# ETERNAL UNIVERSITY, BARU SAHIB, RAJGARH, SIRMOUR HIMACHAL PRADESH

# Restructured and Revised Syllabi of M.Sc. (Ag.) Plant Pathology as per New Education Policy Education Division ICAR - New Delhi

**Syllabi Applicable for Admissions in 2024 onwards**

**Dr. Khem Singh Gill Akal College of Agriculture**

**Restructured and Revised Syllabi of M.Sc. (Ag.) Plant Pathology as per New Education Policy**
**Education Division ICAR - New Delhi**

| (i) Course work | Credits (Minimum requirement) |
|---|---|
| Major courses | 20 |
| Minor courses | 08 |
| Supporting courses | 06 |
| Common courses | 05 |
| Seminar | 01 |
| (ii) Thesis Research | 30 |
| Total | 70 |

**Note:**

**As per New Education Policy, the student has the option to exercise his choice for the courses. Hence semester wise syllabus scheme has to be prepared by the Major Advisor / Head of the Department by instructing and guiding the student to fill Programme of Study for Postgraduate Students (PSPS) popularly known as yellow form within one week after getting admission / registration**

**Course Title with Credit Load M.Sc. (Ag.) Plant Pathology**

| Course Code | Course Title | Credit Hours |
|---|---|---|
| PL PATH 501* | Mycology | 2+1 |
| PL PATH 502* | Plant Virology | 2+1 |
| PL PATH 503* | Plant Pathogenic Prokaryotes | 2+1 |
| PL PATH 504* | Plant Nematology | 2+1 |
| PL PATH 505* | Principles of Plant Pathology | 2+1 |
| PL PATH 506* | Techniques in Detection and Diagnosis of Plant Diseases | 0+2 |
| PL PATH 507 | Principles of Plant Disease Management | 2+1 |
| PL PATH 508 | Epidemiology and Forecasting of Plant Diseases | 1+0 |
| PL PATH 509 | Disease Resistance in Plants | 2+0 |
| PL PATH 510 | Ecology of Soil-borne Plant Pathogens | 1+1 |
| PL PATH 511 | Chemicals and Botanicals in Plant Disease Management | 2+1 |
| PL PATH 512 | Detection and Management of Seed Borne Pathogens | 2+1 |
| PL PATH 513 | Biological Control of Plant Diseases | 1+1 |
| PL PATH 514 | Integrated Disease Management | 2+1 |
| PL PATH 515* | Diseases of Field and Medicinal Crops | 2+1 |
| PL PATH 516 | Diseases of Fruits, Plantation and Ornamental Crops | 2+1 |
| PL PATH 517 | Diseases of Vegetable and Spices Crops | 2+1 |
| PL PATH 518 | Post Harvest Diseases | 2+1 |
| PL PATH 519 | Plant Quarantine and Regulatory Measures | 1+0 |
| PL PATH 591 | Master's Seminar | 0+1 |
| PL PATH 521 | Master's Research | 0+30 |

*Core Courses for Master's

**Major courses:** From the Discipline in which a student takes admission. Among the listed courses, the core courses compulsorily to be taken may be given *mark

**Minor courses:** From the subjects closely related to a student's major subject

**Supporting courses:** The subject not related to the major subject. It could be any subject considered relevant for student's research work (such as Statistical Methods, Design of Experiments, etc.) or necessary for building his/ her overall competence.

**Common Courses:** The following courses (one credit each) will be offered to all students undergoing Master's degree programme:

**Common Courses: 05 credits**

| | | |
|---|---|---|
| PGS 501 | Library and Information Services | 0+1 |
| PGS 502 | Technical Writing and Communications Skills | 0+1 |
| PGS 503 | Intellectual Property and its management in Agriculture | 1+0 |
| PGS 504 | Basic Concepts in Laboratory Techniques | 0+1 |
| PGS 505 | Agricultural Research, Research Ethics and Rural Development Programmes | 1+0 |

## SCHEME OF EXAMINATION

### (Continuous Assessment and End-Semester Examination)

### MARKS DISTRIBUTION FOR DIFFERENT CREDIT HOUR COURSES

| CREDITS | THEORY | | | PRACTICALS | | |
|---|---|---|---|---|---|---|
| T+P | Total | Mid- Session | End Term | Total | Mid- Session | End Term |
| 1+0 | 100 | 40 | 60 | - | - | - |
| 2+0 | 100 | 40 | 60 | - | - | - |
| 3+0 | 100 | 40 | 60 | - | - | - |
| 4+0 | 100 | 40 | 60 | - | - | - |
| 5+0 | 100 | 40 | 60 | - | - | - |
| 6+0 | 100 | 40 | 60 | - | - | - |
| 0+1 | 0 | 0 | 0 | 100 | 50 | 50 |
| 1+1 | 50 | 20 (15+5#) | 30 | 50 | - | 50 |
| 2+1 | 65 | 25 (20+5#) | 40 | 35 | - | 35 |
| 3+1 | 75 | 30 (25+5#) | 45 | 25 | - | 25 |
| 4+1 | 80 | 35 (30+5#) | 45 | 20 | | 20 |
| 0+2 | 0 | 0 | 0 | 100 | 50 | 50 |
| 1+2 | 35 | 15 (10+5#) | 20 | 65 | - | 65 |
| 2+2 | 50 | 20 (15+5#) | 30 | 50 | | 50 |
| 3+2 | 60 | 25 (20+5#) | 35 | 40 | | 40 |
| 0+3 | 0 | 0 | 0 | 100 | 50 | 50 |

#Assignments marks

# Course Contents

**M.Sc. (Ag.) Plant Pathology**
**PL PATH 501**
**Mycology**

Credits: 2 + 1
Contact hours: 28+28

Mid-Session Exam: 25 (20+5#)
Practical Exam : 35
End-Semester Exam: 40

**Aim of the course**

To study the nomenclature, classification and characters of fungi.

**Theory**

| Units | Content | Lectures |
|---|---|---|
| **I** | Introduction, definition of different terms, basic concepts. Importance of mycologyin agriculture, relation of fungi to human affairs. History of mycology. Importanceof 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. | 7 |
| **II** | The general characteristics of protists and life cycle in the Phyla Plasmodiophoromycota, Dictyosteliomycota, Acrasiomycota and Myxomycota. Kingdom Stramenopila: characters and life cycles of respective genera under Hypochytriomycota, Oomycota and Labyrinthulomycota. | 7 |
| **III** | Kingdom fungi: General characters, ultrastructure and life cycle patterns in representative genera under Chytridiomycota, Zygomycota, Ascomycota; Archiascomycetes, Ascomycetous yeasts, Pyrenomycetes, Plectomycetes, Discomycetes, Loculoascomycetes, Erysiphales and anamorphs of ascomycetous fungi. | 7 |
| **IV** | Basidiomycota; general characters, mode of reproduction, types of basidiocarps and economic importance of Hymenomycetes. Uridinales and Ustilaginales; variability, host specificity and life cycle pattern in rusts and smuts. Mitosporic fungi; status of asexual fungi, their teliomorphic relationships, Molecular characterization of plant pathogenic fungi. | 7 |

**Practical**

| | | |
|---|---|---|
| **1** | Detailed comparative study of different groups of fungi; | 1 |
| **2** | Collection of cultures and live specimens; | 1 |
| **3** | Saccardoan classification and classification based on conidiogenesis; | 1 |
| **4** | Vegetative structures and different types of fruiting bodies produced by slime molds,stramenopiles and true fungi; | 2 |
| **5** | Myxomycotina: Fructification, plasmodiocarp, sporangia, plasmodium and aethalia. Oomycota; | 2 |
| **6** | 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; | 2 |
| **7** | General identification characters of Pyrenomycetes, Discomycetes, Loculo-ascomycetes and Laboulbenio-mycetes, Basidiomycetes; characters, ultrastructures and life cycle patterns in Ustilaginomycetes and Teliomycetes, Deuteromycetes; | 2 |

| | | |
|---|---|---|
| **8** | Characters of Hyphomycetes and Coelomycetes and their teliomorphic and anamorphic states, Collection, preservation, culturing and identification of plant parasitic fungi; | 2 |
| **9** | Application of molecular approaches and techniques for identification of fungal pathogens. | 1 |

**Suggested Reading**

Ainsworth GC, Sparrow FK and Susman HS. 1973. *The Fungi – An Advanced Treatise*. Vol. IV(A & B). Academic Press, New York.

Alexopoulos CJ, Mims CW and Blackwell M.2000. *Introductory Mycology.* 5th Ed. John Wiley & Sons, New York.

Maheshwari R. 2016. *Fungi: Experimental Methods in Biology* 2nd edn. CRC Press, US. Mehrotra RS and Arneja KR. 1990. *An Introductory Mycology*. Wiley Eastern, New Delhi. Sarbhoy AK. 2000. *Text book of Mycology*. ICAR, New Delhi.

Singh RS. 1982. *Plant Pathogens – The Fungi*. Oxford & IBH, New Delhi.

Webster J. 1980. *Introduction to Fungi*. 2nd Ed. Cambridge Univ. Press, Cambridge, New York.

**PL PATH 502**
**Plant Virology**

Credits: 2 + 1
Contact hours: 28+28

Mid-Session Exam: 25 (20+5#)
Practical Exam : 35
End-Semester Exam: 40

**Aim of the course**

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

**Theory**

| Units | Content | Lectures |
|---|---|---|
| **I** | History and economic significances of plant viruses. General and morphological characters, composition and structure of viruses. Myco-viruses, arbo and baculo viruses, satellite viruses, satellite RNAs, phages, viroids and prions. Origin and evolution of viruses and their nomenclature and classification. | 4 |
| **II** | Genome organization, replication in selected groups of plant viruses and their movement in host. Response of the host to virus infection: biochemical, physiological, and symptomatical changes. Transmission of viruses and virus-vector relationship. Isolation and purification of viruses. | 4 |
| **III** | Detection and identification of plant viruses by using protein and nucleic acid based diagnostic techniques. Natural (R-genes) and engineering resistance to plant viruses. | 3 |
| **IV** | Virus epidemiology and ecology (spread of plant viruses in fields, host range and survival). Management of diseases caused by plant viruses. | 3 |

**Practical**

| | | |
|---|---|---|
| **1** | Study of symptoms caused by plant viruses (followed by field visit); | 1 |
| **2** | Isolation and biological purification of plant virus cultures; | 1 |
| **3** | Bioassay of virus cultures on indicator plants and host differentials; | 2 |
| **4** | Transmission of plant viruses (Mechanical, graft and vector and study of disease development); | 2 |
| **5** | Plant virus purification (clarification, concentration, centrifugation, high resolution separation and analysis of virions), Electron microscopy for studying viral particlemorphology; | 2 |
| **6** | Antisera production, Detection and diagnosis of plant viruses with serological (ELISA), nucleic acid (Non-PCR–LAMP, Later flow micro array and PCR based techniques); | 3 |
| **7** | EXposure to basic bio-informatic tools for viral genome analysis and their utilization in developing detection protocols and population studies (BLASTn tool, Primer designing software, Bioedit tool, Claustal X/W, MEGA Software). | 3 |

**Suggested Reading**


Bos L. 1964. *Symptoms of Virus Diseases in Plants*. OXford & IBH., New Delhi.

Brunt AA, Krabtree K, Dallwitz MJ, Gibbs AJ and Watson L. 1995. *Virus of Plants: Descriptions and Lists from VIDE Database*. CABI, Wallington.

Gibbs A and Harrison B. 1976. *Plant Virology – The Principles*. Edward Arnold, London. Hull R. 2002. *Mathew's Plant Virology*. 4th Ed. Academic Press, New York.

Noordam D. 1973. *Identification of Plant Viruses, Methods and Experiments*. OXford & IBH,New Delhi.

Wilson C. 2014. *Applied Plant Virology.* CABI Publishing England.

**PL PATH 503**
**Plant Pathogenic Prokaryotes**

Credits: 2 + 1
Contact hours: 28+28

Mid-Session Exam : 25 (20+5#)
Practical Exam : 35
End-Semester Exam: 40

**Aim of the course**

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

**Theory**

| Units | Content | Lectures |
|---|---|---|
| **I** | Prokaryotic cell: History and development of Plant bacteriology, history of plant bacteriology in India. Evolution of prokaryotic life, Prokaryotic cytoskeletal proteins. Structure of bacterial cell. Structure and composition of gram negative and gram positive cell wall; synthesis of peptidoglycan; Surface proteins; Lipopolysaccaride structure; Membrane transport; fimbrae and pili (Type IV pili); Mechanism of flagellar rotatory motor and locomotion, and bacterial movement; Glycocalyx (S-layer; capsule); the bacterial chromosomes and plasmids; Operon and other structures in cytoplasm; Morphological feature of fastidious bacteria, spiroplasmas and Phytoplasmas. | 7 |
| **II** | Growth and nutritional requirements. Infection mechanism, role of virulence factors in eXpression of symptoms. Survival and dispersal of phytopathogenic prokaryotes. | 5 |
| **III** | TaXonomy of phytopathogenic prokarya: TaXonomic ranks hierarchy; Identification, Classification and nomenclature of bacteria, phytoplasma and spiroplasma. The codes of Nomenclature and characteristics. Biochemical and molecular characterization of phytopathogenic prokaryotes. | 5 |
| **IV** | Variability among phytopathogenic prokarya: general mechanism of variability (mutation); specialized mechanisms of variability (seXual like process in bacteria-conjugation; transformation; transduction); and horizontal gene transfer. | 5 |
| **V** | Bacteriophages, L form of bacteria, plasmids and bdellovibrios: Structure; Infectionof host cells; phage multiplication cycle; Classification of phages, Use of phages inplant pathology/ bacteriology, Lysogenic conversion; H Plasmids and their types, plasmid borne phenotypes.Introduction to bacteriocins. Strategies for management of diseases caused by phytopathogenic prokaryotes. | 6 |

**Practical**

| | | |
|---|---|---|
| **1** | Study of symptoms produced by phytopathogenic prokaryotes; | 2 |
| **2** | Isolation, enumeration, purification, identification and host inoculation of phytopathogenic bacteria; | 2 |
| **3** | Stains and staining methods; | 1 |
| **4** | Biochemical and serological characterization; | 1 |
| **5** | Isolation of genomic DNA plasmid; | 1 |
| **6** | Use of antibacterial chemicals/ antibiotics; | 1 |
| **7** | Isolation of fluorescent *Pseudomonas*; | 1 |
| **8** | Preservation of bacterial cultures; | 1 |

| | | |
|---|---|---|
| **9** | Identification of prokaryotic organisms by using 16S rDNA, and other gene sequences; | 2 |
| **10** | Diagnosis and management of important diseases caused by bacteria and mollicutes. | 2 |

**Suggested Reading**


Goto M. 1990. *Fundamentals of Plant Bacteriology*. Academic Press, New York.

Jayaraman J and Verma JP. 2002. *Fundamentals of Plant Bacteriology*. Kalyani Publishers, Ludhiana.

Mount MS and Lacy GH. 1982. *Phytopathogenic Prokaryotes*. Vols. I, II Academic Press, New York.

Salle AJ. 1979. *Fundamental Principles of Bacteriology 7th edn.*

Verma JP, Varma A and Kumar D. (Eds). 1995. *Detection of Plant Pathogens and their Management*. Angkor Publ., New Delhi.

**PL PATH 504**
**Plant Nematology**

Credits: 2 + 1
Contact hours: 28+28

Mid-Session Exam: 25 (20+5#)
Practical Exam : 35
End-Semester Exam: 40

**Aim of the course**

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

**Theory**

| Units | Content | Lectures |
|---|---|---|
| **I** | Characteristics of Phylum Nematoda and its relationship with other related phyla, history and growth of Nematology; nematode habitats and diversity- plant, animal and human parasites; useful nematodes; economic importance of nematodes to agriculture, horticulture and forestry. | 5 |
| **II** | Gross morphology of plant parasitic nematodes; broad classification, nematode biology, physiology and ecology. | 5 |
| **III** | Types of parasitism; nature of damage and general symptomatology; interaction of plant-parasitic nematodes with other organisms. | 4 |
| **IV** | Plant nematode relationships, cellular responses to infection by important phytonematodes; physiological specialization among phytonematodes. | 5 |
| **V** | Principles and practices of nematode management; integrated nematode management. | 4 |
| **VI** | Emerging nematode problems, Importance of nematodes in international trade andquarantine. | 5 |

**Practical**

| | | |
|---|---|---|
| **1** | Studies on kinds of nematodes- free-living, animal, insect and plant parasites; | 7 |
| **2** | Nematode extraction from soil; | 7 |
| **3** | Extraction of migratory endoparasites, staining for sedentary endoparasites; | 7 |
| **4** | Examination of different life stages of important plant parasitic nematodes, their symptoms and histopathology. | 7 |

**Suggested Reading**


Dropkin VH. 1980. *An Introduction to Plant Nematology*. John Wiley & Sons, New York. Maggenti AR. 1981. *General Nematology.* Springer-Verlag, New York.
Perry RN and Moens M. 2013. *Plant Nematology*. 2nd Ed. CABI Publishing: Wallingford, UK.
Perry RN, Moens M, and Starr JL. 2009. *Root-knot nematodes*, CABI Publishing: Wallingford, UK.
Sikora RA, Coyne D, Hallman J and Timper P. 2018. *Plant Parasitic Nematodes in Subtropical and Tropical Agriculture.*3rd edn. CABI Publishing, England.
Thorne G. 1961. *Principles of Nematology*. McGraw Hill, New Delhi.
Walia RK and Bajaj HK. 2003. *Text Book on Introductory Plant Nematology*. ICAR, New Delhi. Walia RK and Khan MR. 2018. *A Compendium of Nematode Diseases of Crop Plants*, ICAR-AICRP (Nematodes), IARI, New Delhi.

**PL PATH 505**
**Principles of Plant Pathology**

Credits: 2 + 1
Contact hours: 28+28

Mid-Session Exam: 25 (20+5#)
Practical Exam : 35
End-Semester Exam: 40

**Aim of the course**

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

**Theory**

| Units | Content | Lectures |
|---|---|---|
| **I** | Importance, definitions and concepts of plant diseases, history and growth of plant pathology, biotic and abiotic causes of plant diseases. | 7 |
| **II** | Growth, reproduction, survival and dispersal of important plant pathogens, role of environment and host nutrition on disease development. | 7 |
| **III** | Host parasite interaction, recognition concept and infection, symptomatology, disease development- role of enzymes, toXins, growth regulators; defense strategies- oXidative burst; Phenolics, PhytoaleXins, PR proteins, Elicitors. Altered plant metabolism as affected by plant pathogens. | 7 |
| **IV** | Genetics of resistance; 'R' genes; mechanism of genetic variation in pathogens; molecular basis for resistance; marker-assisted selection; genetic engineering for disease resistance. | 7 |

**Practical**

| | | |
|---|---|---|
| **1** | Basic plant pathological techniques; | 5 |
| **2** | Isolation, inoculation and purification of plant pathogens and proving Koch's postulates; | 6 |
| **3** | Techniques to study variability in different plant pathogens; | 6 |
| **4** | Purification of enzymes, toxins and their bioassay; | 5 |
| **5** | Estimation of growth regulators, phenols, phytoaleXins in resistant and susceptible plants. | 6 |

**Suggested Reading**


Agrios GN. 2005. *Plant Pathology*. 5th Ed. Academic Press, New York.

Heitefuss R and Williams PH. 1976. *Physiological Plant Pathology.* Springer Verlag, Berlin, New York.

Mehrotra RS and Aggarwal A. 2003. *Plant Pathology*. 2nd Ed. OXford & IBH, New Delhi. Singh RP. 2012. *Plant Pathology* 2nd edn. Kalyani Publishers, New Delhi.

Singh RS. 2017. *Introduction to Principles of Plant Pathology*. 5th edn. MedTech, New Delhi. Singh DP and Singh A. 2007. *Disease and Insect Resistance in Plants.* OXford & IBH, New Delhi.

Upadhyay RK. and Mukherjee KG. 1997. *Toxins in Plant Disease Development and Evolving Biotechnology.* OXford & IBH, New Delhi.

**PL PATH 506**
**Techniques for Detection and Diagnosis of Plant Diseases**

Credits: 0 + 2 Mid-Session Exam: 50
Contact Hours: 0 + 56 End Semester Exam: 50

**Aim of the course**

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

**Practical**

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

**Suggested Reading**


Baudoin ABAM, Hooper GR, Mathre DE and Carroll RB. 1990. *Laboratory Exercises in Plant Pathology: An Instructional Kit*. Scientific Publ., Jodhpur.

Dhingra OD and Sinclair JB. 1986. *Basic Plant Pathology Methods*. CRC Press, London, Tokyo. Fox RTV. 1993. *Principles of Diagnostic Techniques in Plant Pathology,* CABI Wallington. Forster D and Taylor SC. 1998. *Plant Virology Protocols: From Virus Isolation to Transgenic Resistance*. *Methods in Molecular Biology*. Humana Press, Totowa, New Jersey.

Mathews REF. 1993. *Diagnosis of Plant Virus Diseases*. CRC Press, Boca Raton, Tokyo. Matthews REF. 1993. *Diagnosis of Plant Virus Diseases*. CRC Press, Florida.

Noordam D. 1973. *Identification of Plant Viruses, Methods and Experiments*. Cent. Agic. Pub. Doc. Wageningen.

Pathak VN. 1984. *Laboratory Manual of Plant Pathology*. Oxford & IBH, New Delhi. Trigiano RN, Windham MT and Windham AS. 2004. *Plant Pathology-Concepts and Laboratory Exercises*. CRC Press, Florida.Chakravarti BP. 2005. *Methods of Bacterial Plant Pathology*. Agrotech, Udaipur.

**PL PATH 507**
**Principles of Plant Disease Management**

Credits: 2 + 1
Contact hours: 28+28

Mid-Session Exam: 25 (20+5#)
Practical Exam : 35
End-Semester Exam: 40

**Aim of the course**

To acquaint with different strategies for management of plant diseases.

**Theory**

| Units | Content | Lectures |
|---|---|---|
| **I** | Principles of plant disease management by cultural, physical, biological, chemical, organic amendments and botanicals methods of plant disease control, integrated control measures of plant diseases. Disease resistance and molecular approach for disease management. | 10 |
| **II** | History of fungicides, bactericides, antibiotics, concepts of pathogen, immobilization, chemical protection and chemotherapy, nature, properties and mode of action of antifungal, antibacterial and antiviral chemicals. Label claim of fungicides. | 9 |
| **III** | Application of chemicals on foliage, seed and soil, role of stickers, spreaders and other adjuvants, health *vis-a-vis* environmental hazards, residual effects and safety measures. | 9 |

**Practical**

| | | |
|---|---|---|
| **1** | Phytopathometry; | 2 |
| **2** | Methods of *in-vitro* evaluation of chemicals, antibiotics, bio agents against plant pathogens; | 2 |
| **3** | Field evaluation of chemicals, antibiotics, bio agents against plant pathogens; | 2 |
| **4** | Soil solarisation, methods of soil fumigation under protected cultivation; | 2 |
| **5** | Methods of application of chemicals and bio control agents; | 2 |
| **6** | ED and MIC values, study of structural details of sprayers and dusters; | 2 |
| **7** | Artificial epiphytotic and screening of resistance. | 2 |

**Suggested Reading**

Fry WE. 1982. *Principles of Plant Disease Management.* Academic Press, New York.
Hewitt HG. 1998. *Fungicides in Crop Protection*. CABI, Wallington. Marsh RW. 1972. Systemic Fungicides. Longman, New York.
Nene YL and Thapliyal PN. 1993. *Fungicides in Plant Disease Control*. OXford & IBH, NewDelhi.
Palti J. 1981. *Cultural Practices and Infectious Crop Diseases*. Springer Verlag, New York. Vyas SC. 1993 *Handbook of Systemic Fungicides*. Vols. I-III. Tata McGraw Hill, New Delhi.

**PL PATH 508**

**Epidemiology and Forecasting of Plant Diseases**

Credits: 1 + 0 Mid-session exam: 40

Contact hours: 14+0 End-semester exam: 60

**Aim of the course**

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

**Theory**

| Units | Content | Lectures |
|---|---|---|
| **I** | Epidemic concepts, simple interest and compound interest disease, historical development. Elements of epidemics and their interaction. Structures and patterns of epidemics. Modelling, system approaches and eXpert systems in plant pathology. | 4 |
| **II** | Genetics of epidemics. Models for development of plant disease epidemics. Common and natural logarithms, function fitting, area under disease progress curve and correction factors, inoculum dynamics. Population biology of pathogens, temporal and spatial variability in plant pathogens. | 4 |
| **III** | Epidemiological basis of disease management. Survey, surveillance and vigilance. Remote sensing techniques and image analysis. Crop loss assessment. | 2 |
| **IV** | Principles and pre-requisites of forecasting, systems and factors affecting various components of forecasting, some early forecasting and procedures based on weather and inoculum potential, modelling disease growth and disease prediction. Salient features of important forecasting models. | 4 |

**Suggested Reading**


Campbell CL and Madden LV. 1990. *Introduction to Plant Disease Epidemiology*. John Wiley & Sons, New York

Cooke B, Jones DM and Gereth KB. 2018 *The Epidemiology of Plant Diseases*. Springer Publications.

Cowling EB and Horsefall JG. 1978. *Plant Disease*. Vol. II. Academic Press, New York. Laurence VM, Gareth H and Frame Van den Bosch (Eds.). *The Study of Plant Disease Epidemics.*

APS, St. Paul, Minnesota.

Nagarajan S and Murlidharan K. 1995. *Dynamics of Plant Diseases*. Allied Publ., New Delhi. Thresh JM. 2006. *Plant Virus Epidemiology.* Advances in Virus Research 67, Academic Press,

New York.

Van der Plank JE. 1963. *Plant Diseases Epidemics and Control*. Academic Press, New York. Zadoks JC and Schein RD. 1979. *Epidemiology and Plant Disease Management*. OXford Univ.

Press, London.

**PL PATH 509**
**Disease Resistance in Plants**

Credits: 2 + 0 Mid-session exam: 40
Contact hours: 28+0 End-semester exam: 60

**Aim of the course**

To acquaint with the disease resistance mechanisms.

**Theory**

| Units | Content | Lectures |
|---|---|---|
| **I** | Introduction and historical development, dynamics of pathogenicity, process of infection, variability in plant pathogens, gene centres as sources of resistance, disease resistance terminologies. Disease escape,non-host resistance and disease tolerance. | 9 |
| **II** | Genetic basis of disease resistance, types of resistance, identification of physiological races of pathogen, disease progression in relation to resistance, stabilizing selection pressure in plant pathogens. | 9 |
| III | Host defence system, morphological and anatomical resistance, pre-formed chemicals in host defence, post infectional chemicals in host defence, phytoalexins, hypersensitivity and its mechanisms. Genetic basis of relationships between pathogen and host, Gene-for-gene concept, protein-for- protein and immunization basis, management of resistance genes. Strategies for gene deployment. | 10 |

**Suggested Reading**


Deverall BJ. 1977. *Defence Mechanisms in Plants*. Cambridge Univ. Press, Cambridge, New York.

Mills Dallice *et al.*1996. *Molecular Aspects of Pathogenicity and Resistance: Requirement for Signal Transduction.* APS, St Paul, Minnesota.

Parker J. 2008. *Molecular Aspects of Plant Diseases Resistance*. Blackwell Publ. Robinson RA. 1976. *Plant Pathosystems*. Springer Verlag, New York.

Singh BD. 2005. *Plant Breeding – Principles and Methods*. 7th Ed. Kalyani Publishers, Ludhiana Van der Plank JE. 1975. *Principles of Plant Infection*. Academic Press, New York.

Van der Plank JE. 1978. *Genetic and Molecular Basis of Plant Pathogenesis*. Springer Verlag. New York.

Van der Plank JE. 1982. *Host Pathogen Interactions in Plant Disease*. Academic Press, New York.

Van der Plank JE. 1984. *Disease Resistance in Plants*. Academic Press, New York.

**PL PATH 510**
**Ecology of Soil Borne Plant Pathogens**

Credits: 1 + 1
Contact Hours: 14 + 28

Mid-Session Exam: 20 (15+5#)
Practical Exam: 50
End-Semester Exam: 30

**Aim of the course**

To provide knowledge on soil-plant disease relationship.

**Theory**

| Units | Content | Lectures |
|---|---|---|
| **I** | Soil as an environment for plant pathogens, nature and importance of rhizosphere and rhizoplane, host exudates, soil and root inhabiting fungi. Interaction of microorganisms. | 5 |
| **II** | Types of biocontrol agents. Inoculum potential and density in relation to host and soil variables, competition, predation, antibiosis and fungistasis. Conducive and suppressive soils. | 5 |
| **III** | Biological control- concepts and potentialities for managing soil borne pathogens. Potential of Trichoderma and fluorescent Pseudomonas in managing plant diseases. | 4 |

**Practical**

| | | |
|---|---|---|
| **1** | Quantification of rhizosphere and rhizoplane microflora with special emphasis on pathogens; | 2 |
| **2** | Pathogenicity test by soil and root inoculation techniques, correlation between inoculum density of test pathogens and disease incidence, demonstration of fungistasis in natural soils; | 2 |
| **3** | Suppression of test soil-borne pathogens by antagonistic microorganisms; | 2 |
| **4** | Isolation and identification of different biocontrol agents; | 2 |
| **5** | Study of various plant morphological structures associated with resistance, testing the effect of root exudates and extracts on spore germination and growth of plant pathogens; | 2 |
| **6** | Estimating the phenolic substances, total reducing sugars in susceptible and resistant plants; | 2 |
| **7** | Estimating the rhizosphere and root tissue population of microorganisms (pathogens) in plants. | 2 |

**Suggested Reading**


Baker KF and Snyder WC. 1965. *Ecology of Soil-borne Plant Pathogens*. John Wiley, New York.
Cook RJ and Baker KF. 1983. *The Nature and Practice of Biological Control of Plant Pathogens*. APS, St Paul, Minnesota.
Garret SD. 1970. *Pathogenic Root-infecting Fungi*. Cambridge Univ. Press,Cambridge, New York.
Hillocks RJ and Waller JM. 1997. *Soil-borne Diseases of Tropical Crops*. CABI, Wallington. Mondia JL and Timper P 2016. Interactions of microfungi and plant parasitic nematodes. In: *Biology of Microfungi* (De-Wei-Lei Ed.). Springer Publications
Parker CA, Rovira AD, Moore KJ and Wong PTN. (Eds). 1983. *Ecology and Management of Soil-borne Plant Pathogens*. APS, St. Paul, Minnesota.

**PL PATH 511**
**Chemicals and Botanicals in Plant Disease Management**

Credits: 2 + 1
Contact hours: 28+28

Mid-Session Exam: 25 (20+5#)
Practical Exam : 35
End-Semester Exam: 40

**Aim of the course**

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

**Theory**

| Units | Content | Lectures |
|---|---|---|
| **I** | History and development of chemicals; definition of pesticides and related terms; advantages and disadvantages of chemicals and botanicals. | 4 |
| **II** | Classification of chemicals used in plant disease management and their characteristics. | 4 |
| **III** | Chemicals in plant disease control, viz., fungicides, bactericides, nematicides, antiviral chemicals and botanicals. Issues related to label claim. | 4 |
| **IV** | Formulations, mode of action and application of different fungicides; chemotherapyand phytotoXicity of fungicides. | 4 |
| **V** | Handling, storage and precautions to be taken while using fungicides; compatibility with other agrochemicals, persistence, cost-benefit ratio, factor affecting fungicides. New generation fungicides and composite formulations of pesticides. | 6 |
| **VI** | Efficacy of different botanicals used and their mode of action. Important botanicals used against diseases. General account of plant protection appliances; environmental pollution, residues and health hazards, fungicidal resistance in plant pathogensand its management. | 6 |

**Practical**

| | | |
|---|---|---|
| **1** | Acquaintance with formulation of different fungicides and plant protection appliances; | 3 |
| **2** | Formulation of fungicides, bactericides and nematicides; | 2 |
| **3** | *In-vitro* evaluation techniques, preparation of different concentrations of chemicals including botanical pesticides against pathogens; | 3 |
| **4** | Persistence, compatibility with other agro-chemicals; | 2 |
| **5** | Detection of naturally occurring fungicide resistant mutants of pathogen; | 2 |
| **6** | Methods of application of chemicals. | 2 |

**Suggested Reading**

Bindra OS and Singh H. 1977. *Pesticides – And Application Equipment*. OXford & IBH, New Delhi. Nene YL and Thapliyal PN. 1993. *Fungicides in Plant Disease Control.* 3rd edn. OXford & IBH, New Delhi.

Torgeson DC. (Ed.). 1969. *Fungicides.* Vol. II. An Advanced Treatise. Academic Press, New York. Vyas SC. 1993. *Handbook of Systemic Fungicides*. Vols. I-III. Tata McGraw Hill, New Delhi.

**PL PATH 512**
**Detection and Management of Seed Borne Pathogens**

Credits: 2 + 1
Contact hours: 28+28

Mid-Session Exam: 25 (20+5#)
Practical Exam : 35
End-Semester Exam: 40

**Aim of the course**

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

**Theory**

| Units | Content | Lectures |
|---|---|---|
| **I** | History and economic importance of seed pathology in seed industry, plant quarantine and SPS under WTO. Morphology and anatomy of typical monocotyledonous and dicotyledonous infected seeds. | 7 |
| **II** | Recent advances in the establishment and subsequent cause of disease development in seed and seedling. Localization and mechanism of seed transmission in relation to seed infection, seed to plant transmission of pathogens. | 7 |
| **III** | Seed certification and tolerance limits, types of losses caused by seed-borne diseases in true and vegetatively propagated seeds, evolutionary adaptations of crop plants to defend seed invasion by seed-borne pathogens. Epidemiological factors influencing the transmission of seed-borne diseases, forecasting of epidemics through seed-borne infection. | 7 |
| **IV** | Production of toXic metabolites affecting seed quality and its impact on human, animal and plant health, management of seed-borne pathogens/ diseases and procedure for healthy seed production. Seed health testing, methods for detecting microorganism. | 7 |

**Practical**

| | | |
|---|---|---|
| **1** | Conventional and advanced techniques in the detection and identification of seed-borne fungi, bacteria and viruses; | 7 |
| **2** | Relationship between seed-borne infection and eXpression of the disease in the field. | 7 |

**Suggested Reading**

Agarwal VK and Sinclair JB. 1993. *Principles of Seed Pathology*. Vols. I & II, CBS Publ., New Delhi.
Hutchins JD and Reeves JE. (Eds.). 1997. *Seed Health Testing: Progress Towards the 21st Century*. CABI, Wallington.
Paul Neergaard. 1988. *Seed Pathology*. McMillan, London. Suryanarayana D. 1978. *Seed Pathology*. Vikash Publ., New Delhi.

**PL PATH 513**
**Biological Control of Plant Pathogens**

Credits: 1 + 1
Contact Hours: 14 + 28

Mid-Session Exam: 20 (15+5#)
Practical Exam: 50
End-Semester Exam: 30

**Aim of the course**

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

**Theory**

| Units | Content | Lectures |
|---|---|---|
| **I** | Concept of biological control, definitions, importance, principles of plant disease management with bioagents, history of biological control, merits and demerits of biological control. | 3 |
| **II** | Types of biological interactions, competition: mycoparasitism, exploitation for hypovirulence, rhizosphere colonization, competitive saprophytic ability, antibiosis,induced resistance, mycorrhizal associations, operational mechanisms and its relevance in biological control. | 3 |
| **III** | Factors governing biological control, role of physical environment, agroecosystem, operational mechanisms and cultural practices in biological control of pathogens, pathogens and antagonists and their relationship, biocontrol agents, comparative approaches to biological control of plant pathogens by resident and introduced antagonists, control of soil-borne and foliar diseases. Compatibility of bioagents with agrochemicals and other antagonistic microbes. | 5 |
| **IV** | Commercial production of antagonists, their delivery systems, application and monitoring, biological control in IDM, IPM and organic farming system, biopesticides available in market. Quality control system of biocontrol agents. | 3 |

**Practical**

| | | |
|---|---|---|
| **1** | Isolation, characterization and maintenance of antagonists, methods of study of antagonism and antibiosis, application of antagonists against pathogen *in-vitro and in vivo* conditions; | 5 |
| **2** | Preparation of different formulations of selected bioagents and their mass production; | 3 |
| **3** | Quality parameters of biocontrol agents; | 3 |
| **4** | One week exposure visit to commercial biocontrol agents production unit. | 3 |

**Suggested Reading**


Campbell R. 1989. *Biological Control of Microbial Plant Pathogens*. Cambridge Univ. Press, Cambridge.

Cook RJ and Baker KF. 1983. *Nature and Practice of Biological Control of Plant Pathogens.* APS, St. Paul, Minnesota.

Fokkemma MJ. 1986. *Microbiology of the Phyllosphere*. Cambridge Univ. Press, Cambridge.

Gnanamanickam SS (Eds). 2002. *Biological Control of Crop Diseases*. CRC Press, Florida. Heikki MT and Hokkanen James M. (Eds.). 1996. *Biological Control – Benefits and Risks*. Cambridge Univ. Press, Cambridge.

Mukerji KG, Tewari JP, Arora DK and Saxena G. 1992. *Recent Developments in Biocontrol of Plant Diseases*. Aditya Books, New Delhi.

**PL PATH 514**
**Integrated Disease Management**

Credits: 2 + 1
Contact hours: 28+28

Mid-Session Exam: 25 (20+5#)
Practical Exam : 35
End-Semester Exam: 40

**Aim of the course**

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

**Theory**

| Units | Content | Lectures |
|---|---|---|
| **I** | Introduction, definition, concept and tools of disease management, components of integrated disease management- their limitations and implications. | 9 |
| **II** | Development of IDM-basic principles, biological, chemical and cultural disease management. | 9 |
| **III** | IDM in important crops- rice, wheat, cotton, sugarcane, chickpea, rapeseed and mustard, pearl millet, pulses, vegetable crops, fruit, plantation and spice crops. | 10 |

**Practical**

| | | |
|---|---|---|
| **1** | Application of physical, biological and cultural methods; | 5 |
| **2** | Use of chemical and biocontrol agents, their compatibility and integration in IDM.Demonstration of IDM and multiple disease management in crops of regional importance as project work. | 9 |

**Suggested Reading**

Gupta VK and Sharma RC. (Eds). 1995. *Integrated Disease Management and Plant Health*. Scientific Publ., Jodhpur.

Mayee CD, Manoharachary C, Tilak KVBR, Mukadam DS and Deshpande Jayashree (Eds.). 2004. *Biotechnological Approaches for the Integrated Management of Crop Diseases*. Daya Publ. House, New Delhi.

Sharma RC and Sharma JN. (Eds). 1995. *Integrated Plant Disease Management*. Scientific Publ., Jodhpur.

**PL PATH 515**
**Diseases of Field and Medicinal Crops**

Credits: 2 + 1
Contact hours: 28+28

Mid-Session Exam: 25 (20+5#)
Practical Exam : 35
End-Semester Exam: 40

**Theory**

| Units | Content | Lectures |
|---|---|---|
| **I** | Diseases of Cereal crops- Rice, wheat, barley, pearl millet, sorghum and maize. | 5 |
| **II** | Diseases of Pulse crops- Gram, urdbean, mungbean, lentil, pigeonpea, soybean and cowpea. | 5 |
| **III** | Diseases of Oilseed crops- Rapeseed and mustard, sesame, linseed, sunflower, groundnut, castor. | 5 |
| **IV** | Diseases of Cash crops- Cotton, sugarcane. | 4 |
| **V** | Diseases of Fodder legume crops- Berseem, oats, guar, lucerne. | 4 |
| **VI** | Medicinal crops- *Plantago*, liquorice, mulathi, rosagrass, sacred basil, mentha, ashwagandha, *Aloe vera*. | 5 |

**Practical**

| | | |
|---|---|---|
| **1** | Detailed study of symptoms and host parasite relationship of important diseasesof above mentioned crops; | 8 |
| **2** | Collection and dry preservation of diseased specimens of important crops. | 6 |

**Suggested Reading**


Joshi LM, Singh DV and Srivastava KD. 1984. *Problems and Progress of Wheat Pathology inSouth Asia*. Malhotra Publ. House, New Delhi.

Rangaswami G. 1999. *Diseases of Crop Plants in India*. 4th Ed. Prentice Hall of India, NewDelhi.

Ricanel C, Egan BT, Gillaspie Jr AG and Hughes CG. 1989. *Diseases of Sugarcane, Major Diseases*. Academic Press, New York.

Singh RS. 2017. *Plant Diseases*. 10th Ed. Medtech, New Delhi.

Singh US, Mukhopadhyay AN, Kumar J and Chaube HS. 1992. *Plant Diseases of Internatiobnal Importance*. Vol. I. *Diseases of Cereals and Pulses*. Prentice Hall, Englewood Cliffs, NewJersey.

**PL PATH 516**
**Diseases of Fruits, Plantation and Ornamental Crops**

Credits: 2 + 1
Contact hours: 28+28

Mid-Session Exam: 25 (20+5#)
Practical Exam : 35
End-Semester Exam: 40

**Aim of the course**

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

**Theory**

| Units | Content | Lectures |
|---|---|---|
| **I** | Introduction, symptoms and etiology of different fruit diseases. Factors affecting disease development in fruits like apple, pear, peach, plum, apricot, cherry, walnut, almond, strawberry, citrus, mango, grapes, guava, ber, banana, pineapple, papaya, fig, pomegranate, date palm, custard apple and their management. | 10 |
| **II** | Symptoms, mode of perpetuation of diseases of plantation crops such as tea, coffee, rubber and coconut and their management. | 9 |
| **III** | Symptoms and life cycle of pathogens. Factors affecting disease development of ornamental plants such as roses, gladiolus, tulip, carnation, gerbera orchids, marigold, chrysanthemum and their management. | 9 |

**Practical**

| | | |
|---|---|---|
| **1** | Detailed study of symptoms and host parasite relationship of representative diseases of plantation crops; | 8 |
| **2** | Collection and dry preservation of diseased specimens of important crops. | 6 |

**Suggested Reading**

Gupta VK and Sharma SK. 2000. *Diseases of Fruit Crops*. Kalyani Publishers, New Delhi. Pathak VN. 1980. *Diseases of Fruit Crops*. OXford & IBH, New Delhi.
Singh RS. 2000. *Diseases of Fruit Crops*. OXford & IBH, New Delhi. Walker JC. 2004. *Diseases of Vegetable Crops*. TTPP, India.

**PL PATH 517**
**Diseases of Vegetable and Spices Crops**

Credits: 2 + 1
Contact hours: 28+28

Mid-Session Exam: 25 (20+5#)
Practical Exam : 35
End-Semester Exam: 40

**Aim of the course**

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

**Theory**

| Units | Content | Lectures |
|---|---|---|
| **I** | Nature, prevalence, factors affecting disease development of tuber, bulb, leafy vegetable, crucifers, cucurbits and solanaceaous vegetables. Diseases of crops underprotected cultivation. | 9 |
| **II** | Symptoms and management of diseases of different root, tuber, bulb, leafy vegetables, crucifers, cucurbits and solanaceaous vegetable crops. | 9 |
| **III** | Symptoms, epidemiology and management of diseases of different spice crops such as black pepper, nutmeg, saffron, cumin, coriander, turmeric, fennel, fenugreekand ginger. Biotechnological approaches in developing disease resistant transgenics. | 10 |

**Practical**

| | | |
|---|---|---|
| **1** | Detailed study of symptoms and host pathogen interaction of important diseasesof vegetable and spice crops. | 14 |

**Suggested Reading**

Chaube HS, Singh US, Mukhopadhyay AN and Kumar J. 1992. *Plant Diseases of International Importance*. Vol. II. *Diseases of Vegetable and Oilseed Crops*. Prentice Hall, Englewood Cliffs, New Jersey.

Gupta VK and Paul YS. 2001. *Diseases of Vegetable Crops*. Kalyani Publishers, New Delhi Gupta SK and Thind TS. 2006. *Disease Problem in Vegetable Production*. Scientific Publ., Jodhpur. Sherf AF and Mcnab AA. 1986. *Vegetable Diseases and their Control*. Wiley Inter Science, Columbia.

Singh RS. 1999. *Diseases of Vegetable Crops*. Oxford & IBH, New Delhi. Walker JC. 1952. *Diseases of Vegetable Crops*. McGraw-Hill, New York.

**PL PATH 518**
**Post-Harvest Diseases**

Credits: 1 + 1
Contact Hours: 14 + 28

Mid-Session Exam: 20 (15+5#)
Practical Exam: 50
End-Semester Exam: 30

**Aim of the course**

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

**Theory**

| Units | Content | Lectures |
|---|---|---|
| **I** | Concept of post-harvest diseases, definitions, importance with reference to management and health, principles of plant disease management as pre-harvest and post-harvest, Types of post-harvest problems both by biotic and abiotic factors. | 3 |
| **II** | Role of physical environment, agro-ecosystem leading to quiescent infection, operational mechanisms and cultural practices in perpetuation of pathogens, pathogens and antagonist and their relationship, role of biocontrol agents and chemicals in controlling post-harvest diseases, comparative approaches to controlof plant pathogens by resident and introduced antagonists. | 4 |
| **III** | Integrated approaches in controlling diseases and improving the shelf life of produce using nutritional, bio-control agents and other agents, control of aflatoxigenic and mycotoXigenic fungi, application and monitoring for health hazards. | 4 |
| **IV** | Study of symptoms, toXicosis of various pathogens, knowledge of CodeX Alimentarious for each product and commodity. Physical and biological agents/ practices responsible for development/ prevention of post-harvest diseases- traditional and improved practices. | 3 |

**Practical**

| | | |
|---|---|---|
| **1** | Isolation, characterization and maintenance of post-harvest pathogens, applicationof antagonists against pathogens *in vivo* condition; | 4 |
| **2** | Comparative efficacy of different fungicides and bioagents; | 3 |
| **3** | Study of different post-harvest disease symptoms on cereals, pulses, oilseed, commercial crops, vegetables, fruits and flowers; | 4 |
| **4** | Visit to cold storage. | 3 |

**Suggested Reading**

Chaddha KL and Pareek OP. 1992. *Advances in Horticulture* Vol. IV, Malhotra Publ. House,New Delhi.
Pathak VN. 1970. *Diseases of Fruit Crops and their Control*. IBH Publ., New Delhi.

**PL PATH 519**
**Plant Quarentine and Regulations**

Credits: 1 + 0 Mid-session exam: 40
Contact hours: 14+0 End-semester exam: 60

**Aim of the course**

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

**Theory**

| Units | Content | Lectures |
|---|---|---|
| **I** | Historical development in plant quarantine, Definitions of pest, and transgenics as per Govt. notification; Organizational set up of plant quarantine in India. relative importance; quarantine – domestic and international. Quarantine restrictions in the movement of agricultural produce, seeds and planting material; case historiesof eXotic pests/ diseases and their status. | 4 |
| **II** | Acts related to registration of pesticides and transgenics. History of quarantine legislations, Salient features of PQ Order 2003. Environmental Acts, Industrial registration; APEDA, Import and EXport of bio-control agents. | 3 |
| **III** | Identification of pest/ disease free areas; contamination of food with to Xigens, microorganisms and their elimination; Symptomatic diagnosis and other techniquesto detect pest/ pathogen infestations; VHT and other safer techniques of disinfestation/ salvaging of infected material. | 4 |
| **IV** | WTO regulations; non-tariff barriers; Pest risk analysis, good laboratory practices for pesticide laboratories; pesticide industry; Sanitary and Phytosanitary measures. Visit to plant quarantine station and PEQ facilities. | 3 |

**Suggested Reading**

Rajeev K and Mukherjee RC. 1996. *Role of Plant Quarantine in IPM*. Aditya Books.
Rhower GG. 1991. Regulatory Plant Pest Management. In: *Handbook of Pest Management in Agriculture*. 2nd Ed. Vol. II. (Ed. David Pimental). CRC Press.

**PGS 501**
**LIBRARY AND INFORMATION SERVICES**

Credits: 0+1 Mid-session exam : 50
Contact hours: 28 End-semester exam : 50

**Objective:** To equip the library users with skills to trace information from libraries efficiently, to apprise them of information and knowledge resources, to carry out literature survey, to formulate information search strategies, and to use modern tools (Internet, OPAC, search engines etc.) of information search.

| Sr. No | Practical Description | No. of Practicals |
|---|---|---|
| 1. | Introduction to library and its services; Role of libraries in education, research and technology transfer; | 1 |
| 2. | Classification systems and organization of library; | 3 |
| 3. | Sources of information- Primary Sources, Secondary Sources and Tertiary Sources; | 1 |
| 4. | Intricacies of abstracting and indexing services (Science Citation Index, Biological Abstracts, Chemical Abstracts, CABI Abstracts, etc.); | 2 |
| 5. | Tracing information from reference sources; | 1 |
| 6. | Literature survey; Citation techniques/Preparation of bibliography; | 1 |
| 7. | Use of CD-ROM Databases, Online Public Access Catalogue and other computerized library services; | 2 |
| 8. | Use of Internet including search engines and its resources; e-resources access methods | 3 |

**Suggested Readings**

Singh, Ajay Pratap, 2013. Information Communication and Society. New Delhi: EssEss Publishers.
Kumar Krishan, 2013. Reference Service. 5th Rev ed. New Delhi: Vikas.
Dhiman, Anil Kumar, 2005. Information and Reference Sources and Service. New Delhi: EssEss.
Ranganathan, S.R.1989. Reference Service. 2nd Rev. ed. Banglore: Sharda Endowment for Library Science.
Mukjerjee, A.K. 1971. Reference Work and its Tools. 2nd ed. Calcutta: World Press.
Sinha, Pradeep K. 2007. Computer Fundamentals. 4th ed. Delhi: BPB Publications.
#Assignments mark

**PGS 502**
**TECHNICAL WRITING AND COMMUNICATION SKILLS**

Credits: 0+1 Mid-session exam : 50
Contact Hours: 28 End-semester exam : 50

**Objective:** To equip the students/scholars with skills to write dissertations, research papers, etc. To equip the students/scholars with skills to communicate and articulate in English (verbal as well as writing).

| Sr. No | Practical Description | No. of Practicals |
|---|---|---|
| 1. | Technical Writing- Various forms of scientific writings- thesis, technical papers, reviews, manuals, etc; Various parts of thesis and research communications (title page, authorship contents page, preface,. | 2 |
| 2. | Technical Writing- Introduction, review of literature, material and methods, experimental results and discussion); | 2 |
| 3. | Technical Writing- Writing of abstracts, summaries, précis, citations etc.; commonly used abbreviations in the theses and research communications; illustrations, photographs and drawings with suitable captions; | 2 |
| 4. | Technical Writing- pagination, numbering of tables and illustrations; Writing of numbers and dates in scientific write-ups; | 1 |
| 5. | Technical Writing- Editing and proof-reading; Writing of a review article. | 1 |
| 6. | Communication Skills -Grammar (Tenses, parts of speech, clauses, punctuation marks); | 1 |
| 7. | Communication Skills -Error analysis (Common errors); | 1 |
| 8. | Communication Skills -Concord; Collocation; Phonetic symbols and transcription; | 1 |
| 9. | Communication Skills -Accentual pattern: Weak forms in connected speech: | 1 |
| 10. | Communication Skills -Participation in group discussion: Facing an interview; | 1 |
| 11. | Communication Skills -presentation of scientific papers. | 1 |

**Suggested Readings**


Chicago Manual of Style. 14th Ed. 1996. Prentice Hall of India.
Collins' Cobuild English Dictionary. 1995. Harper Collins.
Gordon HM & Walter JA. 1970. Technical Writing. 3rd Ed. Holt, Rinehart & Winston.
Hornby AS. 2000. Comp. Oxford Advanced Learner's Dictionary of Current English. 6th Ed. Oxford University Press.
James HS. 1994. Handbook for Technical Writing. NTC Business Books.
Joseph G. 2000. MLA Handbook for Writers of Research Papers. 5th Ed. Affiliated East-West Press.
Mohan K. 2005. Speaking English Effectively. MacMillan India.
Richard WS. 1969. Technical Writing. Barnes & Noble.
Robert C. (Ed.). 2005. Spoken English: Flourish Your Language. Abhishek. Sethi J &
Dhamija PV. 2004. Course in Phonetics and Spoken English. 2nd Ed. Prentice Hall of India.
Wren PC & Martin H. 2006. High School English Grammar and Composition. S. Chand & Co.

**PGS 503**
**INTELLECTUAL PROPERTY AND ITS MANAGEMENT IN AGRICULTURE**

Credits: 1 + 0 Mid-session exam : 40
Contact hours: 14+0 End-semester exam : 60

**Objective:** The main objective of this course is to equip students and stakeholders with knowledge of intellectual property rights (IPR) related protection systems, their significance and use of IPR as a tool for wealth and value creation in a knowledge-based economy.

**Theory**

| Units | Contents | Lectures |
|---|---|---|
| **I** | Historical perspectives and need for the introduction of Intellectual Property Right regime; TRIPs and various provisions in TRIPS Agreement; | 3 |
| **II** | Intellectual Property and Intellectual Property Rights (IPR), benefits of securing IPRs; 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, protection of plant varieties and farmers' rights and bio-diversity protection | 4 |
| **III** | Protectable subject matters, protection in biotechnology, protection of other biological materials, ownership and period of protection; National Biodiversity protection initiatives; Convention on Biological Diversity | 4 |
| **IV** | International Treaty on Plant Genetic Resources for Food and Agriculture; Licensing of technologies, Material transfer agreements, Research collaboration Agreement, License Agreement. | 3 |

**Suggested Readings**


Erbisch FH & Maredia K.1998. Intellectual Property Rights in Agricultural Biotechnology. CABI.
Ganguli P. 2001. Intellectual Property Rights: Unleashing Knowledge Economy. McGraw-Hill.
Intellectual Property Rights: Key to New Wealth Generation. 2001. NRDC & Aesthetic Technologies.
Ministry of Agriculture, Government of India. 2004. State of Indian Farmer. Vol. V. Technology Generation and IPR Issues. Academic Foundation.
Rothschild M & Scott N. (Ed.). 2003. Intellectual Property Rights in Animal Breeding and Genetics. CABI.
Saha R. (Ed.). 2006. Intellectual Property Rights in NAM and Other Developing Countries: A Compendium on Law and Policies. Daya Publ. House.
The Indian Acts - Patents Act, 1970 and amendments; Design Act, 2000;
Trademarks Act, 1999; The Copyright Act, 1957 and amendments; Layout Design Act, 2000; PPV and FR Act 2001, and Rules 2003; National Biological Diversity Act, 2003.

**PGS 504**
**BASIC CONCEPTS IN LABORATORY TECHNIQUES**

Credits: 0+1 Mid-session Practical: 50
Contact hours: 0+28 End-semester Practical: 50

**Objective:**
To acquaint the students on the basics of commonly used techniques in laboratory.

| Sr. No | Practical Description | No. of Practicals |
|---|---|---|
| 1. | Safety measures while in Lab; Handling of chemical substances; | 1 |
| 2. | Use of burettes, pipettes, measuring cylinders, flasks, separatory funnel, condensers, micropipettes and vaccupets; | 1 |
| 3. | Washing, drying and sterilization of glassware; | 1 |
| 4. | Drying of solvents/chemicals. | 1 |
| 5. | Weighing and preparation of solutions of different strengths and their dilution; | 1 |
| 6. | Handling techniques of solutions; | 1 |
| 7. | Preparation of different agro-chemical doses in field and pot applications; Preparation of solutions of acids; | 1 |
| 8. | Neutralisation of acid and bases; | 1 |
| 9. | Preparation of buffers of different strengths and pH values. | 1 |
| 10. | Use and handling of microscope, laminar flow, vacuum pumps, viscometer, thermometer, magnetic stirrer, micro-ovens, incubators, sandbath, waterbath, oilbath; | 1 |
| 11. | Electric wiring and earthing. | 1 |
| 12. | Preparation of media and methods of sterilization; | 1 |
| 13. | Seed viability testing, testing of pollen viability; | 1 |
| 14. | Tissue culture of crop plants; Description of flowering plants in botanical terms in relation to taxonomy | 1 |

**Reference Books**
*Furr AK. 2000. CRC Hand Book of Laboratory Safety. CRC Press.*
*Gabb MH & Latchem WE. 1968. A Handbook of Laboratory Solutions. Chemical Publ. Co*

**PGS 505**
**AGRICULTURAL RESEARCH, RESEARCH ETHICS AND RURAL DEVELOPMENT PROGRAMMES**

Credits: 1 + 0 | Mid-session exam : 40
Contact hours: 14+0 | End-semester exam : 60

**Objective:** The main objective of this course is to equip students and stakeholders with knowledge of intellectual property rights (IPR) related protection systems, their significance and use of IPR as a tool for wealth and value creation in a knowledge-based economy.

**Theory**

| Units | Contents | Lectures |
|---|---|---|
| **I** | History of agriculture in brief; Global agricultural research system: need, scope, opportunities; Role in promoting food security, reducing poverty and protecting the environment; National Agricultural Research Systems (NARS) and Regional Agricultural Research Institutions; Consultative Group on International | 3 |
| **II** | Agricultural Research (CGIAR): International Agricultural Research Centres (IARC), partnership with NARS, role as a partner in the global agricultural research system, strengthening capacities at national and regional levels; International fellowships for scientific mobility. | 3 |
| **III** | Research ethics: research integrity, research safety in laboratories, welfare of animals used in research, computer ethics, standards and problems in research ethics. Concept and connotations of rural development, rural development policies and strategies. | 4 |
| **IV** | Rural development programmes: Community Development Programme, Intensive Agricultural District Programme, Special group – Area Specific Programme, Integrated Rural Development Programme (IRDP) Panchayati Raj Institutions, Co-operatives, Voluntary Agencies/ Non-Governmental Organisations. Critical evaluation of rural development policies and programmes. Constraints in implementation of rural policies and programmes. | 4 |

**Suggested Readings**

Bhalla GS & Singh G. 2001. Indian Agriculture - Four Decades of Development. Sage Publ.
Punia MS. Manual on International Research and Research Ethics. CCS, Haryana Agricultural University, Hisar.
Rao BSV. 2007. Rural Development Strategies and Role of Institutions - Issues, Innovations and Initiatives. Mittal Publ.
Singh K. 1998. Rural Development - Principles, Policies and Management. Sage Publ.