

GURU KASHI UNIVERSITY



M.Sc. Plant Pathology

Session : 2023-24

Department of Plant Protection

Graduate Outcomes of the programme

The program is designed to provide knowledge of identification and distribution of all plant pathogenic groups, principle of diseases management, diseases etiology and epidemiology. Emphasize on to acquire in depth knowledge on molecular level host-pathogen interactions, development of disease resistance in plants, Phytosanitary measures.

Program Learning Outcomes

After completing the programme, the learner will be able to:

- 1 Comprehend the principles and methodologies used in Plant Pathology.
- 2 Possess deep insight of fungal systematic, fungal structures, their role in identification and recent developments in fungal classification including chemo and molecular taxonomy.
- 3 Understand genetics and variability among fungi and their economic and industrial importance.
- 4 Develop advanced understanding on characterization, identification of bacteria, pathogenesis, mechanism of disease development and recent approach in bacterial disease management.
- 5 Imbibe coherent knowledge in history of plant viruses, their biological properties, diagnostics and management.
- 6 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.
- 7 Pursue analysis in Identification, characterization and isolation of novel genes involved in pest resistance and develops understanding about Molecular basis of host plant-insect and pathogen interactions.
- 8 Imbibe coherent knowledge on host pathogen interaction and its application at molecular level and transmission of pathogen by vectors, their biological & molecular interaction and management.
- 9 Apply acquired knowledge to understand principles and practices of integrated disease/ pest management in different crops.

Programme Structure							
Sr. No.	Course Code	Course Title	Type of Course	(Hours Per Week)			Total Credits
				L	T	P	
Semester I							
1	MPP101	Mycology	Major	3	0	2	4
2	MPP103	Principles of Plant Pathology	Major	3	0	0	3
3	MEN301	Toxicology of Insecticides	Minor (CBCS)	2	0	2	3
4	MEN203	Biological control of insect pest and weeds	Minor (CBCS)				
5	MAR121	Agriculture statistics	Supporting	3	0	2	4
6	MAR125	Library and Information Services	Common	0	0	4	2
7	MPP100	Master Research	Thesis Research	-	-	-	4NC
Total Credits							16+4NC
Semester II							
8	MPP201	Plant Pathogenic Prokaryotes	Major	2	0	2	3
9	MPP202	Molecular Approaches in Plant Protection	Major	2	0	2	3
10	MPP203	Post Harvest Diseases	Major	2	0	2	3
11	MPP204	Plant Quarantine and Regulations	Minor	2	0	0	2
12	MPP205	Seminar	Seminar	-	-	-	2
14	MAR206	Fundamentals of Computer Applications	Supporting		-	4	2
13	MPP100	Master Research	Thesis Research	-	-	-	5NC
Total Credits							15+5NC
Semester III							
15	MPP301	Techniques for Detection and Diagnosis of Plant Diseases	Major	2	0	2	3
16	MPP302	Integrated Disease Management	Major	2	0	2	3
18	MEN204	Host-Plant	Minor	1	0	2	2

				M.Sc. Plant pathology (MPP23)			
		Resistance to Insects	(CBCS)				
19	MEN404	Insect vectors of plant pathogens	Minor (CBCS)				
20	MAR304	Technical writing and communication skills	Common	0	0	4	2
17	MPP100	Master Research	Thesis Research	-	-	-	10NC
Total Credits							10+10 NC

Semester IV							
21	MPP401	Plant Virology	Major	3	0	2	4
22	MPP402	Fungal Diseases of Plants	Minor	2	0	2	3
23	MAR402	Intellectual Property and its Management in Agriculture	Common	2	0	0	2
24	MPP100	Master Research	Thesis Research	-	-	-	13 NC
Total Credits							9+11 NC
Grand total							50+30 NC

- **CBCS- Choice Based Credit System**
- **NC- Non Credit**

Evaluation Criteria for Theory Courses

- A. Continuous Assessment: [25 Marks]
 - Continuous Assessment 1: [10 Marks]
 - Continuous Assessment 2: [10 Marks]
 - Continuous Assessment 3: [05 Marks]
- B. Mid Semester Test: [30 Marks]
- C. End-Term Exam: [40 Marks]
- D. Attendance: [5 Marks]

For the CAs the teacher shall take surprised test/term paper/quiz/assignments

Evaluation Criteria for practical Courses

- ❖ The syllabus of subject is divided into five experiments, each experiment marks is of 20 marks(10 lab performance, 5 viva, 5 lab record)- Total marks 100

Evaluation Criteria for Seminar

- ❖ It is of total Marks-100
 - Collection of review of literature - 20marks
 - Data Analysis -20 marks
 - Power Point Presentation - 20 marks
 - Presentation skills - 20 marks
 - Viva voce - 20 marks

Evaluation Criteria for Master Research

- ❖ The evaluation is Satisfactory or Unsatisfactory on the basis of the performance of the candidate.

Semester I**Course Title: Mycology****Course Code: MPP101**

L	T	P	Credits
2	0	2	3

Total Hours-60

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**7hours**

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**9hours**

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 scomycetous fungi.

Unit IV**6hours**

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.

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 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, Loculoascomycetes 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.

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: MPP103

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: Toxicology of Insecticide
Course Code: MEN301

L	T	P	Credits
2	0	2	3

Total Hours-60

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 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: MEN203**

L	T	P	Credits
2	0	2	3

Total Hours-60

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 Content (Practical)

- 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. 3rdedition.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: Agriculture statistics**Course Code: MAR105**

L	T	P	Credits
3	0	2	4

Total Hours-60

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 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. Snecdecor, 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: Lab-Library and Information services
Course Code: MAR106

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: Master Research

Course Code: MPP23100

L	T	P	Credits
-	-	-	4NC

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: MPP201**

L	T	P	Credits
2	0	2	3

Total Hours-60

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, bdellovibrios 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 plantbacteriology in India. Evolution of prokaryotic life, Prokaryotic cytoskeletal proteins. Structure of bacterial cell. Structure and composition of gram negative and grampositive 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 (Slayer; capsule); the bacterial chromosomes and plasmids; Operon and other structures in cytoplasm; Morphological feature of fastidious bacteria, spiroplasmas and Phytoplasmas.

Unit II**9**

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

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: MPP202**

L	T	P	Credits
2	0	2	3

Total Hours-60

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****12hours**

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**6hours**

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

Unit III**8hours**

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

Unit IV**4hours**

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

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: Post Harvest Diseases**Course Code: MPP203**

L	T	P	Credits
2	0	2	3

Total Hours-60

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 aflatoxigenic and mycotoxigenic 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 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: Plant Quarantine and Regulations**Course Code: MPP204**

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 disinfestation/ 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**Course Code: MAR206**

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: MPP23205

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: Master Research
Course Code: MPP100

L	T	P	Credits
-	-	-	5NC

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: Techniques for Detection and Diagnosis of Plant Diseases

Course Code: MPP301

L	T	P	Credits
2	0	2	3

Total Hours-45

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

- 1 Study the isolation of pathogens using selective media, pure culture techniques. Also the methods to prove Koch's postulates with biotroph and necrotroph pathogens in Lab.
- 2 Learn about the preservation of plant pathogens and disease specimens.
- 3 Understand the use of haemocytometer, micrometer, centrifuge, pH meter, camera lucida.
- 4 Get Familiar with the use of Microscopic techniques and staining methods, chromatography, phase contrast and electron microscopy, spectrophotometer, ultracentrifuge and electrophoretic apparatus.
- 5 Demonstrate the serological and molecular techniques for detection of plant pathogens.

Course Contents**Unit I****10hours**

Isolation of pathogens using selective media, pure culture techniques. Methods to prove Koch's postulates with biotroph and necrotroph pathogens.

Unit II**05hours**

Preservation of plant pathogens and disease specimens, use of haemocytometer, micrometer, centrifuge, pH meter, camera lucida.

Unit III**10hours**

Microscopic techniques and staining methods, chromatography, phase contrast and electron microscopy, spectrophotometer, ultracentrifuge and electrophoretic apparatus.

Unit IV**05hours**

Serological and molecular techniques for detection of plant pathogens. Evaluation of fungicides and bactericides. Data collection and preparation of reports.

Course Content (Practical)**30 hours**

- 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 Pure culture techniques, use of selective media to isolate pathogens.

- Evaluation of fungicides, bactericides etc.; field experiments, data collection and preparation of manuscripts
- Phenotypic and genotypic tests for identification of plant pathogens;
- Molecular identification (16S rDNA and 16s-23S rDNA intergenic spacer regionsequences-prokaryotic organisms; and eukaryotic organism by ITS region) andwhole genome sequencing;

Transaction Mode

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

Suggested Readings

1. Meena, A. K., Godara, S. L. and Meena, P. N. 2020. *Detection and Diagnosis of Plant Diseases*. Scientific Publishers, Jodhpur, Rajasthan. pp. 124.
2. Boonham, N., Tomlinson, J. and Mumford, R. 2016. *Molecular Methods in Plant Disease Diagnostics, Principles and Protocols*. CABI Publishing. New Delhi. pp. 212.
3. Kumar, P. Tiwari, A.K., Kamle, M. Abbas, Z. Singh, P. 2019. *Plant Pathogens, Detection and Management for Sustainable Agriculture*. Apple Academic Press, Florida, USA. pp.362.

Course Title: Integrated Plant Disease Management**Course Code: MPP302**

L	T	P	Credits
2	0	2	3

Total Hours-60

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

- 1 Study importance of integrated disease management.
- 2 Appreciate the concept and tools of integrated disease management
- 3 Learn about the various components of integrated disease management, their limitations and implications
- 4 Study about the development of IDM for the control of diseases
- 5 Familiarize with the IDM adaptation in important crops, rice, wheat, cotton, sugarcane, chickpea, rapeseed mustard, pearl millet, Kharif pulses, vegetable and fruit crops

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

Introduction, definition, concept and tools of disease management.

Unit I**9hours**

Components of integrated disease management, their limitations and implications.

Unit I**5hours**

Development of IDM and its adaptation in important crops, rice, wheat, cotton, sugarcane.

Unit I**10hours**

Development of IDM and its adaptation in important crops chickpea, rapeseed mustard, pearl millet, Kharif pulses, vegetable and fruit crops.

Course Content**30 hours**

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

Transaction Mode

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

Suggested readings:

1. Sharma, R.C. and Sharma, J.N.2018. *Integrated Plant Disease Management, Scientific Publisher, Jodhpur.pp. 362.*
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.
4. Gupta, V.K. and Sharma, R.C. (Eds). 1995. *Integrated Disease Management and Plant Health*. Scientific Publ., Jodhpur. pp. 319.

Course Title: Host Plant Resistance to insect's pests
Course Code: MEN204

L	T	P	Credits
1	0	1	2

Total Hours-45

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 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: MEN404**

L	T	P	Credits
1	0	2	2

Total Hours-45

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 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: MAR304**

L	T	P	Credits
0	0	4	2

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: MPP100

L	T	P	Credits
-	-	-	10NC

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: MPP401**

L	T	P	Credits
2	0	2	3

Total Hours-60

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**

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

Unit III**9hours**

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

Unit IV**6hours**

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

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 ultratomy, 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: Intellectual Property and its Management in Agriculture
Course Code: MAR402

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. 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

8 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

8 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

5 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

7 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: MPP100

L	T	P	Credits
-	-	-	13NC

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.