PLANT PATHOLOGY AND AGRIL. MICROBIOLOGY

Course No. : PATH- 111

Course Title : INTRODUCTORY PLANT PATHOLOGY

Course Credit : 1+1=2

Theory :

Introduction, History of Plant Pathology: History and development of Plant Pathology in ancient, dark, premodern, modem and present eras, Contribution made by different scientists, **Definitions and objectives of Plant Pathology:** Concepts of disease, Disease triangle, **Important plant pathogenic organisms:** Different groups like fungi, bacteria, fastidious vesicular bacteria and phytoplasma with examples of diseases caused by them, **Morphology and reproduction**: of spiroplasmas, viruses, viroids, algae, protozoa and phanerogamic parasites with examples of diseases caused by them, **Prokayotes** - classification of prokaryotes according to Bergey's manual of Systematic bacteriology, **General characters of fungi:** mycelium (septate and non-septate), nutrition of fungi - saprophytes, parasites and symbiosis), definition of fungus, somatic structures, types of fungal thalli, fungus tissues, modification of thallus, reproduction in fungi (asexual and sexual) - spores (asexual and sexual), spore fruits (asexual and sexual), Asexual reproduction: fission, budding, and fragmentation; **Sexual reproduction:** plasmogamy, karyogamy and meiosis, **Method of reproduction:** planogametic copulation, gametangial contact, gametangial copulation, spermatization, dikaryotization; **Nomenclature:** binomial system of nomenclature, rules of nomenclature; **Classification of fungi**-upto genus

Practical:

Morphology of fungi (Vegetative), Reproductive structures and spore fruits in fungi, Symptoms produced by plant pathogens like fungi, bacteria, viruses and phytoplasmas, Acquaintance to Plant Pathology laboratory and equipments, Preparation of culture media for fungi and bacteria, Isolation techniques, Demonstration of Koch’s postulates, Collection of disease specimen and preparation of mounts, Preservation of disease samples, Study of important

genera of plant pathogenic fungi like *Pythium, Phytophthora, Albugo Sclerospora, Perenosclerospora, Pseudoperenospora, Perenospora, Plasmopara,* and *Bremia* (Oomycota); *Mucor* and *Rhizopus* (Zygomycota); *Oidium, Oidiopsis, Ovulariopsis, Erysiphe, Phyllactinia, Uncinula* and *Podosphaera* (Ascomycota); *Puccinia* (Different stages), *Uromyces, Hemiliea, Sphacelotheca* (*Soroporium*), *Ustilago, Tolyposporium Agaricus, Pleurotus and Ganoderma* (Basidiomycota); *Septoria, Colletotrichum, Pestalotiopsis, Pyricularia, Drechslera, Alternaria, Stemphyllium, Cercospora, Phaeoisariopsis, Rhizoctonia* and *Sclerotium* (Asexual Ascomycetes - Deuteromycota)

Text books Recommended :

1. Introduction to principles of plant pathology by R. S. Singh, Oxford and IBH Publ. Co., New Delhi (1996)
2. Essentials of plant pathology by V. N. Pathak, Prakash Publ., Jaipur (l972)
3. Plant pathology by G. N. Agrios 4th edition, Academ. Press, New york (1997)
4. Introductory Plant Pathology by M. N. Kamat, Prakash Publ, Jaipur (l967)
5. Plant diseases by R. S. Singh
6. Introductory Mycology by Alexopoulos, Mims and Blackwel (2004)
7. Introductory Plant Pathology by H.C. Dube

B) Teaching schedule

Lecture No.	Topics to be covered
1	Introduction
2	History, Definition and objectives of Plant Pathology
3	Concepts of disease, disease triangle
4	Definition of Plant Pathology
5	Important plant pathogenic organisms, different groups, Fungi, Bacteria, Fastidious and Vesicular bacteria and Phytoplasma with examples of diseases caused by them.
6	Spiroplasmas, Viruses, Viroids, Algae, Protozoa, and phanerogamic parasites with examples of diseases caused by them.
7,8	Prokaryotes, classification of prokaryotes according to Bergey's manual of Systematic bacteriology.
9	General characters of Fungi

10	Definition of Fungus, somatic structures, types of fungal thalli, fungus tissues, modification of thallus
11	Reproduction in Fungi (Asexual)
12	Reproduction in Fungi (Sexual)
13	Nomenclature, Binomial system of nomenclature
14	Rules of nomenclature
15	Classification of Fungi-up to genus

C) Lesson Plan

Lesson No.	Topics to be covered
1	Introduction
2	History, Definitions and objectives of Plant Pathology History of Plant Pathology- History and development of Plant Pathology in ancient, dark, premodern, modem and present eras. Contribution made by - Surpal, Theophrastus, Pliny, Iwanowski, Robert Hook, Anton van Leeuwenhoek, Needham, Linnaeus, Tillet, Prevost Robert Koch, Marshal Ward, Millardet, Jenson, Meyar, Burril, E.F. Smith, Erikson, Biffen, Iwanwasky, Stakman, Cragie, Luthra, Stanley, Bowden & Pierie, Doi & Asuyama, Butler, Mehta, Mundkur, Dastur, Kulkarni, Bhide, Uppal, Tirumalachar, Patel and Rangaswamy.
3	Concepts of disease, disease triangle
4	Definition of Plant Pathology
5	Important plant pathogenic organisms, different groups: Fungi, Bacteria, Fastidious Vesicular bacteria and Phytoplasma with examples of diseases caused by them.
6	Important plant pathogenic organisms, different groups: Morphology and reproduction -Spiroplasmas, Viruses, Viroids, algae, Protozoa, and phanerogamic parasites with examples of diseases caused by them.
7,8	Prokaryotes, classification of prokaryotes according to Bergey's manual of Systematic Bacteriology.
9	General characters of Fungi - mycelium (septate and non-septate),

	Nutrition of fungi, saprophytes, parasites and symbiosis)
10	Definition of Fungus, somatic structures, types of fungal thalli, fungus tissues, modification of thallus
11	Reproduction in Fungi (asexual and sexual): Spores (asexual and sexual), spore fruits (asexual and sexual)
12	Reproduction in Fungi (Asexual and sexual): Asexual reproduction - Fission, budding, and fragmentation Sexual reproduction - Plasmogamy, karyogamy and meiosis Method of reproduction – Planogametic copulation, Gametangial contact, Gametangial copulation, spermatization, dikaryotization
13	Nomenclature, Binomial system of nomenclature
14	Rules of nomenclature
15	Classification of Fungi-upto genus

D) Weightages

Sr. No.	Name of Topic	Weigh-tages
1	Introduction	6-7
2	Important plant pathogenic organisms, different groups, Fungi, Bacteria, Fastidious vesicular bacteria and Phytoplasma, Spiroplasma, Viruses, Viroids, algae, Protozoa, and phanerogamic parasites with examples of diseases cased by them	6-8
3	Prokaryotes, classification of prokaryotes according to Bergy's manual of systematic bacteriology.	6-7
4	General characters of Fungi	4-5
5	Definition of Fungus, somatic structures, types of fungal thalli, fungus tissues, modification of thallus	6-8
6	Reproduction in Fungi (Asexual and sexual)	4-5
7	Nomenclature, Binomial system of nomenclature	4-5
8	Classification of Fungi – up to genus.	4-5
	Total	**40-50**

E) Exercise schedule (practical)

Exercise No.	Topics to be covered
1	Morphology of fungi (Vegetative)
2	Reproductive structures and spore fruits in fungi
3	Symptoms produced by fungal plant pathogens
4	Symptoms produced by bacterial plant pathogens
5	Symptoms produced by viruses and phytoplasma
6	Acquaintance to Plant Pathology laboratory and equipments
7	Preparation of culture media for fungi and bacteria
8	Isolation techniques, demonstration of Koch's postulates, collection of disease specimen and preparation of mounts
9	Preservation of disease samples
10	Study of Pythium, Phytophthora and Albugo
11	Study of Sclerospora, Perenosclerospora, Pseudoperenospora, Perenospora, Plasmopara, and Bremia
12	Study of genera Mucor and Rhizopus
13	Study of Oidium, Oidiopsis, Ovulariopsis, Erysiphe, Phyllactinia, Uncinula and Podosphaera
14	Study of Puccinia (Different stages), Uromyces, Hemiliea
15	Study of Sphacelotheca, Ustilago and Tolyposporium
16	Study of Agaricus, Pleurotus and Ganoderma
17	Study of Septoria, Colletotrichum, and Pestalotiopsis
18	Study of Pyricularia, Helminthosporium, Drechslera, Alternaria, Stemphyllium, Cercospora, Phaeoisariopsis, Rhizoctonia and Sclerotium

Course No. : MIBO-121

Course Title : AGRICULTURAL MICROBIOLOGY

Course Credit : 2+1=3

Theory:

History of Microbiology: Spontaneous generation theory, Role of microbes in fermentation, Germ theory of disease, Procaryotic and eucaryotic microorganisms. Morphology, cytology and other characters of bacteria, fungi, algae, actinomycetes and mycoplasma. Bacteriophages: structure and properties

of Bacterial viruses – Lytic and Lysogenic cycles: viroids, prions. Metabolism in bacteria: ATP generation, chemoautotrophy, photo autotrophy, respiration, and fermentation. Bacterial genetics; Gene expression; Genetic recombination: transformation, conjugation and transduction, genetic engineering, Plasmids, episomes, genetically modified Organisms. Protection against infections. Plant – Microbe interactions.

Applied areas of Microbiology. Soil Microbiology: Microbial groups in soil, microbial transformations of carbon, nitrogen, phosphorus and sulphur, Biological nitrogen fixation. Microflora of Rhizosphere and Phyllosphere microflora, microbes in composting. Microbiology of Water: potable, irrigation, sewage water and water purification systems. Microbiology of food: microbial spoilage of food and principles of food preservation. Beneficial microorganisms in Agriculture: Biofertilizer (Bacterial Cyanobacterial and Fungal). Methods of application and quality norms of biofertilizer. Microbial insecticides. Microbial agents for control of Plant diseases. Biodegradation, Biogas production,

Practical:

General instructions, Familiarization with instruments, materials, glassware etc. in a microbiology laboratory: Practice of Aseptic methods: I - Evaluation of aseptic technique with Nutrient broth tubes. II- Evaluation of aseptic technique with a Nutrient agar plate. Methods of Sterilization and Preparation of media I- Preparation of nutrient broth, nutrient agar plates, nutrient agar slant and nutrient agar stabling; II- Sterilization of glassware by Dry heating; III - Sterilization of nutrient broth by Filtration. Plating methods for Isolation and Purification of bacteria I - Isolation of bacteria by Streak plate method. II - Isolation of aerobic spore forming bacteria by Enrichment using Streak plate method. III - Checking of purity of a bacterial culture by Streak plating method. Identification of bacteria by staining methods and Biochemical tests: I– Morphological examination of bacteria by Simple and Differential staining. II – Different biochemical tests for identification of bacterial culture; Enumeration of bacteria: I - Enumeration of bacteria by Stain slide method. II- Enumeration of bacteria by most probable number method. III - Enumeration of bacteria by Pour plate method and Spread plate method.

Books recommended:

1. Agricultural Microbiology. 1998. G. Rangaswani and D.J. Bagyraj. Prentice Hall of India., New Delhi.
2. An Introduction to Microbiology. 1996. P. Tauro, K.K. Kapoor and K.S. Yadav. Wiley Eastern Ltd., New Delhi.
3. Microbiology, 1986. M.J.Pelczar, E.C.S. Chan and N.L. Krieg. Mc Graw Hill 5th Edition, New York, USA.
4. Soil microorganisms and plant growth. 1977. N.S.. Subbarao Oxford & IBH Publ. Co. , New Delhi.

B) Teaching Schedule

Lecture No.	Topics to be covered
1.	Microbiology: Introduction, Scope in Agriculture and allied fields
2.	History of Microbiology.
3.	Spontaneous generation.
4.	Role of microbes in fermentation and germ theory of disease
5.	Microbial world: Prokaryotic and eukaryotic microorganisms
6 & 7.	Morphology, cytology and other characters of bacteria.
8.	Morphology, cytology and other characters of fungi
9.	Morphology, cytology and other characters of algae
10.	Morphology, cytology and other characters of actinomycetes
11.	Metabolism in bacteria: ATP generation, chemoautotrophy. photo autotrophy
12.	Metabolism in bacteria; respiration and fermentation.
13.	Bacterial genetics. Gene expression, genetic recombination.
14.	Bacterial transformations
15.	Transduction, genetic engineering, plasmids, episomes, genetically modified organisms
16.	Bacterial viruses- Lytic and lysogenic cycles, viroids, prions.
17.	Protections against infections and plant microbe interactions
18	Applied areas of microbiology.
19.	Soil Microbiology. Microbial groups in soil.
20.	Microbial transformations of carbon.

21.	Microbial transformations of nitrogen.
22.	Biological Nitrogen Fixation. .
23.	Microbial transformations of phosphorus..
24.	Microbial transformations of sulphur and iron.
25.	Microflora of rhizosphere, phyllosphere and microbes in composting.
26 & 27	Microbiology of water: potable/irrigation / sewage water and water purification system
28 & 29	Microbial spoilage and principles of food preservation
30 & 31	Beneficial microorganisms in Agriculture: Biofertilizers. Bacterial, Cyanobacterial and fungal biofertilizers.
31 & 32	Methods of application of biofertilizers and Quality control of biofertilizers.
33	Microbial insecticides. Microbial agents for plant disease control.
34	Biodegradation and Biogas production.

C) Lesson Plan

Lecture No.	Topics to be covered
1.	Microbiology: Introduction, Scope in Agriculture and allied fields
2.	History of Microbiology, Origin of life. Discovery of microorganisms, Invention of microscope.
3.	Spontaneous generation, Settlement of spontaneous generation conflict, Era of germ theory of disease. Immunization research. Development of Agricultural Microbiology.
4.	Role of microbes in fermentation and germ theory of diseases. Contributions of Robert Koch and Louis Pasteur. Koch's Postulates.
5.	Microbial world: Prokaryotic and eukaryotic microorganisms. Microorganisms. Groups of Microorganisms.. Microflora and microfauna. Characters and importance of bacteria, fungi, actinomycetes, algae, viruses, mycoplasma, nematodes and earthworms.
6.	Bacteria: Morphology, cytology and other characters. Bacterial cell structure and functions of external and internal parts. Morphology of bacteria: size, shape, cell grouping, endosperm formation, and capsule

	formation.
7.	Bacteria: Nutrients required for growth of bacteria. Nutritional types of bacteria. Bacterial growth. Growth curve. Growth phases. Reproduction of bacteria. Methods of reproduction
8.	Morphology, cytology and other characters of fungi: Fungal hyphae, mycelium, types of mycelia, reproduction methods of fungi, nutritional mode of fungi. Agriculturally important fungi.
9.	Morphology, cytology and other characters of algae. Algae, distribution and growth requirements. Morphology and cytology of algae. Major groups of algae and their importance.
10.	Morphology, cytology and other characters of actinomycetes. Actinomycetes, similarities with bacteria and fungi, habitat, general characters, reproduction, important actinomycetes and their importance in agriculture and allied fields.
11.	Bacterial metabolism: Catabolism and anabolism. ATP generation Chemoautotrophy. Photo autotrophy
12.	Metabolism in bacteria: Respiration and Fermentation.
13.	Bacterial genetics. Bacterial genome. Arrangement of genes. Mutation in bacteria. Genetic variability. Bacterial conjugation. Properties of plasmids. Properties of clones Genetic exchange by conjugation.
14.	Bacterial Transformations.
15	Transduction. Generalized and Specialized transduction. Genetic Engineering. Cutting and joining of DNA. Genetic recombination. Genetically modified organisms
16.	Bacterial viruses- Bacteriophages. Structure of bacteriophages. Properties of bacteriophages. Lytic and lysogenic cycles.
17.	Protection against infections and plant microbe interactions. Immunity, types of immunity. Parasitism, Predation, Symbiosis, Commensalisms.
18.	Applied areas of Microbiology. Scope of Agricultural Microbiology in other fields. Beneficial and harmful activities of microbes in agriculture and allied branches of Microbiology.
19.	Soil Microbiology. Introduction and importance. Microorganisms present in soil. Bacteria, fungi, actinomycetes, algae in soil. Protozoa

	and earthworms, nematodes in soil.
20.	Microbial transformations of carbon. Carbon cycle. Decomposition of organic matter.
21.	Microbial transformations of nitrogen. Nitrogen cycle. Steps of N cycles and microbes involved.
22.	Biological Nitrogen Fixation. Symbiotic and asymbiotic N fixation *Rhizobium* légume symbiosis. Associative dinitrogen fixation.
23.	Transformation of phosphorus in soil. P cycle, steps and microbes involved. Phosphate solubilization, mechanism and organisms involved.
24.	Microbial transformation of sulphur. Sulphur cycle, steps and microbes involved. Sulphur compound in soil. Oxidation of Sulphur Iron transformations in soil. Iron cycle, steps and Microbes involved
25	Microflora of Rhizosphere, Phyllosphere and microbes in composting. Rhizosphere. Rhizosphere concept. Microflora of rhizosphere . Effect of rhizospheric microflora on crop plants. Factors affecting rhizospheric microfloral population. Phyllosphere: Phyllosphere microflora and their effect on crop plants.. Microbes in composting. Cellulolytic microbes. Microbes in prevailing in different phases of composting.
26.	Microbiology of water: Sanitary quality of water. Polluted water. BOD and water purification methods
27.	Microbiology of water: Waste water. Sewage and microbial flora in sewage, Effects of waste water on plants and microorganisms. Purification methods
28.	Microbiology of Food: Food microflora. Food intoxication, Food infections, Food poisoning. Microbial spoilage of important foods. Methods of food preservation.
29.	Microbiology of Food: Spoilage and preservation of f agricultural produce. Preservation of fruits, vegetables, milk, and other food products.
30	Beneficial microorganisms in agriculture: Biofertilizers. Definition, Types of biofertilizers. Types based on the basis of microbial group involved, activity performed by microbial agent used to prepare biofertilizer, physical consistency and relation with the host crop. Role

	of biofertilizers.
31& 32.	Methods and rate of application of biofertilizer. Seed treatment method with precautions while treating seeds with biofertilizer, Application through soil, irrigation water and other methods. Quality control of biofertilizers. Specified quality control norms for biofertilizers
33	Microbial insecticides. Microbial agents for plant disease control. Bioinsecticides and biopesticides. *Trichoderma*, *Pseudomonas*.
34	Biodegradation and Biogas production.

D) Weightages

Group	Topics	Weightages
I	Microbiology. History of Microbiology. Spontaneous Generation. Role of microbes in fermentation and germ theory of diseases. Microbial world. Prokaryotes and eucalypts. General characters of microbes	8 to 9
II	Bacteria, Cytology, Morphology, nutrition, growth curve, reproduction	10 to 11
III	Morphology, cytology and other characteristics of fungi, algae, actinomycetes, mycoplasma.	10 to 11
IV	Metabolism in bacteria and Bacterial Genetics	10 to 11
V	Bacterial Viruses. Lytic and lysogenic cycle, viroids and prions.	4 to 5
VI	Applied areas of Microbiology, Soil Microbiology and microbial transformation of carbon	4 to 5
VII	N cycle, Biological N fixation	10 to 11
VIII	Sulphur and Iron transformations and S and Fe cycles. Microflora of rhizosphere, phyllosphere and microbes in composting.	6 to 7
X	Microbiology of food. Microbiology of water	4 to 5
XI	Biofertilizer, Types, Methods of application and quality control	8 to 9
XII	Microbial insecticides, biodegradation and biogas production	6-7
	Total	**80 to 92**

E) Exercise schedule (Practical)

Exercise No.	Title of exercise
1.	Acquaintance with microscope and other lab equipments.
2.	Study of morphology of bacteria
3.	Simple staining of bacteria
4.	Gram staining of bacteria
5.	Methods of sterilization
6.	Preparation of culture media.
7.	Preparation of nutrient broth, pour plate, slants and stabs
8.	Isolation of bacteria by streak method.
9.	Isolation of *Rhizobium* bacteria by pour plate technique
10.	Purification methods of bacterial cultures
11	Estimation of soil microflora by dilution pour plate technique
12.	Estimation of soil microflora by buried slide techniques
13.	Enumeration of bacteria by direct microscopic count method.
14.	Isolation of bacteria (*Azotobacter)* by enrichment culture technique
15.	Isolation of phosphate solubilizing bacteria using specific medium.
16.	Tests for Acid and gas production and liquefaction of gelatin by bacteria
17.	Enumeration of bacteria (*Azospirillum)* by most probable method

Course No. : PATH-232

Course Title : PRINCIPLES OF PLANT PATHOLOGY

Course Credit : 1+1=2

Theory :

Terms **and concepts, Survival and dispersal of plant pathogens:** Survival - mode of perpetuation of pathogen, facultatism by dormant mycelium and sclerotia; perpetuation on alternate and collateral hosts; heteroecism, autocism, polymorphism, physiological specialization, **Dispersal:** continuous dissemination - autonomous dissemination, Role of air, wind, water, animals, birds, insects, nematodes and mites in dissemination of plant pathogens, Discontinuous dissemination – man, seed, soil and agricultural operations, **Phenomenon of infection:** pre-penetration, penetration and post penetration, Mechanism of infection and avenues of penetration, direct and indirect penetration, Pathogenesis: role of enzymes, toxins, growth regulators and polysaccharides, **Defense mechanisms in plant:** structural and biochemical (pre and post infection), **Plant disease epidemiology and disease forecasting:** remote sensing, Epidemiology - definition, simple interest and compound interest diseases, essential conditions for epiphytotics, decline of epidemics, **Plant disease forecasting:** methods of disease forecasting, survey and surveillance, forecasting models, satellite imaginary forecasting; **General principles of plant disease management:** importance, principles – avoidance, exclusion, eradication, protection and resistance

Practical:

Study of different groups of fungicides and antibiotics, Preparation of fungicides: Bordeaux mixture, Bordeaux paste and chestnut compound, Methods of application of fungicides: seed, soil, and foliar, Bioassay of fungicides: poisoned food techniques; inhibition zone technique; slide germination technique, Biocontrol of plant pathogens: Dual culture technique, Detection of seed microflora, Seed treatment, Visit to quarantine station and remote sensing laboratory, Soil solarization, Handling of plant protection equipments.

Text books Recommended :

1. Introduction to principles of plant pathology by R. S. Singh, Oxford and IBH Publ. Co., New Delhi (1996)

2. Essentials of plant pathology by V. N. Pathak, Prakash Publ., Jaipur (l972)
3. Plant pathology by G. N. Agrios 4th edition, Academ. Press, New york (1997)
4. Introductory Plant Pathology by M. N. Kamat, Prakash Publ, Jaipur (l967)
5. Plant diseases by R. S. Singh
6. Introductory Plant Pathology by H.C. Dube

Theory : B) Teaching schedule

Lecture No.	Topics to be covered
1	Terms and concepts
2	Survival and dispersal of Plant Pathogens
3	Phenomenon of infection: Pre-penetration, penetration and post penetration
4	Pathogenesis: Role of enzymes, toxins, growth regulators and polysaccharides, Defense mechanism in plants: Structural and biochemical (pre and post infection)
5	Plant disease epidemiology and disease forecasting, Remote sensing
6	General principles of plant disease management - Importance General principles: Avoidance, exclusion, eradication, protection and resistance
7	Plant quarantine and inspection: Quarantine rules and regulations and pest risk analysis
8	Cultural methods: Rouging, eradication of alternate and collateral hosts, crop rotation, manure and fertilizer management, mixed cropping, sanitation, hot weather ploughing, soil amendments, time of sowing, seed rate and plant density, irrigation and drainage.
9	Mechanism of biological control and PGPR
10	Physical methods: Use of heat, steam
11	Chemical methods: Methods of application of fungicides
12	Host plant resistance
13	Application of biotechnology in plant disease management (Development of disease resistant transgenic plants through gene

	cloning).
14	Integrated plant disease management (IDM) concept, advantages and importance.

C) Lesson plan

Lesson No.	Topics to be covered
1	Terms and concepts in Plant Pathology: Immunity, Immunization, Perpetuation, Incubation period, Polygenic resistance, Setae, Antherezoid, Blastospores, Parasite, Facultative parasite, Facultative saprophyte, Obligate parasite, Homothalism, Heterothalism, Holocarpism, Eucarpism, Dikaryosis, Entomochory, Plasmogamy, Spore, Karyogamy, Haustoria, Alternate Host, Colateral host, Heteroecism, Autoecism, Anamorph, Teleomororph, Chronic symptom, conjugation, Horizontal resistance, Verticle resistance, Host, Parasite, Pathogen, Hyperparasite, Hypersensitivity, Inoculum, Masked symptoms, Nonhost resistance, Paraphysis, Pathogenicity, Phytoalexin, Propogule, Resistance, Susceptibility, Symptomless carrier and Tolerance.
2	Survival and dispersal of plant pathogens: Survival: Mode of perpetuation of pathogen, facultatism by dormant mycelium and sclerotia; perpetuation on alternate and collateral hosts; heteroecism, autocism, polymorphism, physiological specialization. Dispersal: Continuous dissemination - Autonomous dissemination. Role of air, wind, water, animals, birds, insects, nematodes and mites in dissemination of plant pathogens . Discontinuous dissemination – Man, seed, soil and agricultural operations
3	Phenomenon of infection: Pre-penetration, penetration and post penetration Mechanism of infection and avenues of penetration, direct and indirect penetration
4	Pathogenesis: Role of enzymes, toxins, growth regulators and polysaccharides Defense mechanisms in plant: structural and biochemical (pre and post infection)

5	Plant disease epidemiology and disease forecasting: Remote sensing Epidemiology: A) Definition, B) Simple interest and compound interest diseases, C) Essential conditions for epiphytotics - 1. Distance of susceptible plants from the source of primary inoculum, 2. Abundance of distribution of susceptible host, 3. Disease proneness in the host, 4. Presence of suitable alternate and collateral host for survival, 5. Presence of aggressive isolate of pathogen, 6. High multiplication rate of pathogen, 7. Low death rate, 8. Easy and rapid disposal of the pathogen, 9. Adaptability of pathogen D) Decline of epidemics: saturation of pathogen in host population, reduction the aggression of the pathogen E) Plant disease forecasting: a) Methods of disease forecasting, b) Survey and surveillance, c) Forecasting models, d) Satellite imaginary forecasting
6	General principles of plant disease management: Importance, General principles – Avoidance, exclusion, eradication, protection and resistance
7	Plant Quarantine and inspection: Quarantine rules and regulations and pest risk analysis,. A) Plant quarantine - domestic and international seed certification, B) PEQ, C) Eradication – 1. Removal of plant parts and sanitation, 2. Eradication of alternate hosts, 3. Destruction of collateral host, 4. Rouging, 5. Cultural practices
8	Cultural methods: Rouging, eradication of alternate and collateral hosts, crop rotation, manure and fertilizer management, mixed cropping, sanitation, hot weather ploughing, soil amendments, time of sowing, seed rate and plant density, irrigation and drainage.
9	Role of biological control and PGPR . Biological-cross protection, use of suppressive soil, introduction of newer antagonist, use of hypo-virulent strain, use of hyperparasites
10	Physical methods: heat, steam, hot water, solar heat
11	Chemical methods: methods of application of fungicides, seed

	treatment, soil application and spray/dust application
12	Host plant resistance
13	Application of biotechnology in plant disease management (Development of disease resistance transgenic plant through gene cloning)
14	Integrated plant disease management (IDM) concept, advantages and importance

D) Weightages

Lesson No.	Topics to be covered	Weight-ages
1	Terms and concepts	4-6
2	Survival and dispersal of plant pathogens, Phenomenon of infection-pre-penetration, penetration and post penetration	4-4
3	Pathogenesis-Role of enzymes, toxins, growth regulators and polysaccharides, defense mechanisms in plant structural and biochemical (pre and post infection) Plant disease epidemiology and disease forecasting - Remote sensing	7-8
4	General principles of plant disease management – Importance, General principles – Avoidance, exclusion, eradication, protection and resistance	5-6
5	Plant quarantine and inspection- Quarantine rules and regulations	4-6
6	Cultural methods - Rouging, eradication of alternate and collateral hosts, crop rotation, manure and fertilizer management, mixed cropping, sanitation, hot weather	4-6

	ploughing, soil amendments, time of sowing, seed rate and plant density, irrigation and drainage.	
7	Role of Mechanism of biological control and PGPR	4-6
8	Physical methods: heat, steam, hot water, solar heat Chemical methods: methods of application of fungicides - seed treatment, soil application and spray/dust application	4-6
9	Host plant resistance: Application of biotechnology in plant disease management (Development of disease resistance transgenic plant through gene cloning)	4-6
10	Integrated plant disease management (IDM): concept, advantages and importance	4-6
Total		**40-50**

E) Exercise schedule (Practical)

Exercise No	Topics to be covered
1	Study of different groups of fungicides and antibiotics
2,3	Preparation of fungicides: Bordeaux mixture, Bordeaux paste and chestnut compound
4	Methods of application of fungicides: seed ,soil, and foliar
5	Bioassay of fungicides: poisoned food techniques
6	Inhibition zone technique
7	Slide germination technique
8	Biocontrol of plant pathogens
9	Dual culture technique
10	Detection of seed microflora
11	Seed treatment
12	Visit to quarantine station and remote sensing laboratory
13	Soil solarization
14	Handling of plant protection equipments

Course No. : PATH-243

Course Title : DISEASES OF FIELD CROPS AND THEIR MANAGEMENT

Course Credit : 2+1=3

Theory:

Economic importance, symptoms, cause, epidemiology and disease cycle and integrated management of diseases of rice, sorghum, bajra, maize, wheat, sugarcane, *ragi,* finger millet, turmeric, ginger, tobacco, groundnut, sesamum, sunflower, safflower, linseed, castor, cotton, red gram, Bengal gram, black gram, green gram, tea, soybean.

Practical:

Study of symptoms, etiology, host-parasite relationship and specific control measures of diseases of rice, sorghum, wheat, bajra, maize, *ragi,* finger millet, sugarcane, turmeric, ginger, tobacco, groundnut, castor, sunflower, safflower, sesamum, linseed, cotton, red gram, green gram, black gram, Bengal gram, soybean. Field visits at appropriate time during the semester. Survey and collection of disease samples of above crops and their preservation.

Sr. No.	**Lecture No.**	**Topic to be covered**	**Sr. No.**	**Lecture No.**	**Topic to be covered**
Economic importance, symptoms, cause, epidemiology, disease cycle and integrated management of diseases of :					
1	1, 2	Rice	13	19	Linseed
2	3, 4	Sorghum	14	20	Cotton
3	5, 6	Bajra	15	21, 22	Red gram
4	7	Maize	16	23	Bengal gram
5	8	Ragi and Nagli (Finger millet)	17	24	Black gram
6	9, 10	Wheat	18	25	Green gram
7	11, 12	Sugarcane	19	26	Soybean
8	13	Tobacco	20	27, 28	Turmeric

9	14	Groundnut	21	29	Ginger
10	15	Sesamum	22	30	Onion
11	16	Sunflower	23	31	Garlic
12	17, 18	Safflower	24	32	Castor

Note: Students should submit 50 pressed, well mounted diseased specimens in three installments during the semester. Books recommended

Teaching schedule (Lesson plan)

Lesson No.	Lesson	Topic to be covered
1, 2	Rice diseases	Blast, bacterial blight, false smut, udbatta, sheath blight, leaf scald and rice tungro virus
3, 4	Sorghum diseases	Smuts, charcoal rot, grain mold, leaf spots, rust
5, 6	Bajra diseases	Rust, smut, downy mildew, ergot, rust
7	Maize diseases	Downy mildew, smut
8	Ragi & finger millet	Leaf spots, blast
9, 10	Wheat diseases	Stem rust, brown rust, yellow rust, blights, loose smut, bunt of wheat
11, 12	Sugarcane diseases	Smut, mosaic, grassy shoot, rust, red rot
13	Turmeric diseases	Leaf spots, rhizome rot
14	Ginger diseases	Leaf spots, rhizome rot
15	Tobacco diseases	TMV, leaf curl, broom rape
16, 17	Groundnut diseases	Leaf spots (Tikka), rust, bud necrosis, stem rot
18	Sesamum diseases	Leaf spots, wilt, powdery mildew, phyllody
19, 20	Sunflower diseases	Downy mildew, leaf spot, rust, necrosis virus

21	Safflower diseases	Wilt, leaf spot, mosaic, root rot
22	Linseed diseases	Wilt, rust
23, 24	Cotton diseases	Angular leaf spot, grey mildew, anthracnose, leaf spots, boll rot, wilt, and reddening
25	Red gram diseases	Wilt, sterility mosaic, leaf spot
26	Bengal gram diseases	Wilt, stunt, stem rot, root rot and blight
27	Black gram diseases	Powdery mildew, leaf spot, virus
28	Green gram diseases	Powdery mildew, leaf spots, blight, yellow mosaic
29	Soybean diseases	Rust, anthracnose, bacterial blight, viruses
30	Onion diseases	Smudge, *Alternaria* blight, blast, downy mildew, storage rots
31	Garlic diseases	Leaf spots, blight
32	Caster diseases	Rust, leaf spots
	Total lessons	**32**

Reference Books :

1. Diseases of tropical and subtropical field, fibre and oil plants by Cook, A. A. 1981, Mac Millan Pub NewYork
2. Diseases of crop plants in India by Rangaswamy G. 1988, Pub New Delhi
3. Plant Diseases by Singh, R. S. 1996, Oxford & IBM Ltd New Delhi.
4. Plant Pathology by G. N. Agreose 5th Edition.

D) Weightages :

Sr. No.	**Topic**	**Weightages/ Marks**	**Sr. No.**	**Topic**	**Weightages/ Marks**
Economic importance, symptoms, cause, epidemiology, disease cycle and integratemanagement of diseases of :					
1	Rice	5-6	13	Linseed	2-3
2	Sorghum	5-6	14	Cotton	6-7
3	Bajra	4-5	15	Red gram	3-4

4	Maize	3-4	16	Bengal gram	4-5
5	Ragi and Nagli (Finger millet)	2-3	17	Black gram	2-3
6	Wheat	6-7	18	Green gram	2-3
7	Sugarcane	4-5	19	Soybean	4-4
8	Tobacco	2-3	20	Turmeric	3-3
9	Groundnut	5-6	21	Ginger	2-3
10	Sesamum	2-3	22	Onion	3-4
11	Sunflower	5-6	23	Garlic	1-1
12	Safflower	4-5	24	Castor	1-1
				Total	**80-100**

Practical :

1. Study of symptoms, etiology, host-parasite relationship and specific control measures of the following crop diseases.

2. Survey, collection and preservation of disease samples of rice, sorghum, *bajra,* wheat, maize, sugarcane, turmeric, tobacco, groundnut, castor, sunflower; sesamum, cotton, redgram, green gram, black gram, Bengal gram and beans.

3. Field visits at appropriate time during the semester

Crops to be covered	**Diseases to be covered**	**Exercise No.**
Study of symptoms, etiology, host-parasite relationship and specific control measures of the following diseases of:		
Rice	Blast, bacterial blight, false smut, leaf scald and rice tungro virus	1

Sorghum	Smuts, charcoal rot, grain mold, leaf spots	2
Bajra	Rust, smut, downy mildew	3
Maize	Downy mildew, smut	3
a) *Ragi*	Leaf spots	4
b) Finger-millet	Leaf spots	4
Wheat	Stem rust, brown rust, yellow rust, loose smut, bunt of wheat	5
Sugarcane	Smut, mosaic, grassy shoot, downy mildew	6
Groundnut	Leaf spots, rust, bud necrosis, stem rot	7
Sunflower	Downy mildew, leaf spot, rust, necrosis virus	8
Safflower	Wilt, leaf spot, mosaic, root rot	8
Turmeric	Leaf spots	9
Garlic	Leaf spots, blight	9
Cotton	Angular leaf spot, grey mildew, anthracnose leaf spots, boll rot, wilt, and reddening	10
Red gram	Wilt, sterility mosaic	11
Bengal gram	Wilt, stunt, stem rot, root rot and blight	11
Green gram	Powdery mildew, leaf spots and blight, yellow mosaic	12
Black gram	Powdery mildew leaf spot, virus diseases	12
Soybean	Rust, anthracnose, bacterial blight, viruses	12
Tobacco	TMV, leaf curl, broom rape	13
Linseed	Wilt, rust	13
Castor	Rust, leaf spots,	14
Sesamum	leaf spots, wilt, powdery mildew, phyllody	14
	Total	**14**
Note: Students should submit 50 pressed, well mounted diseased specimens in three installments during the semester		

Course No. : PATH-354

Course Title : DISEASES OF HORTICULTURAL CROPS AND THEIR MANAGEMENT

Course Credit : 2+1=3

Theory:

Economic importance symptoms cause disease cycle and integrated management of diseases of citrus, mango, banana, grapevine, pomegranate, papaya, guava, sapota, custard, apple, ber, fig, strawberry, cashew, aonla, jamun, cocum, arecant, coconut, apple, chili, brinjal, lady finger, potato crucifers, cucurbits, tomato, beans, onion, garlic, leafy vegetables, betelvine, mulberry, coffee, tea, oil, palm, rose, chrysanthemum and jasmine, aster, marigold, gladiolus, carnation, tuberose, gerbera .

Practical:

Study of symptoms, etiology, host-parasite relationship and specific control measures of diseases of citrus, mango,banana, grapevine, pomegranate, papaya, guava, sapota, custard apple, ber, fig, strawberry, cashew, aonla, jamun, cocum, arecanut, coconut, apple, chili, brinjal, ladies finger, potato, crucifers, cucurbits, tomato, beans, onion, garlic, leafy vegetables, betelvine, mulberry, coffee, tea, oil, plam, rose, chrysanthemum and jasmine, aster, marigold, gladiolus, carnation, tuberose, gerbera. Field visits at appropriate time during the semester. Survery and collection of disease samples of above crops and their preservation.

Note: students should submit 50 pressed well mounted diseased specimens in three installments during the semester.

Books recommended :

1. Diseases of fruit crops by Pathak, V.N. 1980 Oxford & BH Pub
2. Diseases of tropical and subtropical field fibre and oil plants by Cook A.A. 1981, Mac Millan Pub NewYork
3. Diseases of crop plants in India by Rangaswamy G 1988, Pub New Delhi
4. Diseases of ornamental plants in India by Sohi H.S. 1992 ICAR, New Delhi.
5. Diseases of vegetable crops. Singh, R.S 1994 Oxford & IBM, New Delhi
6. Plant Diseases by Singh, R.S. 1996, Oxford & IBM Ltd New Delhi
7. Plant Pathology by G.N. Agreose 5th Edition.

Teaching schedule

Lecture No.	Topic to be covered
1 & 2	Diseases of citrus : Gummosis, anthracnose, bacterial canker tristeza greening mottle leaf sooty mould die-back exocortis
3 & 4	Diseases of mango : Anthracnose powdery mildew stone graft mortality pink disease dieback sooty mould red rust loran thus malformation bacterial leaf soot
5 & 6	Diseases of Banana : Wilt (Panama) sigatoka cigar end rot Moko wilt, bunchy top, infectious chlorosis
7 & 8	Diseases of grapevine : Downy mildew powdery mildew anthracnose, rust, bacterial leaf sopts and blight crown gall viral diseases
9	Diseases of pomegranate : Leaf and fruit spots anthracnose fruit rot wilt complex oily spot
10	Diseases of Papaya : Anthracnose root and stem rot leaf blight leaf curl ring spot and mosaic
11	Diseases of guava : Wilt anthracnose fruit canker leaf reddening
12	Diseases of sapota ; Leaf spots leaf blight fruit rot and flat limb
13	Diseases of strawberry : wilt leaf spots blights Diseases of apple : Scab fire blight crown gall blight mosaic
14	Diseases of Chili : Anthracnose and dieback wilt powdery mildew leaf spots leaf curl mosaic
15	Diseases of Brinjal ; Damping off Verticillium and other wits Phomopsis blight and fruit rot bacteria wilt life
16	Diseases of ladies finger : Powdery mildew wilt and yellow vein mosaic
17	Diseases of Crucifer : Downy mildew white rust, Alter aria leaf spots, and black root.
18	Diseases of cucurbits : Downy mildew powdery mildew wilt angular leaf spots and mosaics
19	Diseases of potato : Early and late blights scab black heart brown rot, potato virus X and Y
20 &21	Diseases of tomato : Damping off of seedling, early and late blights

	powdery mildew wilts, buck eye rot, leaf curl mosaic big bus blossom end rot
22	Diseases of beans and means : Anthracnose, rust, powdery mildew wilt/root rot, bacterial blight mosaic
23 &24	Diseases of Onion and garlic : Smut, purple blotch / blight, smudge, downy mildew neck and bulb rot, white rot, aspergillus blackening
25 & 26	Diseases of coconut and areca nut : wilt, stem bleeding cadang-cadang lethal yellow Ganoderma root rot Koleroga of areca nut
27	Diseases of betelving : Foot rot and wilt anthracnose powdery mildew bacterial leaf spot
28	Diseases of coffee, tea and fig : Rust Diseases of custard apple : fruit rot leaf spots and blight
29	Diseases of cashew : Anthracnose die-back blight wilt rust
30	Diseases of rose : Powdery mildew, black spots, die-back, wilt crown galls, mosaic
31	Diseases of carnation gladiolus gerbera : Root and foot rot / wilt, leaf spost / blight, powdery mildew of carnation and gerbera
32	Chrysanthemum Leaf blight wilt/root rot Aster, Marigold : leaf spots Jasmin : Rust

Lesson Plan and Weightage :

Lesson No	Crop	Topic to be covered	Weightage
1 & 2	Citrus	Gummosis anthracnose bacterial canker tristeza greenig mottle leaf sooty mould	5
3 & 4	Mango	Anthracnose powdery mildew stone graft mortality pink disease disease dieback sooty mould red rust loranthus malformation	5
5 & 6	Banana	Wilt (Panama) sigatoka cigar end rot Moko wilt bunchy top infectious chlorosis	5
7 & 8	Grapevine	Downy mildew powdery mildew	5

		anthracnose rust bacteria blight crown gall virus diseases	
9	Pomegranate	Leaf and fruit spots anthracnose fruit rot wilt complex oily spot	3
10	Papaya	Anthracnose stem rot leaf blight leaf blight leaf curl ring spot mosaic	3
11	Guave	Wilt anthracnose fruit canker leaf reddening	3
12	Sapota	Leaf spots leaf blight fruit rot and flat limb	3
13	Strawberry, Apple	Wilt leaf spots blights scab fire blight crown gall blight mosaic	3
14	Chili	Anthracnose and dieback wilt powdery mildew leaf spots leaf curl mosaic	5
15	Brinjal	Damping off, Verticillium and other wilts Phomopsis blight and fruit rot bacterial wilt little leaf	5
16	Ladies Finger	Powdery mildew wilt and yellow vein mosaic	5
17	Crucifers	Downy mildew white rust Alterna leaf spots and black rot	4
18	Cucurbits	Downy mildew powdery mildew wilt angular leaf spots and mosaics	4
19	Potato	Late and early blight scab black heart brown	4
20 -21	Tomato	Damping off of seeding late and early blight powdery mildew wilts buck eye rot leaf curl mosaic big bud blossom end rot	5
22	Beans and peas	Anthracnose rust powdery mildew with/root rot bacterial blight mosaic	4
23 & 24	Onion and Garlic	Smut purple blotch/blight smudge downy mildew neck and bulb rot white	5

		rot Aspergillus blackening	
25 & 26	Coconut and areca nut	Wilt, stem bleeding candang-cadang lethal yellow Ganoderma root rot koleroga o areca nut	4
27	Betelvine	Foot rot and wilt anthracnose powdery mildew bacterial leaf spot	3
28	Coffee, tea fig & custard apple	Rust Fruit rot leaf spots and blight	4
29	Ber Cashew	Powdery mildew leaf spots Anthracnose die-back blight wilt rust	4
30	Rose	Powdery mildew black spot, die back, wilt, crown galls, mosaic	3
31	Carnation gladiolus & gerera	Root and foot rot/wilt, leaf spots/blight, powdery mildew of carnation and gerbera	4
32	Chrysanthemum Aster Marigold Jasmin	Leaf blight, wilt/root rot Leaf spots Rust	3
		Total	**100**

D) Exercise Schedule (Practical)

1. Study of symptoms, etiology, host-parasite relationship and specific control measures of the following crop diseases.

2. Survey collection and preservation of diseases sample of citrus, mango, banana, grapevine, pomegranate, papaya, guava, sapota, custard apple, ber fig, strawberry, cashew, aonla, jamun, cocum, arecanut, coconut, apple, chili, brinjal, bhendi, potato, crucifers, cucurbits, tomato, beans, onions, garlic, leafy vegetables, betel vine, mulberry, coffee, tea, oil plam, rose, chrysanthemum and jasmine, aster, marigold, gladiolus, carnation, tuberose, gerbera.

3. Field visits at appropriate time during the semester.

Sr.No	Exercise No	Topic to be covered
	Study of symptoms, etiology, host-parasite relationship and specific control measures of the following diseases	
1	1	Diseases of citrus and mango
2	2	Diseases of banana and grapevine
3	3	Diseases of pomegranate and papaya
4	4	Diseases of guava, sapota, strawberry and apple
5	5	Diseases of chili, binjal & ladies finger
6	6	Diseases of crucifer & cucurbits
7	7	Diseases of potato & tomato
8	8	Diseases of beans peas, onion & garlic
9	9	Diseases of coconut & areca nut
10	10	Diseases of betelvine & cashew
11	11	Diseases of coffee, tea
12	12	Diseases of ber, fig & custard apple
13	13	Diseases of rose, chrysanthemum & jasmine
14	14	Diseases of carnation , Gladiolus
15	15	Diseases of gerbera, aster, marigold
16	16	Field visit at appropriate time during the semester