion of this course, the learner will be able to:

- 1 Conduct an investigation and solve scientific problems using a range of methods, and apply appropriate and/or theoretical techniques
- 2 Negotiate, plan, design and execute a research-based project,
- 3 Analyse data and provide a written report or thesis on the methodology and outcomes in an appropriate format
- 4 Learn the methodology of planning, layout, data recording, analysis, interpretation and report writing of plant pathology experiments
- 5 Familiarize with indexing databases, citation databases: web of science, scopus, etc.

Semester III**Course Title: Biological Control of Plant Pathogens****Course Code: PATH600**

L	T	P	Credits
2	0	0	2

Total Hours-30

Learning Outcomes: On successful completion of this course, the students will able to:

- 1 To study principles and application of ecofriendly and sustainable management strategies of plant diseases
- 2 Study of virulence analysis and genetic diversity
- 3 Acquire knowledge about disease distribution, symptomatology, etiology, epidemiology and control
- 4 Understand the description of important phytopathogenic genera
- 5 Study about identification of fungal cultures and biocontrol agents

Course Content**Unit I****7hours**

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**7hours**

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**11hours**

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**9hours**

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.

Course Title: Biological Control of Plant Pathogens Lab**Course Code: PATH601**

L	T	P	Credits
0	0	2	1

Course Content**30 hours**

- 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.

Transaction Mode

Lecture, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning

Suggested Readings

1. Campbell R. 1989. *Biological Control of Microbial Plant Pathogens*. Cambridge Univ. Press, Cambridge.
2. Cook RJ and Baker KF. 1983. *Nature and Practice of Biological Control of Plant Pathogens*. APS, St. Paul, Minnesota.
3. Fokkema MJ. 1986. *Microbiology of the Phyllosphere*. Cambridge Univ. Press, Cambridge.
4. Gnanamanickam SS (Eds). 2002. *Biological Control of Crop Diseases*. CRC Press, Florida.

Course Title: Post Harvest Diseases**Course Code: PATH602**

L	T	P	Credits
2	0	0	2

Total Hours-30

Learning Outcomes: After completion of this course, the learner will be able to:

- 1 Comprehend methods of post harvest technology and its role in providing better quality produce to the consumer.
- 2 Understand functional foods and nutraceuticals Understand utilization of the produce and methods for shelf-life extension.
- 3 Learn quality control and various standards required for domestic and export market
- 4 Interpret the feasibility of implementing integrated disease management programs (IDMP) in agricultural crops
- 5 Acquire knowledge about management of post harvest diseases

Course Content**Unit I****5hours**

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.

Unit II**9hours**

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 control of plant pathogens by resident and introduced antagonists.

Unit III**8hours**

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

Unit IV**8hours**

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

Course Title: Post Harvest Diseases Lab**Course Code: PATH603**

L	T	P	Credits
0	0	2	1

Course Content**30 hours**

- Isolation, characterization and maintenance of important post-harvest pathogens.
- Role of different storage conditions for disease development.
- Application of antagonists against pathogens under in vitro and in vivo conditions.
- Comparative efficacy of different chemicals, fungicides, phyto-extracts and bioagents.

Transaction Mode

e-Team Teaching, e-Tutoring, Lecture, Seminar, Peer Group Discussion, Collaborative Learning and Cooperative Learning

Suggested readings

1. Narayanasamy, P. 2005. *Postharvest Pathogens and Disease Management*. John Wiley & Sons, New Jersey, United States. Pp. 672.
2. Singh, D., Sharma, R.R., Devappa, V. and Kamil, D. 2021. *Postharvest Handling and Diseases of Horticultural Produce*. CRC Press. London. Pp.454.
3. Snowden, A.L. 1992. *Post-Harvest Diseases and Disorders of Fruits and Vegetables. Volume 2: Vegetables* CRC Press, London. Pp. 642.

Course Title: Host Plant Resistance to insect's pests

Course Code: ENTO558

L	T	P	Credits
1	0	0	1

Total Hours-15

Learning Outcomes: After completion of this course, the learner will be able to:

- 1 Apart knowledge on the sources of resistant plants to insect pest.
- 2 Learn about various factors affecting plant resistance to insects.
- 3 Apply various techniques of plant resistance to insect pest
- 4 Acquaint with the breeding techniques for insect resistance in crops.
- 5 Acquire knowledge about role of biotechnology.

Course Content

Unit-I

4hours

History, importance, principles and classification of Host-Plant Resistance, Components and mechanisms of resistance.

Unit-II

4hours

Insect and host plant relationships. Theories and basis of host-plant selection. Chemical ecology. Tritrophic relations. Volatiles and secondary plant substances.

Unit-III

4hours

Basis of resistance. Factors affecting plant resistance including biotypes and measures to combat them. Screening techniques. Breeding for insect resistance in crop plants.

Unit-IV

3hours

Exploitation of wild plant species and gene transfer. Role of biotechnology in plant resistance to insects.

**Course Title: Host Plant Resistance
to insect's pests Lab**
Course Code: ENTO559

L	T	P	Credits
0	0	2	1

Course Content (Practical)

Total Hours-30

- Screening techniques for measuring resistance.
- Measurement of plant characters and working out their correlations with plant resistance.
- Testing of resistance in important crops.
- Demonstration of antibiosis, tolerance and antixenosis.

Transaction Mode

Lecture, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning

Suggested readings:

1. Dhaliwal, G.S. and Singh, R. (Eds). 2004. *Host Plant Resistance to Insects - Concepts and Applications*. Panima Publ., New Delhi.
2. Maxwell, F.G. and Jennings, P.R. (Eds). 1980. *Breeding Plants Resistant to Insects*. John Wiley & Sons, New York.
3. Painter, R.H. 1951. *Insect Resistance in Crop Plants*. MacMillan, London.

Course Title: Insect vectors of plant pathogens
Course Code: ENTO663

L	T	P	Credits
1	0	0	1

Total Hours-15

Learning Outcomes: After completion of this course, the learner will be able to:

- 1 Study of typical features of insect vectors of plant pathogens
- 2 Reframe the significance of insect vectors vis-à-vis other pest insects of plants
- 3 Study about the potential of insect vectors in spreading crop diseases
- 4 Associate the transmission of viruses through insects
- 5 Learn about disease control mechanisms of insect vectors

Course Content

Unit I **10hours**

History of developments in the area of insects as vectors of plant pathogens. Important insect vectors and their characteristics.

Unit II **05hours**

Mouth parts and feeding processes of important insect vectors. Efficiency of transmission. Transmission of plant viruses and fungal pathogens. Relation between viruses and their vectors.

Unit III **10hours**

Transmission of plant viruses by insect vectors and mites. Transmission of mycoplasma and bacteria by leaf hoppers and plant hoppers.

Unit IV **05hours**

Epidemiology and management of insect transmitted diseases through vector management. Paratransgenesis.

Course Title: Insect vectors of plant pathogens lab
Course Code: ENTO664

L	T	P	Credits
0	0	2	1

Course Content

30 hours

- Identification of common vectors of plant pathogens- culturing and handling of vectors.
- Demonstration of virus transmission through vectors. Vector virus relationship studies.

Transaction Mode

Lecture, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning

Suggested readings:

1. Butter, N. S. 2021. *Insect vectors and plant pathogens*. CRC Press, Taylor & Francis Group. London. pp. 496.
2. Harris, K.F. and Maramorosch, K. 1980. *Vectors of Plant Pathogens*. Academic Press. United States. pp. 418.

Course Title: Lab- Technical writing and communication skills
Course Code: PGC600

L	T	P	Credits
0	0	2	1

60 hours

Learning Outcomes: After completion of this course, the learner will be able to:

- 1 Understand and know how to follow the stages of the writing process (prewriting/writing/rewriting) and
- 2 Apply them to technical and workplace writing tasks
- 3 Produce a set of documents related to technology and writing in the workplace and will have improved their ability to write clearly and accurately
- 4 Understand the basic components of definitions, descriptions, process explanations, and other common forms of technical writing
- 5 Familiarise with basic technical writing concepts and terms, such as audience analysis, jargon, format, visuals, and presentation

Course Content

Various forms of scientific writings: theses, technical papers, review, manuals etc., various parts of thesis and research communications: title page, authorship contents page, preface, introduction, review of literature, material and methods, experimental results and discussion; writing of abstracts, summaries, precis, citations etc. commonly used abbreviations in the theses and research communications; illustrations, photographs and drawings with suitable captions; paginations, numbering of tables and illustrations; writing of numbers and dates in scientific write-ups; editing and proof reading; writing a review article, access methods.

Transaction Mode

Lecture, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning

Suggested readings:

1. Day, R.A. and Gastel, B. 2011. *How to Write and Publish a Scientific Paper*, 7th Edition. Greenwood Press, United States. pp. 300.
2. Laplante, P.A. 2011. *Technical Writing: A Practical Guide for Engineers and Scientists*. CRC Press, London. pp. 250.

3. *Greenlaw, R. 2012. Technical Writing, Presentational Skills and Online Communication: Professional Tools and Insights. Idea Group, U.S. pp. 247.*

Course Title: Master Research
Course Code: PATH500

L	T	P	Credits
-	-	-	10

Learning Outcomes: After completion of this course, the learner will be able to:

- 1 Conduct an investigation and solve scientific problems using a range of methods, and apply appropriate and/or theoretical techniques
- 2 Negotiate, plan, design and execute a research-based project,
- 3 Analyse data and provide a written report or thesis on the methodology and outcomes in an appropriate format
- 4 Learn the methodology of planning, layout, data recording, analysis, interpretation and report writing of plant pathology experiments
- 5 Familiarize with indexing databases, citation databases: web of science, scopus, etc.

Semester IV**Course Title: Plant Virology****Course Code: PATH651**

L	T	P	Credits
2	0	0	2

Total Hours-30

Learning Outcomes: After completion of this course, the learner will be able to:

- 1 Acquire basic knowledge of biology, classification nomenclature and survival of phytopathogenic viruses
- 2 Summarize the structure of plant virus, genome organization, replication and movement of viruses
- 3 Learn about the isolation and purification, estimation of virus titre and purity, electron microscopy, protein and nucleic acid based diagnostics.
- 4 Study the origin and evolution, mechanism of resistance
- 5 Understand genetic engineering, ecology, and management of plant viruses

Course Content**Unit I****8hours**

History of plant viruses, their composition and structure. Symptomatology of important plant viral diseases, transmission, chemical and physical properties. Host virus interaction and virus vector relationship.

Unit II

7hours nomenclature and classification, genome organization, replication and movement. Isolation, purification, electron microscopy, protein and nucleic acid based diagnostics.

Unit III**8hours**

Mycoviruses, phytoplasmas and baculoviruses, satellite viruses, satellite RNAs, phages, viroids, and prions. Origin and evolution, mechanism of resistance and genetic engineering of plant viruses.

Unit IV**7hours**

Study of representative viral/mycoplasmal diseases, emphasizing their distribution, symptomatology, etiology, epidemiology and principles of plant viral disease control.

Course Title: Plant Virology Lab
Course Code: PATH652

L	T	P	Credits
0	0	2	2

Course Content (Practical)

30 hours

- Study of symptoms caused by viruses, transmission,
- Assay of viruses, physical properties, purification,
- Method of raising antisera, serological tests, electron microscopy and ultratotomy, PCR.

Transaction Mode

Lecture, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning

Suggested readings:

1. Walkey, D. 2012. *Applied Plant Virology*, 2nd edition. Springer, Philippines. pp. 352.
2. Kolte, S.J. and Tewari, A.K. 2011. *The Elements of Plant Virology: Basic Concepts and Practical Class Exercises*. Kalyani Publishers, Ludhiana, Punjab. pp. 213.
3. Hull, R. 2013. *Plant Virology*. 5th edn. Academic Press, New York. pp. 1118.

Course Title: Epidemiology and Forecasting of Plant Diseases

Course Code: PATH653

L	T	P	Credits
2	0	0	2

Total Hours-30

Learning Outcomes: After completion of this course, the learner will be able to:

- 1 Catalogue and Understand the biotic and abiotic causes of plant diseases for the study of Growth, reproduction, survival and dispersal of important plant pathogens.
- 2 Assess the concept of host parasite interaction, recognition concept and infection.
- 3 Recognize the biofertilizers, disease development, role of enzymes, toxins, growth regulators to identify the disease.
- 4 Acquaint about defense strategies and altered plant metabolism as affected by plant pathogens.

Course Content

Unit I

8hours

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

7 hours

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

8hours

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

Unit IV

7 hours

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

****•** The visit to Flowerdale, Shimla, CSIR- Institute of Microbial Technology (IMTECH), Chandigarh and National Bureau of Plant Genetic Resources (NBPGR), New Delhi visit need to including in study scheme for practical exposure of Students.

Transaction Mode

Lecture, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning

Suggested Reading:

1. Campbell CL and Madden LV. 1990. *Introduction to Plant Disease Epidemiology*. John Wiley & Sons, New York.
2. Cooke B, Jones DM and Gereth KB. 2018 *The Epidemiology of Plant Diseases*. Springer Publications.
3. Cowling EB and Horsefall JG. 1978. *Plant Disease*. Vol. II. Academic Press, New York.
4. Laurence VM, Gareth H and Frame Van den Bosch (Eds.). *The Study of Plant Disease Epidemics*. APS, St. Paul, Minnesota.
5. Nagarajan S and Murlidharan K. 1995. *Dynamics of Plant Diseases*. Allied Publ., New Delhi.
6. Thresh JM. 2006. *Plant Virus Epidemiology*. *Advances in Virus Research* 67, Academic Press, New York.

Course Title: Intellectual Property and its Management in Agriculture
Course Code: PGC651

L	T	P	Credits
1	0	0	1

Total Hours-15

Learning Outcomes: After completion of this course, the learner will be able to:

1. Equip students and stakeholders with
2. Distinguish about Intellectual Property Rights (IPR) related protection systems
3. Make use of IPR as a tool for wealth and value creation in a knowledge-based economy.
4. Prioritize about Protection of plant varieties and farmers' rights.
5. Hypothesize National Biodiversity protection initiatives.

Course Content

Unit-I

4 hours

Historical perspectives and need for the introduction of Intellectual Property Right regime; TRIPs and various provisions in TRIPS Agreement; Intellectual Property and Intellectual Property Rights (IPR), benefits of securing IPRs.

Unit-I

4 hours

Indian Legislations for the protection of various types of Intellectual Properties; Fundamentals of patents, copyrights, geographical indications, designs and layout, trade secrets and traditional knowledge, trademarks.

Unit-I

3 hours

Protection of plant varieties and farmers' rights and biodiversity protection; Protectable subject matters, protection in biotechnology, protection of other biological materials, ownership and period of protection.

Unit-I

4 hours

National Biodiversity protection initiatives; Convention on Biological Diversity; International Treaty on Plant Genetic Resources for Food and Agriculture; Licensing of technologies, Material transfer agreements, Research collaboration Agreement, License Agreement.

Transaction Mode

Lecture, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning

Suggested readings:

1. *Erbisch FH and Maredia K. 1998. Intellectual Property Rights in Agricultural Biotechnology. CABI.*
2. *Ganguli P. 2001. Intellectual Property Rights: Unleashing Knowledge Economy. McGraw-Hill.*
3. *Intellectual Property Rights: Key to New Wealth Generation. 2001. NRDC and Aesthetic Technologies*

Course Title: Master Research
Course Code: MPP1500

L	T	P	Credits
-	-	-	13

Learning Outcomes: On successful completion of this course, the students will be able to:

- 1 Conduct an investigation and solve scientific problems using a range of methods, and apply appropriate and/or theoretical techniques
- 2 Negotiate, plan, design and execute a research-based project,
- 3 Analyse data and provide a written report or thesis on the methodology and outcomes in an appropriate format
- 4 Learn the methodology of planning, layout, data recording, analysis, interpretation and report writing of plant pathology experiments
- 5 Familiarize with indexing databases, citation databases: web of science, scopus, etc.