CH. CHARAN SINGH UNIVERSITY, MEERUT

SYLLABUS

For

M. Sc. (Ag.) PLANT PATHOLOGY

(Under Choice Based Credit System)

Effective from

ACADEMIC SESSION 2019-2020

DEPARTMENT OF PLANT PROTECTION
FACULTY OF AGRICULTURE

Ch. Charan Singh University, Meerut
Department of Plant Protection

Syllabus for M.Sc. Ag. (Plant Pathology) as per Choice Based Credit System w.e.f. 2019-20

Course Type	Sl. No.	Course Title	Code	Credits	Maximum Marks			
					Int.	Ext.	Prac.	Total
SEMESTER I								
Compulsory core	I	Mycology	CJ-1531	4	40	40	20	100
	II	Principles of Plant Pathology	CJ-1532	4	40	40	20	100
	III	Detection and Diagnosis of Plant Diseases	CJ-1533	4	40	40	20	100
Elective core	IV	Statistical Methods	CJ-1534	4	40	40	20	100
Practical	I	Based on courses I-IV	CJ-531	2+2+2+2				
Open elective	I	Hindi/ English/ Urdu/ Sanskrit		4				100
		Total of Credits/ marks		**28**				**500**
SEMESTER II								
Compulsory core	V	Plant Virology	CJ-2531	4	40	40	20	100
	VI	Diseases of Field, Vegetable and Medicinal Crops	CJ-2532	4	40	40	20	100
	VII	Biological Control of Plant Diseases	CJ-2533	4	40	40	20	100
	VIII	Seed Health Technology	CJ-2534	4	40	40	20	100
Practical	II	Based on courses V-VIII	CJ-631	2+2+2+2				
Open elective	II	Principles of Nematology		4				100
		Total of Credits/ marks		**28**				**500**
SEMESTER III								
Compulsory core	IX	Plant Bacteriology	CJ-3531	4	40	40	20	100
	X	Chemicals in Plant Disease Management	CJ-3532	4	40	40	20	100
	XI	Diseases of Fruits, Plantation and Ornamental Crops	CJ-3533	4	40	40	20	100
Elective core	XII	Computer Applications and Bioinformatics	CJ-534	4	40	40	20	100
Practical	III	Based on courses IX-XII	CJ-731	2+2+2+2				
Open elective	III	Integrated Disease Management		4				100
		Total of Credits/ marks		**28**				**500**
SEMESTER IV								
Compulsory core	XIII	Plant Quarantine	CJ-4531	4	40	40	20	100
	XIV	Principles of Plant Disease Management	CJ-4532	4	40	40	20	100
Practical	IV	Based on courses XIII-XIV	CJ-831	2+2				
Elective core	XV	Thesis and Viva-voce	CJ-832	12				200
Open elective	IV			4				100
		Total		**28**				**500**
		Grand Total of Credits/ marks		**112**				**2000**

Compulsory Core Courses

Course –I (CJ-1531): Mycology
(Credits: 4+2)

Teaching hours: 50

UNIT-I: Introduction: General introduction, basic concept and definition of different terms. 8

UNIT-II: Historical development: Importance of mycology in agriculture, relation of fungi to human affairs and history of mycology. 10

UNIT-III: Fungal biodiversity, reproduction in fungi, Concepts of nomenclature and classification. 12

UNIT-IV: The comparative morphology, ultrastructure, characters of different groups of fungi up to generic level: (a) Myxomycota and (b) Eumycota: (i) Mastigomycotina, (ii) Zygomycotina, (iii) Ascomycotina, (iv) Basidiomycotina, (v) Deuteromycotina. Fungal genetics and variability in fungi. 20

Practical:

Detailed comparative study of different groups of fungi; collection, identification and preservation of specimens. Isolation and identification of plant pathogenic fungi.

Suggested Readings:

1. Agrios, N. George (2009). Plant Pathology. 5th Ed., Academic press publishers, U.K.
2. Arora, Rai, Mukerji and Knudsen (2008). Hand Book of Applied Mycology. Volume-I, 1st Ed., Academic press publishers, U.K.
3. Ainsworth, G.C., Sparrow, F.K. and Susman, H.S. (1973). The Fungi: An Advanced Treatise. Vol. IV (A & B). Academic Press, New York.
4. Alexopoulos, C.J., Mims, C.W. and Blackwell, M. (2000). Introductory Mycology. 5th Ed., John Wiley & Sons, New York.
5. Mehrotra, R.S. and Arneja, K.R. (1990). An Introductory Mycology. Wiley Eastern, New Delhi.
6. Sarbhoy, A.K. (2000). Text book of Mycology. ICAR, New Delhi.
7. Singh, R.S. (1982). Plant Pathogens: The Fungi. Oxford & IBH, New Delhi.
8. Webster, J. (1980). Introduction to Fungi. 2nd Ed., Cambridge Univ. Press, Cambridge, New York.

Course –II (CJ-1532): Principles of Plant Pathology
(Credits: 4+2)

Teaching hours: 50

UNIT-I: History and Introduction: Importance, definitions and concepts of plant diseases, history and growth of plant pathology, biotic and abiotic causes of plant diseases. 10

UNIT-II: Growth, reproduction, survival and dispersal of important plant pathogens; role of environment and host nutrition on disease development. 8

UNIT-III: Host parasite interaction: A brief idea of recognition concept and infection, symptomatology, Disease development: Role of enzymes, toxins, growth regulators. Defense strategies: Oxidative burst; Phenolics, Phytoalexins, PR proteins and elicitors. Altered plant metabolism as affected by plant pathogens, molecular basis of host plant interaction. 14

UNIT-IV: Genetics of resistance; 'R' genes; mechanism of genetic variation in pathogens; molecular basis for resistance; marker-assisted selection; genetic engineering for disease resistance, physiology specialization – race identification. 12

UNIT-V: Disease management strategies. 6

Practical:

Acquaintance to plant pathology laboratory and equipments; Preparation of culture media for fungi and bacteria; Isolation techniques, preservation of disease samples.

Suggested Readings:

1. Agrios, N. George (2009). Plant Pathology. 5th Ed., Academic press publishers, U.K.
2. Heitefuss, R. and Williams, P.H. (1976). Physiological Plant Pathology. Springer Verlag, Berlin, New York.
3. Mehrotra, R.S. and Aggarwal, A. (2003). Plant Pathology. 2nd Ed., Oxford & IBH, New Delhi.
4. Singh, R.S. (2002). Introduction to Principles of Plant Pathology. Oxford & IBH, New Delhi.
5. Singh, D.P. and Singh, A. (2007). Disease and Insect Resistance in Plants. Oxford & IBH, New Delhi.
6. Upadhyay, R.K. and Mukherjee, K.G. (1997). Toxins in Plant Disease Development and Evolving Biotechnology. Oxford & IBH, New Delhi.

Course –III (CJ-1533): Detection and Diagnosis of Plant Diseases
(Credits: 4+2)

Teaching hours: 50

UNIT-I: Methods of studying plant disease: Methods to prove Koch's postulates with biotroph and necrotroph pathogens, pure culture techniques and use of selective media to isolate pathogens. 6

UNIT-II: Fungal and bacterial disease diagnosis: Symptomatology, collection of samples and their preservation, isolation techniques, purification and single spore isolation, inoculation technique and creation of artificial epiphytotics of fungal and bacterial pathogens, long term storage and preservation of fungal and bacterial cultures and disease specimens. 12

UNIT-III: Micrometry, pH meter and Camera-Lucida: Use of haemocytometer, micrometer, centrifuge, pH meter and camera lucida. 4

UNIT-IV: Microscopy: Microscopic techniques and staining methods, phase contrast system and use of electron microscope. 8

UNIT-V: Modern analytical techniques: Chromatography, spectrophotometer, ultracentrifuge and electrophoretic apparatus, ELISA and PCR-based diagnosis. 10

UNIT-VI: Disease diagnostics, serological and molecular techniques for detection of plant pathogens. Evaluation of fungicides, bactericides etc.; field experiments, data collection and preparation of references. 10

Practical:
Methods to prove Koch's postulates with biotroph and necrotroph pathogens, pure culture techniques, use of selective media to isolate pathogens, preservation of plant pathogens and disease specimens. Microscopic techniques and staining methods, phase contrast system, chromatography, use of spectrophotometer and electrophoretic apparatus, disease diagnostics, serological and molecular techniques for detection of plant pathogens.

Suggested Readings:

1. Aneja, K.R. (2001). Experiments in Microbiology, Plant Pathology, Tissue culture and Mushroom production technology. 1st Ed., New Age International publishers, New Delhi.
2. Baudoin, A.B.A.M., Hooper, G.R, Mathre, D.E. and Carroll, R.B. (1990). Laboratory Exercises in Plant Pathology: An Instructional Kit. 1st Ed., Scientific publishers, Jodhpur, India.
3. Freeman, S. and Herron, J.C. (1998). Evolutionary Analysis. Prentice Hall, New Delhi.
4. Fox, R.T.V. (1996). Principles of Diagnostics Techniques in Plant Pathology. 1st Ed., International Mycological Institute, CABI International publishers, Wallington, U.K.
5. Dhingra, O.D. and Sinclair, J.B. (1986). Basic Plant Pathology Methods. CRC Press, London, Tokyo.
6. Pathak, V.N. (1984). Laboratory Manual of Plant Pathology. Oxford & IBH, New Delhi.
7. Vishunavat, Karuna and Kolte, S.J. (2005). Essentials of Phytopathological Techniques. 1st Ed., Kalyani Publishers, New Delhi.

Course –IV (CJ-1534): Statistical Methods
(Credits: 4+2)

Teaching hours: 50

UNIT-I: Statistics: Definition and its scope. 2

UNIT-II: Presentation of data: Frequency distributions; graphical presentation of data by histogram, frequency polygon, frequency curve and cumulative frequency curves. 6

UNIT-III: Measures of locations and dispersion: Mean, mode, median and their simple properties (with-out derivation) and calculation of median by graphs; range, mean deviation, standard deviation, standard error and coefficient of variation. 6

UNIT-IV: Probability and distributions: Random distributions; events exhaustive, mutually exclusive and equally likely; definition of probability (with simple exercises); definitions of binomial, Poisson and normal distributions; and simple properties of the above distributions (without derivation). 4

UNIT-V: Correlation and regression: Bivariate data-simple correlation and regression coefficients and their relation; Spearman rank correlation; limits of correlation coefficient; effect of change of origin and scale on correlation coefficient; linear regression and equations of line of regression; association and independence of attributes. 8

UNIT-VI: Sampling: Concept of population and sample; random samples; methods of taking a simple random sample. 4

UNIT-VII: Tests of significance: Sampling distribution of mean and standard error; z and t-test (equality of means; paired and unpaired t-test); t-test for comparison of means when variances of two populations differ; Chi- square test for goodness of fit; independence of attributes, and homogeneity of samples; interrelation between t-test and F-test. 10

UNIT-VIII: Experimental designs: Principles of experimental designs; completely randomized, randomized complete block design (missing plot value in RBD); latin square designs; augmented block design; simple factorial experiments (mathematical derivations not required); analysis of variance (ANOVA) and its use including estimation of LSD (CD). 10

Practical:
Measurement of central tendency and dispersion, standard deviation and standard error, principle uses of X^2, F and 't, test, Correlation Coefficient, Regression coefficient and Regression equation. Analysis of data obtained from CRD, RBD & LSD.

Suggested Readings:

1. Goulden, C.H. (1952). Methods of Statistical Analysis. 2/e, John Wiley, New York.
2. Hoshmand, A. Reza. (1988). Statistical Methods for Agriculture Sciences. Timber Press, Portland, Oregan, USA.
3. Hogg, R.V and Carig, A.T. (2004). Introduction to Mathematical Statistics. Mac-Millan Publication Ltd., New York.
4. Gomez, A.G. and Gomez, A.A. (1994). Statistical Procedures for Agriculture Research, Second edition, John Wiley & Sons, New York.
5. Panse, V.C. and Sushatme, P.V. (1967). Statistical Methods for Agriculture Workers. I.C.A.R., New Delhi.

Course –V (CJ-2531): Plant Virology
(Credits: 4+2)

Teaching hours: 50

UNIT-I: History and Introduction: History of plant viruses, shape, size, composition, structure and physical properties of viruses. 6

UNIT-II: Symptomatology of important plant viral diseases, transmission of important plant viral diseases, chemical and physical properties of virus, host virus interaction and virus vector relationship. 10

UNIT-III: Virus nomenclature and classification, genome organization of viruses, replication and movement of viruses. 10

UNIT-IV: Isolation and purification of viruses, electron microscopy, protein and nucleic acid based diagnostics. 10

UNIT-V: Mycoviruses, phytoplasma arbo- and baculoviruses, satellite viruses, satellite RNAs, phages, viroids and prions. 8

UNIT-VI: Origin and evolution, mechanism of resistance, genetic engineering, ecology and management of plant viruses. 6

Practical:
Study of symptoms caused by viruses, transmission, assay of viruses, physical properties, purification and serological tests.

Suggested Readings:

1. Bos, L. (1964). Symptoms of Virus Diseases in Plants. Oxford & IBH., New Delhi.
2. Brunt, A.A., Krabtree, K., Dallwitz, M.J., Gibbs A.J. and Watson, L. (1995). Virus of Plants: Descriptions and Lists from VIDE Database. CABI, Wallington.
3. Gibbs, A. and Harrison, B. (1976). Plant Virology: The Principles. Edward Arnold, London.
4. Hull, R. (2002). Mathew's Plant Virology. 4th Ed., Academic Press, New York.
5. Khan, A. Juwaid and Dijkstra, Jeannea. (2007). Hand Book of Plant Viorology. 1st Ed., Heritage Publishers, New Delhi.
6. Noordam, D. (1973). Identification of Plant Viruses, Methods and Experiments. Oxford & IBH, New Delhi.

Course –VI (CJ-2532): Diseases of Field, Vegetables and Medicinal Crops
(Credits: 4+2)

Teaching hours: 50

Introduction, nature, prevalence, etiology, factors affecting disease development and control measures of diseases of crops caused by fungi, bacteria, viruses, nematodes, etc.

UNIT-I: Diseases of Cereal crops: Wheat, barley, rice, pearl millet, sorghum and maize. 8

UNIT-II: Diseases of Pulse crops: Gram, urdbean, mungbean, lentil, pigeonpea and soybean. 6

UNIT-III: Diseases of Oilseed crops: Rapeseed and mustard, sesame, linseed, sunflower, groundnut and castor. 6

UNIT-IV: Diseases of Cash crops: Cotton and sugarcane. 6

UNIT-V: Diseases of Fodder legume crops: Berseem, oats, guar, lucerne and cowpea. 4

UNIT-VI: Symptoms, etiology and management of diseases of root, bulb and leafy vegetables: Beets, carrots, turnip, radish, sweet potatoes; onion, garlic; Brussels, sprouts, cabbage, lettuce and spinach. 8

UNIT-VII: Symptoms, etiology and management of diseases of crucifers, cucurbits and solanaceaous vegetable crops: Broccoli, cabbage, cauliflower; Cucurbitaceous vegetables; Potato, tomato, brinjal and chilli. 8

UNIT-VIII: Symptoms, etiology and management of diseases of medicinal crops: Plantago, ashwagandha and aloe vera. 4

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

Suggested Readings:

1. Chaube, H.S., Singh, U.S., Mukhopadhyay A.N. and Kumar, J. (1992). Plant Diseases of International Importance. Vol. II. Diseases of Vegetable and Oilseed Crops. Prentice Hall, Englewood Cliffs, New Jersey.
2. Gupta, V.K. and Paul, Y.S. (2001). Diseases of Vegetable Crops. Kalyani Publi., New Delhi.
3. Gupta, S.K. and Thind, T.S. (2006). Disease Problem in Vegetable Production. Scientific Publ., Jodhpur.
4. Joshi, L.M., Singh, D.V. and Srivastava, K.D. (1984). Problems and Progress of Wheat Pathology in South Asia. Malhotra Publ. House, New Delhi.
5. Ricanel, C., Egan, B.T., Gillaspie, Jr A.G. and Hughes, C.G. (1989). Diseases of Sugarcane, Major Diseases. Academic Press, New York.
6. Singh, R.S. (1998). Plant Diseases. 7th Ed., Oxford & IBH, New Delhi.

Course –VII (CJ-2533): Biological Control of Plant Diseases
(Credits: 4+2)

Teaching hours: 50

UNIT-I: Concept of biological control, definitions, importance, principles of plant disease management with bioagents, history of biological control, merits and demerits of biological control. 10

UNIT-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. 12

UNIT-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. 16

UNIT-IV: Commercial prormulations 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. 12

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

Suggested Readings:

1. Campbell, R. (1989). Biological Control of Microbial Plant Pathogens. Cambridge Univ. Press, Cambridge.
2. Cook, R.J. and Baker, K.F. (1983). Nature and Practice of Biological Control of Plant Pathogens APS, St. Paul, Mennisota.
3. Fokkemma, M.J. (1986). Microbiology of the Phyllosphere. Cambridge Univ. Press, Cambridge.
4. Gnanamanickam, S .S. (Eds). (2002). Biological Control of Crop Diseases. CRC Press, Florida.
5. Heikki, M.T. and Hokkanen, James M. (Eds.). (1996). Biological Control -Benefits and Risks. Cambridge Univ. Press, Cambridge.
6. Mukerji, K.G., Tewari, J.P., Arora, D.K. and Saxena, G. (1992). Recent Developments in Biocontrol of Plant Diseases. Aditya Books, New Delhi.

Course –VIII (CJ-2534): Seed Health Technology
(Credits: 4+2)

Teaching hours: 50

UNIT-I: History and economic importance of seed pathology in seed industry, plant quarantine and SPS under WTO. Morphology and anatomy of typical monocotyledonous and dicotyledonous infected seeds. 10

UNIT-II: Recent advances in the establishment and subsequent cause of disease development in seed and seedling. Localization and mechanism of seed transmission in relation to seed infection, seed to plant transmission of pathogens. 10

UNIT-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. 16

UNIT-IV: Production of toxic metabolites affecting seed quality and its impact on human, animal and plant health, management of seed-borne pathogen/diseases and procedure for healthy seed production, seed health testing, methods for detecting microorganism. 14

Practical:
Conventional and advanced techniques in the detection and identification of seed-borne fungi, bacteria and viruses. Relationship between seed-borne infection and expression of the disease in the field.

Suggested Readings:

1. Agarwal, V.K. and Sinclair, J.B. (1996). Principles of Seed Pathology. 1st edition, CRC Press, Inc., Boca Raton, FL.
2. Hutchins, J.D. and Reeves, J.E. (1997). Seed Health Testing: Progress Towards the 21st Century. CABI, Wallington.
3. Karuna, V. (2007). Seed Health Testing. Kalyani Publishers, Ludhiana.
4. Maude, R.B. (1996). Seed borne Diseases and Their Control Principles and Practice. CAB International, Wallingford, Oxon, UK.
5. Neergaard, P. (1979). Seed Pathology Vol. 1. The Macmillan Press. Ltd.
6. Singh, Tribhwan and Triwedi, P.P (2005). Seed Pathology. Second edition, Daya Publishing House, New Delhi.
7. Suryanarayana, D. (1978). Seed Pathology. Vikash Publ., New Delhi.

Course –IX (CJ-3531): Plant Bacteriology
(Credits: 4+2)

Teaching hours: 50

UNIT-I: History of bacteriology, nomenclature and classification of bacteria, bacteriophages-morphology, types and uses, mycoplasma and bdellovibrios. 8

UNIT-II: Bacterial cell-morphology, organelles and their functions, cell wall structure and chemistry, endospore and its formation, composition and function, flagellar structure, arrangements, movements. 8

UNIT-III: Growth, nutrition requirements, reproduction, preservation of bacterial cultures and variability among phytopathogenic procarya. 8

UNIT-IV: Plasmids, bacterial conjugation, transduction and transformation. 6

UNIT-V: Important bacterial diseases: Bacterial leaf blight of rice, bacterial blight of pomegranate, cotton bacterial blight, bacterial wilt of solanaceous vegetables, soft rot of vegetables and black rot of crucifers. 14

UNIT-VI: Management strategy for bacterial diseases, survival and dissemination of bacteria. 6

Practical:

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

Suggested Readings:

1. Goto, M. (1990). Fundamentals of Plant Bacteriology. Academic Press, New York.
2. Frobisher, M. (1944). Fundamentals of Bacteriology, W. B. Sauners Company.
3. Gerhardt, P., Murray, R.G.E., Wood, A.W. and Krieg, N.R. (1994). Methods for Molecular Bacteriology, American Society of Microbiology, Washington, DC, USA.
4. Jackson, R.W. (2009). Plant Pathogenic Bacteria: Genomics and Molecular Biology, Caister Academic Press, USA.
5. Jayaraman, J. and Verma, J.P. (2002). Fundamentals of Plant Bacteriology. Kalyani Publishers, Ludhiana.
6. Mount, M.S. and Lacy, G.H. (1982). Phytopathogenic Prokaryotes. Vols. I, II. Academic Press, New York.
7. Salle, A.J. (1967). Fundamental Principles of Bacteriology, Mc Graw-Hill, Inc., New York.
8. Schaad, N.W., Jones, J.B. and Chun, W. (2001). Laboratory Guide for Identification of Plant Pathogenic bacteria, APS Press, St. Paul, Minnisota.
9. Verma, J.P. (1998). The Bacteria. Malhotra Publ. House, New Delhi.

Course –X (CJ-3532): Chemicals in Plant Disease Management
(Credits: 4+2)

Teaching hours: 50

UNIT-I: History and development of chemicals; definition of pesticides and related terms; advantages and disadvantages of chemicals. 6

UNIT-II: Classification of chemicals based on chemical nature and mode of action used in plant disease control and their characteristics. 8

UNIT-III: Chemicals in plant disease control, viz., fungicides, bactericides, nematicides and botanicals. 8

UNIT-IV: Formulations, mode of action and application of different fungicides; chemotherapy and phytotoxicity of chemical pesticides. 10

UNIT-V: Handling, storage and precautions to be taken while using fungicides; compatibility with other agrochemicals, persistence, cost-benefit ratio, factor affecting fungicides. 10

UNIT-VI: General account of plant protection appliances; environmental pollution, residues and health hazards, fungicidal resistance in plant pathogens and its management. 8

Practical:
Acquaintance with formulation of different fungicides and plant protection appliances, Formulation of fungicides and bactericides; in vitro evaluation techniques, preparation of different concentrations of chemicals including botanical pesticides based on active ingredients against pathogens; persistence, compatibility with other agro-chemicals; methods of application of chemicals.

Suggested Readings:

1. Bindra, O.S and Singh, H. (1977). Pesticides - An Application Equipment. Oxford & IBH, New Delhi.
2. Green, M.B. and Spilker, D.A. (1986). Fungicide Chemistry: Advances and Practical Applications (ACS Symposium Series, 304). American Chemical Society, Oxford University Press.
3. Hewitt, H.G. (1998). Fungicides in Crop Protection CABI Publishing, CAB International, Oxon, United Kingdom.
4. Hutson, D. and Miyamoto, J. (1999). Fungicidal Activity: Chemical and Biological Approaches to Plant Protection, John Wiley & Sons. New York.
5. Koller, W. (1992). Target Sites of Fungicide Action CRC Press. Baca Raton, FL.
6. Nene, Y.L. and Thapliyal, P.N. (1993). Fungicides in Plant Disease Control. 3rd Ed., Oxford & IBH, New Delhi.
7. Vyas, S.C. (1993). Handbook of Systemic Fungicides. Vols. I-III. Tata McGraw Hill, New Delhi.

Course –XI (CJ-3533): Diseases of Fruits, Plantation and Ornamental Crops
(Credits: 4+2)

Teaching hours: 50

Introduction, nature, prevalence, etiology, factors affecting disease development and control measures of diseases of crops caused by fungi, bacteria, viruses, nematodes, etc.

UNIT-I: Introduction, symptoms and etiology of different fruit diseases. Factors affecting disease development in fruits like apple, pear, peach, strawberry, citrus, mango, grapes, guava, ber, banana, pineapple, papaya, pomegranate and management of the fruits diseases. 20

UNIT-II: Introduction, symptoms, mode of perpetuation of diseases of plantation crops such as tea, coffee, rubber and coconut and their management. 12

UNIT-III: Introduction, symptoms and life cycle of pathogens. Factors affecting disease development of ornamental plants such as roses, gladiolus, tulip, carnation, orchids, marigold, chrysanthemum and their management. 18

Practical:
Detailed study of symptoms and host parasite relationship of representative diseases of plantation crops, fruits and ornamental plants. Collection and dry preservation of diseased specimens of important crops.

Suggested Readings:

1. Gupta, V.K. and Sharma, S.K. (2000). Diseases of Fruit Crops. Kalyani Publ., New Delhi.
2. Marshall, E.M., Alois, A.B. and Backman, C.H. (1981). Fungal wilt diseases of plants, Academic Press.
3. Naqvi, S. and Kluwer. (2004). Disease of Fruits and Vegetables Diagnosis and Management. Academic publisher.
4. Parvatha Reddy, P. (2010). Fungal Diseases and Their Management in Horticultural Crops. Scientific Publication.
5. Pathak, V.N. (1980). Diseases of Fruit Crops. Oxford & IBH, New Delhi.
6. Sharma, L.R., Sharma, R.C. and Gidwani, M. (1999). Disease of Horticultural Crops Vegetables, Ornamental and Mushrooms. Indus Publishing Co.
7. Singh, R.S. (2000). Diseases of Fruit Crops. Oxford & IBH, New Delhi.
8. Smith, I.M., Dunez, L., Lelliott, R.A., Phillips, D.H. and Archer, S.A. (1988). European Handbook of Plant Disease. Blackwell Scientific Publications.
9. Walker, J.C. (2004). Diseases of Vegetable Crops. TTPP, India.

Course –XII (CJ-3534): Computer Applications and Bioinformatics
(Credits: 4+2)

Teaching hours: 50

UNIT-I: Introduction to computers: General characteristics, generation, component, (input/output and memory unit) and classification of computer, internal representation of data (binary, octal and hexa-decimal system, bits and bytes). 4

UNIT-II: Brief idea of operating systems: Disc operating systems (DOS), UNIX/Linux, WINDOWS and its upgraded versions; Mobile operating system. 4

UNIT-III: Introduction to networking: Types of Networking (LAN: local area network, WAN: wide area network, MAN: metropolitan area network), Client-Server Architecture, Network topologies and Internet. 6

UNIT-IV: Microsoft (MS) office and its applications: Introduction to MS Excel and its applications for statistical analyses with particular reference to agricultural data (tabular and graphical representation of data, analyses of variance, regression and correlation); introduction to MS Word and its application for document preparation; power Point and its application for preparing presentations. 8

UNIT-V: Introduction to statistical packages: Introductory knowledge of SPSS (Statistical Package for the Social Sciences), SAS (Statistical Analysis Software) packages for statistical analysis of agricultural data, handling software for data analyses. 8

UNIT-VI: An overview of bioinformatics: Introduction, definition and scope of bioinformatics, kind of data used in bioinformatics; Biological databases (nucleic acid, protein sequence and protein structure database); multiplicity of data and redundancy, major bioinformatics websites; PubMed and other databases; on-line access to abstracts and full text of articles; online books; free and paid access. 10

UNIT-VII: Sequence analysis: Sequence Alignment, Introduction to sequence analysis, Sequence database similarity searching algorithms, local alignment, global alignment, FASTA, BLAST (BLASTP, BLASTN, BLASTX, TBLASTN, TBLASTX) and similarity searching scores. 10

Suggested Readings:

1. Gear, CW (1980). Computer Organization and Programming. McGraw-Hill Inc., New York.
2. Gotefried, B.S. (1986). Theories and Problems of Programming with BASIC. Schaum's Outline Series, McGraw-Hill Book Company, Singapore.
3. Lipschutz, M.M and Lipschutz, S. (1981). Theories and Problems of Data Processing. Schaum's Outline Series, McGraw-Hill Book Company, Singapore.
4. Subramanian, N. (1986). Introduction to Computer. Fundamentals of Computer Science. Tata McGraw-Hill Publishing Company Ltd., New Delhi.
5. Rajaraman, V. Fundamentals of Computers. Prentice-Hall of India (Pvt.) ltd., New Delhi.
6. Rastogi, S.C., Mendiratta, N. and Rastogi, P. (2003). Bioinformatics: Concepts, Skills and Applications. CBS Publishers, New Delhi.

Course – XIII (CJ-4531): Plant Quarantine
(Credits: 4+2)

Teaching hours: 50

UNIT-I: Introduction: Definition of pest, pesticides and transgenics as per Govt. notification; relative importance; Quarantine: domestic and international. Quarantine restrictions in the movement of agricultural produce, seeds and planting material; case histories of exotic pests/diseases and their status. 12

UNIT-II: Plant protection organization in India. Acts related to registration of pesticides and transgenics. 6

UNIT-III: History of quarantine legislations, PQ Order 2003. Environmental acts, Industrial registration; APEDA, Import and Export of bio-control agents. 8

UNIT-IV: Identification of pest/disease free areas; contamination of food with toxigens, microorganisms and their elimination; Symptomatic diagnosis and other techniques to detect pest/pathogen infestations; VHT and other safer techniques of disinfestation/salvaging of infected material. 14

UNIT-V: WTO regulations; non-tariff barriers; Pest risk analysis, good laboratory practices for pesticide laboratories; pesticide industry; Sanitary and Phytosanitary measures. 10

Suggested Readings:

1. Rajeev, K. and Mukherjee, R.C. (1996). Role of Plant Quarantine in IPM. Aditya Books.
2. Rhower, G.G. (1991). Regulatory Plant Pest Management. In: Handbook of Pest Management in Agriculture. 2nd Ed., Vol. II. (Ed. David Pimental). CRC Press.
3. Saha, L.R. (2006). Handbook of Plant Protection. First edition, C.B.S. Publishers, New Delhi.
4. Srivastava, K.P. (2004). A Text book of Applied Entomology. 2nd Ed., Volume-I and II, Kalyani Publishers, New Delhi.

Course –XIV (CJ-4532): Principles of Plant Disease Management
(Credits: 4+2)

Teaching hours: 50

UNIT-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 (IDM- Integrated disease management). Disease resistance and molecular approach for disease management. 20

UNIT-II: Foliage, seed and soil application of chemicals, role of stickers, spreaders and other adjuvants, health vis-a-vis environmental hazards, residual effects and safety measures. 14

UNIT-III: 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. 16

Practical:

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

Suggested Readings:

1. Fry, W.E. (1982). Principles of Plant Disease Management. Academic Press, New York.
2. Hewitt, H.G. (1998). Fungicides in Crop Protection. CABI, Wallington.
3. Marsh, R.W. (1972). Systemic Fungicides. Longman, New York.
4. Nene, Y.L. and Thapliyal, P.N. (1993). Fungicides in Plant Disease Control. Oxford & IBH, New Delhi.
5. Palti, J. (1981). Cultural Practices and Infectious Crop Diseases. Springer-Verlag, New York.
6. Vyas, S.C. (1993). Handbook of Systemic Fungicides. Vols. I-III. Tata McGraw Hill, New Delhi.

Open Elective Courses

Open Elective Course –I: Principles of Nematology
(Credits: 4)

Teaching hours: 50

UNIT-I: 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. 14

UNIT-II: Gross morphology of plant parasitic nematodes; broad classification, nematode biology, physiology and ecology. 10

UNIT-III: Types of parasitism; nature of damage and general symptomatology; interaction of plant parasitic nematodes with other organisms. 10

UNIT-IV: Plant nematode relationships, cellular responses to infection by important phytonematodes; physiological specialization among phytonematodes. 10

UNIT-V: Principles and practices of nematode management; integrated nematode management. 6

Practical:
Studies on kinds of nematodes- free-living, animal, insect and plant parasites; nematode extraction from soil; extraction of migratory endoparasites, staining for sedentary endoparasites; examination of different life stages of important plant parasitic nematodes, their symptoms and histopathology.

Suggested Readings:

1. Dropkin, V.H. (1980). An Introduction to Plant Nematology. John Wiley & Sons, New York.
2. Perry, R.N. and Moens, M. (2006). Plant Nematology. CABI, London.
3. Singh, R.S. and Sitaramaiah, K. (1994). Plant Pathogens – Nematodes. Oxford & IBH, New Delhi.
4. Khan, M.R. (2008). Plant Nematodes… Oxford & IBH, New Delhi.
5. Walia, R.K. and Bajaj, H.K. (2003). Text Book on Introductory Plant Nematology. ICAR, New Delhi.

Open Elective Course –II: Integrated Diseases Management
(Credits: 4)

Teaching hours: 50

UNIT-I: Introduction, definition, concept and tools of disease management, components of integrated disease management- their limitations and implications. 14

UNIT-II: Development of IDM- basic principles, biological, chemical and cultural disease management. 14

UNIT-III: IDM in important crops- rice, wheat, cotton, sugarcane, chickpea, rapeseed-mustard, pearlmillet, *kharif* pulses, vegetable crops and fruit crops. 22

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

Suggested Readings:

1. Ciancia, A. and Mukerji, K.J. (2007). General Concepts of Integrated Pest and Disease Management. Edited Published by Springer.
2. Gupta, V.K. & Sharma, R.C. (Eds). (1995). Integrated Disease Management and Plant Health. Scientific Publ., Jodhpur.
3. Mayee, C.D., Manoharachary, C., Tilak, K.V.B.R., Mukadam, D.S. & Deshpande, Jayashree. (2004). Biotechnological Approaches for the Integrated Management of Crop Diseases. Daya Publ. House, New Delhi.
4. Sharma, R.C. and Sharma, J.N. (Eds). (1995). Integrated Plant Disease Management. Scientific Publ., Jodhpur.