

**CURRICULUM**  
**OF**  
**PLANT PATHOLOGY**  
**FOR**  
**B S/B.Sc (Hons)**  
**M S (Hons)**  
**Ph. D**

**(Revised 2010)**



**HIGHER EDUCATION COMMISSION**  
**ISLAMABAD**

# **CURRICULUM DIVISION, HEC**

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## PREFACE

The curriculum of subject is described as a throbbing pulse of a nation. By viewing curriculum one can judge the stage of development and its pace of socio-economic development of a nation. With the advent of new technology, the world has turned into a global village. In view of tremendous research taking place world over new ideas and information pours in like of a stream of fresh water, making it imperative to update the curricula after regular intervals, for introducing latest development and innovation in the relevant field of knowledge.

In exercise of the powers conferred under Section 3 Sub-Section 2 (ii) of Act of Parliament No. X of 1976 titled “**Supervision of Curricula and Textbooks and Maintenance of Standard of Education**” the erstwhile University Grants Commission was designated as competent authority to develop review and revise curricula beyond Class-XII. With the repeal of UGC Act, the same function was assigned to the Higher Education Commission under its Ordinance of 2002 Section 10 Sub-Section 1 (v).

In compliance with the above provisions, the HEC undertakes revamping and refurbishing of curricula after regular intervals in a democratic manner involving universities/DAs, research and development institutions and local Chamber of Commerce and Industry. The intellectual inputs by expatriate Pakistanis working in universities and R&D institutions of technically advanced countries are also invited to contribute and their views are incorporated where considered appropriate by the National Curriculum Revision Committee (NCRC).

To bring international compatibility to qualifications held from Pakistani universities/DAs for promotion of students mobility and job seekers around the globe, a Committee comprising of Conveners of the National Curriculum Revision Committee of HEC met in 2009 and developed a unified template for standardized 4-years/8-semesters BS degree programmes. This unified template was aimed to inculcate broader base of knowledge in the subjects like English, Sociology, Philosophy, Economics etc in addition to major discipline of study. The Bachelor (BS) degree course requires to be completed in 4-years/8-semesters, and shall require qualifying of 130-140 credit hours of which 77% of the curriculum will constitute discipline specific and remaining 23% will comprise compulsory and general courses.

In line with above, NCRC comprising senior university faculty and experts from various stakeholders and the respective accreditation councils has finalized the curriculum for BS and MS (Plant Pathology). The same is being recommended for adoption by the universities/DAs channelizing through relevant statutory bodies of the universities.

**PROF. DR. ALTAF ALI G. SHAIKH**  
**Member Academics**

**March 2010**

# CURRICULUM DEVELOPMENT

## INTRODUCTION

Plant Pathology is the scientific study of plant diseases caused by pathogens and environmental conditions. Plant pathology also involves the study of pathogen identification, disease etiology, disease cycles, economic impact, crop losses and the economical disease management.

The HEC constituted National Curriculum Revision Committee (NCRC) for Plant Pathology consisting of professionals from universities/colleges and national research centers to review the existing curriculum of Plant Pathology and draft innovative Plant Pathology curricula for under graduate and post graduate degree programs. The NCRC on Plant Pathology developed frame work and revised the curriculum in two different meetings. Both meetings were held at Higher Education Commission, Regional Centre, Lahore during February 22-24 and June 10-12, 2010, respectively.

### **Proceeding of the Preliminary NCRC meeting:**

The following members attended the meeting:-

Prof. Dr. Muhammad Irfan Ul-Haque, Chairman, Department of Plant Pathology, PMAS Arid Agriculture University, Rawalpindi	Convener
Prof. Dr. Rukhsana Bajwa Director, Institute of Mycology and Plant Pathology University of the Punjab, Lahore	Member
Dr. Safdar Ali Anwar Foreign Faculty, Department of Plant Pathology University of Agriculture Faisalabad, Faisalabad	Member
Prof. Dr. Noor Jehan Ismaili, Department of Botany, Shah Abdul Latif University, Khairpur	Member

<p>Prof. Dr. Abdul Hakim Shaikh  Department of Botany,  Federal Urdu University of Arts and Technology,  Ghulshan-e-Iqbal,  Karachi,</p>	Member
<p>Prof. Dr. Saleem Shahzad,  Chairman,  Department of Agriculture and Agri-Management,  University of Karachi,  Karachi,</p>	Member
<p>Prof. Dr. S. Riaz Ali Gardezi  Department of Entomology/Plant Pathology,  Faculty of Agriculture, University of Azad Jammu  &amp; Kashmir, Rawalakot,  AJ &amp; K</p>	Member
<p>Dr. Nazir Javed  Associate Professor/Chairman  Department of Plant Pathology, University of Agriculture Faisalabad,  Faisalabad</p>	Member
<p>Dr. Abdul Rauf Bhutta  Project Director,  Federal Seed Certification and Registration Department,  Mauve Area, Sector G-9,  Islamabad</p>	Member
<p>Dr. Ghazala Nasim  Assistant Professor,  Institute of Mycology &amp; Plant Pathology,  University of the Punjab,  Lahore.</p>	Member
<p>Dr. Samiya Mahmood Khan  Assistant Professor,  University College of Agriculture  B. Z. University,  Multan</p>	Member
<p>Dr. Abdul Mubeen Lodhi,  Assistant Professor,  Department of Plant Pathology,  Sindh Agricultural University,</p>	Member

Tandojam

Mr. Ahmad Khan  
Assistant Professor,  
Department of Plant Pathology  
Baluchistan Agricultural College,  
Quetta

Member

Mr. Lutfullah Khosa  
Assistant Professor,  
Department of Plant Pathology  
Baluchistan Agricultural College,  
Quetta

Member

Dr. Yasir Iftikhar  
Assistant Professor,  
Department of Plant Pathology  
College of Agriculture, University of Sargodha,  
Sargodha

Member

Mr. Naveed Aslam,  
University College of Agriculture and Environmental Sciences,  
Islamia University Bahawalpur  
Bahawalpur

Member

Prof. Dr. Muhammad Arif,  
Chairman, Department of Plant Pathology,  
NWFP Agricultural University,  
Peshawar

Member/Secretary

Meeting started with the recitation from Holy Quran. Ms. Ghayyur Fatima, Director (Curriculum) HEC, Islamabad, welcomed the participants and briefed them of the obligations of the Commission for review, revision and development of curricula. She appraised the Committee about the academic activities of HEC for improvement of education in the shape of teachers training program, indigenous & foreign scholarship programs and short courses by subject experts. It was desired by the HEC officials that curriculum should be developed keeping in view the new challenges at national and international level. We have to develop a standard course irrespective of present infrastructure. It will be our duty to improve the facilities to meet the implementation requirements of the new curriculum.

The committee members unanimously selected Prof. Dr. Muhammad Irfan UI-Haque as Convener and Prof. Dr. Muhammad Arif as Secretary of the NCRC in Plant Pathology. The committee thoroughly reviewed the existing curricula for B.Sc. (Hons) Agri., M. Sc. (Hons) Agri. and Ph .D in Plant

Pathology and made various sub-committees of the members to review existing curricula and incorporate recent trends in different areas of Plant Pathology in the light of template provided by HEC. The committee suggested improvements in almost all the courses, replacement and addition of new courses at under graduate and graduate levels.

### **Proceeding of the final NCRC meeting:**

The following members attended the meeting:-

Prof. Dr. Muhammad Irfan Ul-Haque, Chairman, Department of Plant Pathology, PMAS Arid Agriculture University, Rawalpindi	Convener
Dr. Ahmad Saleem Akhtar, Member, Planning & Programming, Punjab Agricultural Research Board, Lahore	Member
Dr. Safdar Ali Anwar Foreign Faculty, Department of Plant Pathology University of Agriculture, Faisalabad	Member
Prof. Dr. Noor Jehan Ismaili, Department of Botany, Shah Abdul Latif University, Khairpur	Member
Prof. Dr. Abdul Hakim Shaikh Department of Botany, Federal Urdu University of Art and Technology, Ghulshan-e-Iqbal, Karachi,	Member
Prof. Dr. Saleem Shahzad, Chairman, Department of Agriculture and Agri-Management, University of Karachi, Karachi,	Member
Dr. Nazir Javed Associate Professor/Chairman Department of Plant Pathology,	Member



University of Agriculture Faisalabad,  
Faisalabad

Dr. Abdul Mubeen Lodhi, Member  
Associate Professor, Department of Plant Pathology,  
Sindh Agricultural University, Tandojam

Dr. S. M. Sarwar Alam, Member  
Principal Scientific Officer, Nuclear Institute for Agri. &  
Biology (NIAB), Faisalabad

Dr. Anjum Munir, Member  
Principal Scientific Officer, Institute of Plant and  
Environmental Protection, National Agricultural  
Research Center (NARC, Islamabad.

Dr. Abdul Rauf Bhutta Member  
Project Director,  
Federal Seed Certification and Registration Department,  
Mauve Area, Sector G-9,  
Islamabad

Dr. Ghazala Nasim Member  
Assistant Professor,  
Institute of Mycology & Plant Pathology,  
University of the Punjab,  
Lahore.

Dr. Salik Nawaz Khan, Member  
Assistant Professor,  
Institute of Mycology & Plant Pathology,  
University of the Punjab,  
Lahore

Dr. Samiya Mahmood Khan Member  
Assistant Professor, University College of Agriculture  
B. Z. University,  
Multan

Mr. Ahmad Khan Member  
Assistant Professor, Department of Plant Pathology  
Baluchistan Agricultural College,  
Quetta

Mr. Lutfullah Khosa Member  
Assistant Professor, Department of Plant Pathology  
Baluchistan Agricultural College,

Quetta

Dr. Yasir Iftikhar  
Assistant Professor, Department of Plant Pathology  
College of Agriculture, University of Sargodha,  
Sargodha

Member

Mr. Naveed Aslam,  
University College of Agriculture and Environmental Sciences,  
Islamia University Bahawalpur  
Bahawalpur

Member

Prof. Dr. Muhammad Arif,  
Chairman, Department of Plant Pathology,  
NWFP Agricultural University,  
Peshawar

Member/Secretary

Meeting started with the recitation from Holy Quran. Ms. Ghayyur Fatima, Director (Curriculum) HEC, Islamabad, welcomed the participants and briefed them about the so far progress in the development of Plant Pathology Curriculum. She appraised the Committee for doing excellent work through making significant contributions in the upgradation/ improvement of the curriculum. It was desired by the HEC that curriculum should meet the new challenges at national and international levels.

Prof. Dr. Muhammad Irfan Ul-Haque and Prof. Dr. Muhammad Arif continued as Convener and Secretary of NCRC in Plant Pathology. The Secretary presented the draft curricula after incorporation of suggestions in preliminary meeting. The committee thoroughly reviewed the draft curricula for undergraduate and post-graduate programs in Plant Pathology and made various sub-committees of the members to review draft curricula and incorporate recent trends in different areas of Plant Pathology. A number of courses were improved and addition/deletion was made in existing courses both at under-graduate and post graduate levels. Many advanced and recent literatures were included in the curricula. The committee finalized curriculum for B. S (Hons), M. S (H) and Ph. D programs in Plant Pathology. The committee also recommended various suggestions to HEC for uniformity of Plant Pathology programs at different levels in different institutions of Pakistan.

## FRAMEWORK / TEMPLATE FOR BS/B.Sc (HONS) IN AGRICULTURAL DISCIPLINES

Duration	4 years
Number of semesters:	8
Weeks per semester:	16-18 (16 for teaching and 2 for exams)
Total credit hours:	130-140
Credit hours per semester:	15-18
Agriculture Courses:	77%
Non-Agriculture Courses:	23%

<b>Non-Agriculture Domain</b>							
Knowledge Area	Subject Area	Name of Course	CR	Total Courses	Total Credits	% Area	% overall
Humanities	English	English-I (Functional En	3	2	6	19.35	4.44
		English-II (Communication Skills)	3				
	Culture	Pakistan Studies	2	2	4	12.9	2.96
		Islamic Studies/Ethics	2				
	Social Sciences		Rural Development	3	2	6	19.35
Marketing & Agri Business			3				
Computing	IT	Intro to Communication Technology	3	1	3	9.70	2.22
Natural Science	Mathematics/Biology	Maths-1 / Botany	3	2	6	19.35	4.44
		Maths-II / Zoology	3				
	Statistics	Statistics-I	3	2	6	19.35	4.44
		Statistics-II	3				
		Sub-Total		11	31	100	23

## Agriculture Domain

Interdisciplinary	Agriculture Foundation	Basic Agriculture	3	9	27	26.0	20.0
		Agronomy	3				
		Plant Breeding & Genetics	3				
		Entomology	3				
		Plant Pathology	3				
		Food Technology	3				
		Horticulture	3				
		Soil Sciences	3				
		Agricultural Economics	3				
Supporting Courses (6-8 Courses)	Breadth Courses	Agriculture Extension	3	4-6	12-18	15.0	11.0
		Forestry & Range Management	3				
		Animal Sciences	3				
		Human Nutrition	3				
		Agriculture Chemistry	3				
		Agriculture Engineering	3				
		Water Management	3				
		Any other recommended by University	3				
Major Courses (18-20 Courses)	Major Based Core (Depth)	Major	3	18-20	56-60	55.0	43.0
Project / Internship		Project / Internship	4	-	-	4	3
Total			-	31-35	99-109	100	77
Grand-Total			-	42-46	130-140	-	100

# Template for 4-Year BS/B.Sc. (Hons) in Agricultural Disciplines

## 1. Compulsory Courses

	<b>Credits Hours</b>
Mathematics / Biology (2 courses)	6 (3-0) (2-1)
Statistics 1 & 2	6 (3-0) (3-0)
Computers / IT	3 (2-1)
Pakistan Studies	2 (2-0)
Islamic Studies	2 (2-0)
Communications Skills	3 (3-0)
English	3 (3-0)
Basic Agriculture	3 (2-1)
<b>Sub-Total</b>	<b>28</b>

## 2. Interdisciplinary Foundation Courses

Agronomy	3 (2-1)
Plant Breeding & Genetics	3 (2-1)
Entomology	3 (2-1)
Plant Pathology	3 (2-1)
Food Technology	3 (2-1)
Horticulture	3 (2-1)
Soil Sciences	3 (2-1)
Agriculture Economics	3 (2-1)
<b>Sub-Total</b>	<b>24</b>

## 3. Supporting Courses (6-8 courses (3 Cr. hr) amongst below

Agriculture Extension  
Forestry & Range Management  
Animal Science  
Marketing & Agri Business  
Rural Development  
Human Nutrition  
Agriculture Chemistry  
Agriculture Engineering  
Water Management  
Any other discipline recommended by the university

**Sub-Total 18-24**

**Sub-Total during the first four semesters**  
**Semester 5, 6, 7 & 8**

**70-76**  
**56-60**

**Project / Internship**  
**Grand Total**

**04**  
**130-140**

- . 1 credit of theory = one contact hour per week for 16-18 weeks and 1 practical / Lab hour = two contact hours per week for 16-18 weeks.
- . In case of non availability of department of supporting courses, courses from foundation courses can be opted.

**SCHEME OF STUDIES  
FOR UNDER-GRADUATE PROGRAM IN  
PLANT PATHOLOGY**

**LIST OF COURSES**

<b>Sr. No.</b>	<b>Title of Courses</b>	<b>Credit Hours</b>
1.	Introduction to Plant Pathogens	3(2-1)
2.	Introductory Plant Pathology	3(2-1)
3.	Introduction to Plant Viruses	3(2-1)
4.	Introduction to Plant Prokaryotes	3(2-1)
5.	Introductory Mycology	3(2-1)
6.	Introduction to Plant Parasitic Nematodes	3(2-1)
7.	Beneficial Microorganisms	3(2-1)
8.	Diseases of Field Crops	3(2-1)
9.	Introductory Forest Pathology	3(2-1)
10.	Diseases of Vegetable Crops	3(2-1)
11.	Plant Resistance to Diseases	3(2-1)
12.	Soil-borne Plant Pathogens and their Management	3(2-1)
13.	Plant Disease Diagnosis	3(1-2)
14.	Diseases of Fruits and Ornamentals	3(2-1)
15.	Seed and Post-harvest Pathology	3(2-1)
16.	Plant Disease Management	3(2-1)
17.	Introduction to Molecular Plant Pathology	3(2-1)
18.	Plant Disease Epidemiology	3(2-1)
19.	Pesticides, their Action and Application	3(2-1)
20.	Abiotic Diseases of Plants	3(2-1)
21.	Methods and Techniques in Plant Pathology	3(2-1)
22.	Internship / Project Study.	4(0-4)

**Total = 57**

# **DETAIL OF COURSES UNDER GRADUATE PROGRAM IN PLANT PATHOLOGY**

## **1. INTRODUCTION TO PLANT PATHOGENS**

**Credit Hours: 3(2-1)**

**Prerequisites:** Biology (Secondary level)

### **Objectives:**

To acquaint students with basic concepts and identification of plant pathogens

### **Course Contents:**

#### **Theory**

Introduction; economic importance; general characteristics (morphology and ecology); Identification of plant pathogens including fungi, bacteria and mollicutes, viruses and viroids, nematodes

#### **Practical**

Orientation of laboratory equipment; preparation of media and isolation of different plant pathogens; study of characteristics of various plant pathogens through slides, live specimens and their comparative account/study

### **Recommended Books:**

1. Agrios, G.N. 2005. Plant Pathology, 5th edition. Academic Press, New York, USA.
2. Alexopoulos, C.J., C.W. Mims and M. Blackwell. 1996. Introductory Mycology. 4<sup>th</sup> edition, John Wiley and Sons, Inc., New York, USA
3. Khan, J.A. and J. Dijkstra. 2002. Plant Virus as Molecular Pathogens. The Haworth Press Inc. USA.
4. Mehrotra, R.S. and A. Agarwal. 2003. Plant Pathology. 2<sup>nd</sup> Edition. TATA McGraw Hill. Pub. Company Ltd. New Delhi.
5. Singh, R.S. 1982. Plant Pathogens: The Fungi. Oxford and IBH Publishing Company, New Delhi, India
6. Singh, R.S. 1989. Plant Pathogens: The Prokaryotes. Oxford and IBH Publ. Company, New Delhi, India.
7. Trigiano, R.N., M.T. Windham and A.S. Windham. 2008. Plant Pathology: Concepts and Laboratory Exercises. 2<sup>nd</sup> edition. CRC Press.
8. Vidhyasekram, P. 2004. Concise Encyclopedia of Plant Pathology. Food product Press and Haworth Press Inc. Binghamton, New York, USA.



## **2. INTRODUCTORY PLANT PATHOLOGY**

**Credit Hours: 3(2-1)**

**Prerequisites:** Biology (Secondary level)

### **Objectives:**

To acquaint students with basic concepts of Plant Pathology

### **Course Contents:**

#### **Theory**

Introduction and history of plant pathology; definition of disease in plants; economic importance of plant diseases; nature and cause of (biotic and abiotic) diseases; Components of plant disease development; Principles of plant disease management; Symptoms, etiology, mode of infection, disease cycle and management of representative diseases of field and horticultural crops

#### **Practical**

Collection, preservation and identification of plant diseases based on symptoms; Demonstration of Koch's postulates; Demonstration of plant pathological laboratory equipment

### **Recommended Books:**

1. Agrios, G.N. 2005. Plant Pathology, 5<sup>th</sup> edition, Academic Press, New York, USA.
2. Ahmad, I. and A.R. Bhutta. 2005. A Text Book of Introductory Plant Pathology. Published by National Book Foundation, Islamabad, Pakistan.
3. Hafiz, A. 1986. Plant Diseases. Pakistan Agricultural Research Council, Islamabad, Pakistan.
4. Mathew, J.D. 2003. Molecular Plant Pathology. Bios Scientific Publishers Ltd. UK.
5. Mehrotra, R.S. and A. Agarwal. 2003. Plant Pathology, 2<sup>nd</sup> Edition. TATA McGraw Hill. Pub. Company Ltd. New Dehli.
6. Chaube, H.S. and R. Singh. 2002. Introductory Plant Pathology. International Book Distributing Co.
7. Strange, R.N. 2003. Introduction to Plant Pathology. John Willey & Sons, New York.

## **3. INTRODUCTION TO PLANT VIRUSES**

**Credit Hours: 3(2-1)**

**Prerequisites:** Introductory Plant Pathology

### **Objectives:**

To introduce to the students the basic and applied concepts of plant viruses

## **Course Contents:**

### **Theory**

Introduction, history and importance, morphology, composition and structure; virus transmission and movement; symptomatology; serology and serological methods; ecology and epidemiology; management; study of specific virus diseases in Pakistan

### **Practical**

Field visits and study of virus infected plants; methods of virus transmission (mechanical inoculation, grafting, insect vectors); Virus detection through biological (indicator hosts and host range) and serological methods (ELISA, Immunodiffusion)

### **Recommended Books:**

1. Bashir, M. and S. Hassan. 1998. Diagnostic Methods for Plant Viruses. Pakistan Agricultural Research Council, Islamabad, Pakistan.
2. Compendia of different crops. American Phytopathological Society, St. Paul, Minnesota, USA.
3. Hadidi, A., R. K. Khetarpal and H. Koganezawa (Eds.). 1998. Plant Virus Disease Control. APS, USA.
4. Hull, R. 2009. Comparative Plant Virology. 2<sup>nd</sup> edition. Academic Press.
5. Loebenstein, G. and G. Thottappilly (Eds.). 2004. Virus and Virus-like Diseases of Major Crops in Developing Countries. Springer Press.
6. Matthews. R.E.F. 1991. Plant Virology. 3<sup>rd</sup> revised edition. Academic Press.
7. Thresh, M. (Ed.). 2006. Plant Virus Epidemiology. Academic press.
8. Walkey, D.G.A. 1985. Applied Plant Virology. John Wiley & Sons

## **4. INTRODUCTION TO PLANT PROKARYOTES**

**Credit Hours: 3(2-1)**

**Prerequisites:** Introductory Plant Pathology

### **Objectives:**

To introduce basic and applied concepts of Plant associated bacteria and mollicutes.

### **Course Contents:**

#### **Theory**

Introduction, economic importance, general characteristics; morphology, reproduction and physiology; cultural characteristics; mode of infection and transmission of bacteria and mollicutes and their management; Study of specific prokaryotic plant diseases in Pakistan.

## **Practical**

Isolation, purification, identification and preservation of plant pathogenic prokaryotes; hypersensitive reactions and pathogenicity tests; Inoculum preparation and testing with known concentration.

## **Recommended Books:**

1. Agrios, G.N. 2005. Plant Pathology. 5<sup>th</sup> edition. Academic Press, New York, USA.
2. Dworkin, M., S. Falkow, E. Rosenberg and K.H. Schleifer. 2006. The Prokaryotes: A Handbook on the Biology of Bacteria: Symbiotic Associations, Biotechnology, Applied Microbiology. 3<sup>rd</sup> edition. Springer
3. Elliott, C. 2008. Manual of bacterial plant pathogens. The Williams & Wilkins Company.
4. Jackson, R.W. 2009. Plant Pathogenic Bacteria: Genomics and Molecular Biology. Caister Academic Press
5. Janse, J.D. 2008. Phytobacteriology: Principles and Practice. CABI Publishing.
6. Mishra, R.S. 2003. Bacterial Plant Diseases. Discovery Publication House, India.
7. Mukesh, S. 2006. Introductory Phytobacteriology. Eastern Book Corporation.

## **5. INTRODUCTORY MYCOLOGY**

**Credit Hours: 3(2-1)**

**Prerequisites:** Introductory Plant Pathology

### **Objectives:**

To study the basic and applied aspects of fungi and fungi like organisms

### **Course Contents:**

#### **Theory**

History, significance and evolution of classification of fungi and fungi-like organisms; General Characters; methods of reproduction and economic importance of various phyla; Study of morphology and classification of economically important fungi and fungi-like organisms belonging to Plasmodiophoromycota, Oomycota, Chytridiomycota, Zygomycota, Ascomycota, Basidiomycota and Deuteromycota.

#### **Practical**

Collection, isolation, identification and preservation of fungi from various sources; Use of diagnostic keys for identification of important fungi; Comparative study of representatives of various phyla.

### **Recommended Books:**

1. Alexopoulos, C.J., C.W. Mims and M. Blackwell. 1996. Introductory Mycology. 4<sup>th</sup> edition, John Wiley & Sons, Inc. New York, USA.
2. Barnett, H.L. 1998. Illustrated Genera of imperfect Fungi. ACS, Washington, DC, USA.
3. Carlile, M.J., S.C. Watkinson and G.W. Gooday. 2001. The Fungi. Academic Press.
4. Deacon, J. 2005. Fungal Biology 4<sup>th</sup> edition. Blackwell.
5. Johri, R.M. 2005. A Text Book of Fungi. Dominant Publishers and Distributors, India.
6. Rai, M. 2010. Progress in Mycology. Springer.
7. Swanton, E.W. 2004. Hand Book of Fungi. Reprint Publication, India.
8. Ulloa, M. and R.T. Hanlin. 2000. Illustrated Dictionary of Mycology, American Phytopathological Society, St. Paul, Minnesota, USA.
9. Webster, J. and R. Weber. 2007. Introduction to Fungi. Cambridge University Press.

## **6. INTRODUCTION TO PLANT PARASITIC NEMATODES**

**Credit Hours: 3(2-1)**

**Prerequisites:** Introductory Plant Pathology

### **Objectives:**

To acquaint the students with basic and applied aspects of plant parasitic nematodes

### **Course Contents:**

#### **Theory**

Introduction and importance of plant parasitic nematodes; Nematode morphology, anatomy and their various systems including digestive, reproductive and nervous; taxonomy of plant parasitic nematodes; Nematode feeding habits, types of plant parasitic nematodes according to feeding habits and cellular changes brought during feeding; Impact of important nematodes on plant health and their management.

#### **Practical**

Sampling, extraction, staining and identification of nematodes from soil and infested plant materials; Preparation of temporary and permanent slides to study morphological features of nematodes; Staining of nematodes and their egg masses in roots; Demonstration of nematode inflicted foliage and root symptoms.

### **Recommended Books:**

1. Agrios, G.N. 2005. Plant Pathology. 5<sup>th</sup> edition. Academic Press.
2. Bridge, J. and J.L. Starr. 2007. Plant Nematodes of agriculture

- importance: A color hand book. Manson Publishing.
3. Dropkin, H.V. 1980. Introduction to Plant Nematology. A Wiley-Interscience Publication, New York.
  4. Hunt, D.J. 1993. Aphelenchida, Longidoridae and Trichodoridae: Their Systematics and Bionomics. CABI Publishing.
  5. Noe, P. J. 2003. Plant-parasitic Nematodes. pp 61-67. In: Plant Pathology: Concepts and Laboratory Exercises. R. N. Trigiano, M. T. Windham, and A. S. Windham. (Eds.). CRC Laboratory Press, USA.
  6. Noe, P.J. 2003. Pathogenicity and Isolation of Plant-parasitic Nematodes. pp 69-73. In: Plant Pathology: Concepts and Laboratory Exercises. R. N. Trigiano, M. T. Windham, and A. S. Windham. (Eds.). CRC Press, USA.
  7. Saeed, M. 1990. Development of Phytonematology in Pakistan. pp 515-525. In: Progress in Plant Nematology. S. K. Saxena, A. Rashid, and R. M. Khan. (Eds.). CBS Publications Pvt. Ltd. Delhi.
  8. Siddiqui, M.R. 2000. Tylenchida: Parasites of Plants and Insects. 2nd ed. Wallingford, CABI Publishing.

## **7. BENEFICIAL MICROORGANISMS**

**Credit Hours: 3(2-1)**

**Prerequisites:** Introductory Plant Pathology

**Objectives:**

To acquaint the students with beneficial aspects of microbes

**Course Contents:**

### **Theory**

Introduction to beneficial microorganisms; Role of microorganisms in bioremediation and biodegradation of agricultural and industrial by-products/wastes; Use of microorganisms (bacteria, cyanobacteria, nematodes and fungi inclusive of mycorrhizae) in bio-geochemical cycling and biocontrol of plant diseases; Cultivation of edible fungi and yeasts.

### **Practical**

Isolation and identification of microorganisms from various substrates and screening of industrially important microbes; Isolation, identification and mass multiplication of mycorrhizal fungi; Demonstration of antagonism, competition and antibiosis; Isolation and identification of nitrogen fixing bacteria; Spawn production and cultivation of edible mushrooms; Identification of edible and poisonous mushrooms.

**Recommended Books:**

1. Bahl, N. 1988. Handbook on Mushroom. 2<sup>nd</sup> edition. Oxford and IBH Publishing Company New Delhi, India.
2. Burges, H.D. 1998. Formulation of microbial biopesticides: beneficial

microorganisms, nematodes and seed treatments. Kluwer Academic press.

3. Chang, S.T. and P.G. Miles. 2004. Mushroom cultivation, nutritional value, medicinal effect and environmental impact. CRC Press, NYC, USA.
4. Nasim, G. and R. Bajwa. 2010. Glomalean spore flora of Pakistan. HEC, Islamabad, Pakistan.
5. Podila, K. and D.D. Douds, 2000. Current advances in mycorrhizae research. APS Press, USA.

## **8. DISEASES OF FIELD CROPS**

**Credit Hours: 3(2-1)**

**Prerequisites:** Introductory Plant Pathology

**Objectives:** To study the important diseases of field crops and their management

**Course Contents:**

### **Theory**

Importance of field crop diseases; detailed study of symptoms, etiology, nature and extent of losses; disease cycle, methods of perpetuation, epidemiology and management of major diseases of cereal, pulses, fodder, oil seed, fiber and sugar crops; integrated crop and disease management; field sanitation program and good agricultural practices (GAP).

### **Practical**

Field surveys; collection, preservation of diseased specimens; identification of diseases based on symptoms and microscopic studies; isolations of major pathogens of above mentioned crops.

### **Recommended Books:**

1. Bhutta. A.R. 2010. Text book of Introductory Seed Pathology. HEC Pakistan.
2. Compendia of wheat, barley, rice, maize, cotton, sorghum, pea, peanut diseases. American Phytopathological Society, St. Paul, Minnesota, USA.
3. Dickson, J. G. 2008. Diseases of Field Crops Biotech Books; Reprint of McGraw Hill.
4. Gupta, G. P. 2004. Textbook of Plant Diseases. DPH, India.
5. Hafiz, A.1986. Plant Diseases. Pakistan Agricultural Research Council, Islamabad.
6. Mew, T. W. and P. Gonzales. 2002. A Hand Book of Rice Seed Borne Diseases. IRRI, Science Publication, Philippine.
7. Nyal. R. F. 1989. Field Crops Disease Handbook. AVI Publishing Company Inc. Westport, Connecticut, USA.
8. Rangaswami, G. and A. Mahadevan. 2004. Diseases of Crop Plants in

- India. Prentice Hall, India.
9. Sharma R. S. 2000. Plant Disease. Campus Book International, Delhi, India.
  10. Vidhyasekram, P. 2004. Concise Encyclopedia of Plant Pathology. Kaganviva, India.
  11. Zadoks, J.C. 2004. Modern Crop Protection. International Book Distribution Co, India.

## **9. INTRODUCTORY FOREST PATHOLOGY**

**Credit Hours: 3(2-1)**

**Prerequisites:** Introductory Plant Pathology

### **Objectives:**

To introduce students on range and forest diseases and their management

### **Course Contents:**

#### **Theory**

Economic importance of forest and shade tree diseases; development, epidemiology and management of important forest and shade tree diseases caused by biotic and abiotic agents; management of forest nursery diseases; mycorrhizae, their significance and application in forestry; management of important tree diseases in Pakistan.

#### **Practical**

Visit to forest plantation; collection of disease samples and identification based on symptoms and identification of causal agents of important diseases in tree deterioration of timber and other forest trees; preservation of specimens of tree diseases; seed health testing of forest and shade tree seed; seed treatment and their effect on nursery seedlings/plants.

### **Recommended Books:**

1. Bhutta. A.R. 2010. Text book of Introductory Seed Pathology. HEC Pakistan.
2. Khan, A.H. 1989. Pathology of Trees, Vol. II, Univ. of Agriculture, Faisalabad.
3. Manion, P.D. 1991. Tree Disease Concepts, 2<sup>nd</sup> Ed. Prentice Hall.
4. Sharma, R.C. and G.N. Sharma. 2006. Challenging Problems in Horticultural and Forest Pathology. Indus Publishing Company, India.
5. Sharma, V.K. 2004. Trees and Protection of Environment. Deep and Deep Publication (Pvt.) Ltd. India.
6. Strouts, R.G. and T.G. Winter. 1994. Diagnosis of ill-health in trees. HMS Office. London.
7. Tainter, F.H. and F.A. Baker. 1996. Principles of Forest Pathology. John Wiley & Sons. USA.

8. Zabel, R. and J.J. Morell, 1992. Wood Microbiology: Decay and its Preservation. Academic Press, San Diego. California, USA.

## **10. DISEASES OF VEGETABLE CROPS**

**Credit Hours: 3(2-1)**

**Prerequisites:** Introductory Plant Pathology

### **Objectives:**

To study basic and applied aspects of economically important diseases of vegetable crops of Pakistan

### **Course Contents:**

#### **Theory**

Importance and symptoms of various vegetable diseases; disease cycle; methods of perpetuation and control of major diseases of okra, pea, solanaceous (chilies, potato, tomato, eggplant), crucifers (radish, turnip, cabbage, cauliflower), cucurbits (gourd, cucumber, squash, melon), bulbs (onion, garlic), lettuce, spinach, carrot and non traditional vegetables

#### **Practical**

Identification of diseases on the basis of symptoms and isolation of pathogens; Field visits, collection and preservation of diseased specimens; preparation of permanent mounts.

### **Recommended Books:**

1. Bhutta. A.R. 2010. Text book of Introductory Seed Pathology. HEC Pakistan.
2. Compendia of cucurbits, onion and garlic, potato, tomato and pea diseases. American Phytopathological Society, St. Paul, Minnesota, USA.
3. Dixon, D.R. 1981. Vegetable Crop Diseases. McMillan Press, London, UK.
4. Gupta, V.K. and Y.S. Paal. 2001. Diseases of vegetables crops. Kalyani Publishers, New Dehli, India.
5. Hafiz, A. 1986. Plant Diseases. Pakistan Agricultural Research Council, Islamabad, Pakistan.
6. Koike, S., P. Gladders and A. Paulus. 2006. Vegetable Diseases: A Colour Handbook Manson Publishing Ltd.
7. Leslie, A.R. 1994. Handbook of Integrated Pest Management for Fruit and Ornamentals. CRC Press, London.
8. Mukerji, K.G. 2004. Fruit and Vegetable Diseases. Springer.
9. Naqvi, S.A.M.H. 2004. Diseases of Fruits and Vegetables: Diagnosis and Management. Vol. 1 & 2. Kluwer Academic Publishers.
10. Sherf, A. F. and A. A. MacNab.1986. Vegetable Diseases and their



## **11. PLANT RESISTANCE TO DISEASES**

**Credit Hours: 3(2-1)**

**Prerequisites:** Introductory Plant Pathology

### **Objectives:**

To introduce students about various resistance mechanisms involved in plant against pathogens.

### **Course Contents:**

#### **Theory**

Importance of plant resistance against various pathogens; types and mechanisms of resistance; transgenic approaches for crop protection; induced systemic resistance; screening of germplasm and resistance mitigation by using different rating scales/parameters and disease modeling.

#### **Practical**

Preparation of inocula; inoculation techniques for various plant pathogens; demonstration of hypersensitive reaction, resistance and susceptibility; screening of germplasm in field and green house against major plant pathogens by using different rating scales/parameters and disease modeling.

### **Recommended Books:**

1. Agrios, G.N. 2005. Plant Pathology, 5<sup>th</sup> edition, Academic Press, New York, USA.
2. Boland, G.J., L. David and Kuykendall. 1998. Plant Microbe Interactions and Biological Control. Marcel Dekker, Inc, USA.
3. Moore, D. and L.A.N. Frazer. 2002. Essential Fungal Genetics. Springer Verlag, New York, USA.
4. Punja, Z.K. and Z. Punja. 2004. Fungal Disease Resistance in Plants Biochemistry, Molecular Biology, and Genetic Engineering. CRC Press.
5. Russel, G.C. 1981. Plant Breeding for Pest and Disease Resistance Butterworths and Company, Ltd., London, UK.
6. Sadasivan, S. and B. Thayumanavan. 2003. Molecular Host Plant Resistance to Pest. Marcel Dekker, USA.
7. Singh, D. P. 2002. Breeding for Resistance to Biotic Stress, International Books Distribution Co. India.
8. Slusarenko, A.J., R.S.S. Fraser and L.C. Van Loon. 2000. Mechanisms of Resistance to Plant Diseases. Kluwer Academic Publishers.
9. Staples, C.R. and G.H. Toenniessen. 1981. Plant Disease Control Resistances and Susceptibility. John Wiley & Sons, Inc. New York, USA.
10. Stubbs, R.W., J.M. Prescott, E.E. Sarri and H.J. Dubin. 1986. Cereals

## **12. SOIL BORNE PLANT PATHOGENS AND THEIR MANAGEMENT**

**Credit Hours: 3(2-1)**

**Prerequisites:** Introductory Plant Pathology

### **Objectives:**

To acquaint students with basic concepts of soil-borne plant pathogens and their management

### **Course Contents:**

#### **Theory**

Importance of soil borne diseases; introduction to soil borne plant pathogenic fungi, bacteria, nematodes and viruses; survival mechanism of soil borne plant pathogens; interaction between soil borne plant pathogens; effect of soil edaphic factors on soil borne pathogens; interaction of soil borne pathogens with saprophytic soil microorganisms; management of soil-borne pathogens through chemicals, bio-control agents, plastic mulching and other cultural methods

#### **Practical**

Techniques for isolation and identification of soil borne pathogens; *in vitro* evaluation of chemical, physical and biological methods for the management of soil borne pathogens; demonstration of different methods for management of soil borne pathogens

### **Recommended Books:**

1. Ashok, P. and K.G. Mukerji. 2007. Biological Control of Plant Diseases. CRC Press.
2. Boland, G. and L. Bolis. 1998. Plant-microbe Interactions and Biological Control. CRC Press.
3. Bruehl, G.W. 1987. Soilborne Plant Pathogens. Free Press.
4. Gnanamanickam, S.S. 2002. Biological Control of Crop Diseases. Marcel Dekker, Inc.
5. Hillocks, R.J. and J.M. Waller. 1997. Soilborne Diseases of Tropical Crops. CABI, UK.
6. Jenkins, R. and C.K. Jain. 2010. Advances In Soil-borne Plant Diseases. Oxford Book Co., India.
7. Naik, M.K. and G.S. Devikarani, 2008. Advances in Soil-borne Plant Diseases. New India Publishing Agency Delhi India.

## **13. PLANT DISEASE DIAGNOSIS**

**Credit Hours:** 3(1-2)

**Prerequisites:** Introductory Plant Pathology

### **Objectives:**

To impart knowledge about concepts and techniques of plant disease diagnosis

### **Course Contents:**

#### **Theory**

Plant disease clinic and its requirements; Expert-client interaction; Methods for collection, handling, transport and preservation of disease specimens; Equipment, glassware, chemicals and reagents for plant disease clinic; Diagnostic protocols; Isolation and identification of plant pathogens from disease samples; Maintenance and preservation of cultures; Pre- and post-harvest handling to reduce losses in vegetables and fruits.

#### **Practical**

Isolation, identification and characterization of the causal agents from disease samples; Recommendations and report preparation for the clients; Maintenance and preservation of cultures.

### **Recommended Books:**

1. Ahmad, I., M. Aslam and A. Munir. 1992. Phytopathological Diagnostic Techniques. Pakistan Agricultural Research Council, Islamabad, Pakistan.
2. Bashir, M. and S. Hassan. 1998. Diagnostic methods for plant viruses. PARC, Islamabad.
3. Fox, R.T.V. 1994. Principles of Diagnostic Techniques in Plant Pathology. CAB International, UK.
4. Hampton, R., E. Ball and DeBoer, S. 1990. Serological methods for detection and identification of viral and bacterial plant pathogens - A Laboratory Manual. American Phytopathological Press, Saint Paul, Minnesota, USA
5. Hawksworth, D.L. 2000. Plant pathologist pocket book 3<sup>rd</sup> ed. IMI, Egham, UK.
6. Naqvi, S.A.M.H. 2004. Diseases of Fruits and Vegetables: Diagnosis and Management vol. 2. Springer.
7. Narayanasamy, P. 2001. Plant Pathogen-Detection & Disease Diagnosis. 2<sup>nd</sup> ed. CRC Press.
8. Schots, A., F.M. Dewey and F. Oliver. 1994. Modern Detection Assays for Plant Pathogenic Fungi. CAB International, UK.
9. Walker, J.M. 1998. Plant clinic handbook. CAB International. Ferry lane, Kew, UK.

## **14. DISEASES OF FRUITS AND ORNAMENTALS**

**Credit Hours: 3(2-1)**

**Prerequisites:** Introductory Plant Pathology

### **Objectives:**

To study basic and applied aspects of economically important diseases of fruit and ornamental plants and their management

### **Course Contents:**

#### **Theory**

Importance, symptoms, disease cycle, methods of perpetuation; management of major diseases of tropical (banana and papaya), subtropical (guava, mango and citrus) and temperate (pome, stone and nut fruits, grapes) fruits and common ornamental plants.

#### **Practical**

Field visits, collection and preservation of diseased specimens; Identification of diseases on the basis of symptoms; isolation of pathogens and preparation of permanent mounts; orientation with management practices.

#### **Recommended Books:**

1. Alford, D.V. 2003 A Color Atlas of Pests of Ornamental Trees, Shrubs, and Flowers [Illustrated]. Timber Press.
2. Chase A. R. 1987. Compendium of foliage ornamental plant diseases. APS USA.
3. Compendia of apple and pear, citrus, grapes, stone fruits and tropical fruits diseases. American Phytopathological Society, St. Paul, Minnesota, USA.
4. Compendium of ornamental plants, Foliage plant diseases, 1988. American Phytopathological Society, St. Paul, Minnesota, USA.
5. Gupta, V.K. and S.K. Sharma. 2000. Diseases of fruit crops. Kalyani Publishers New Delhi, India
6. Leslie, A.R. 1994. Handbook of Integrated Pest Management for Fruit and Ornamentals. CRC Press, London.
7. Machardv, W.E. 1996. Apple Scab. Biology, Epidemiology and Management. American Phytopathological Society, St. Paul, Minnesota, USA.
8. Pathak, V.N. 1981. Diseases of Fruit Crops. Oxford and IBH Publishing Company, New Delhi, India.
9. Ploutz, R.C. 2003. Diseases of Tropical Fruit Crops. CABI – UK.
10. Singh, R.S. 2001. Diseases of Fruit Crops. Science Publ. Inc.
11. Stefrud, A. 2005. Diseases of Fruits and Nuts. Biotech Book, Delhi.

## **15. SEED AND POST HARVEST PATHOLOGY**

**Credit Hours: 3(2-1)**

**Prerequisites:** Introductory Plant Pathology

### **Objectives:**

To study seed borne and post harvest diseases and their management

### **Course Contents:**

#### **Theory**

Morphology and anatomy of healthy and infected seed; seed-borne diseases and their effect on seed germination and planting value; histopathology of infected seed; seed transmission of pathogen and mechanism of infection; effect of biotic and abiotic stresses and storage/ transit conditions on shelf life of seed and perishables; seed health testing; mycotoxins and their hazards; types of post harvest losses, economic importance of post harvest in seed, fruit and vegetables. Factor effecting post harvest losses (physical, physiological, biochemical and pathological concentration); management of seed and post harvest diseases; storage structure and method of storage at farm and public level; inspection and suitability of building and commodity; grain storage management and fumigation technology.

#### **Practical**

Seed health testing - different techniques of isolation and identification of microorganisms associated with seeds and their effect on germination; post harvest losses estimation/ assessment. Visit of cold storage and food storage; collection and identification of biotic and abiotic disease specimen/sample of perishables; use of safe chemicals for management of seed and post-harvest diseases; demonstration of spray and fumigation.

#### **Recommended Books:**

1. Bartz, J.A. and J.K. Brecht. 2002. Post-harvest Physiology and Pathology of Vegetables. Marcel Dekker. India
2. Bhutta, A.R. and I. Ahmad. 2001. Seed Pathological Techniques and their Application. National Book Foundation, Islamabad, Pakistan
3. Bhutta, A.R., A. Hussain and M.R. Rahman. 2004. Hand book on Seed Processing and Storage. Federal Seed Certification and Registration Department, Islamabad, Pakistan.
4. Bhutta.A.R. 2010. Text Book of Introductory Seed Pathology. HEC, Pakistan.
5. Dennis, S.H. 2002. Pests of stored foodstuffs and their control. Kluwer Academic publishers. India
6. Gullino, M.L. and D. Prusky. 2009. Post-Harvest Pathology (Plant Pathology in the 21st Century). Springer.

7. Singh, T. and K. Agrawal. 2001 Seed Technology and Seed Pathology. Pointer Publishers, India

## **16. PLANT DISEASE MANAGEMENT**

**Credit Hours: 3(2-1)**

**Prerequisites:** Introductory Plant Pathology

### **Objectives:**

To introduce the students about plant disease management practices

### **Course Contents:**

#### **Theory**

Principles and methods of plant disease management based on avoidance, exclusion, eradication of pathogens, protection (preventive and curative) and resistance (pathogen derived resistance, host resistance); Management of plant diseases with emphasis on regulatory, cultural, biological, physical and chemical strategies; integrated disease management (IDM) seed health certification system; philosophy of TOF (Training of Facilitators) and FFS (Farmer Field School); epidemiological basis of disease management strategies, concept of field biodiversity, conservation and crop appraisal.

#### **Practical**

Demonstration of different disease management practices; Equipment and machinery used for disease management and their calibration; safety measures for disease managing chemicals; handling and application procedures; Crop Agro Ecosystem Analysis.

### **Recommended Books:**

1. Agrios. G.N. 2005. Plant Pathology 5<sup>th</sup> ed. Academic Press New York.
2. Ahmad, I. and A.R. Bhutta. 2005. Textbook of Introductory Plant Pathology. National Book Foundation, Islamabad, Pakistan.
3. Atwal, A.S and G.S. Dhaliwal. 2008. Agricultural Pests of South East Asia and their Management. Kalyani Publishers, Ludhiana. India
4. Bhutta, A.R. 2010. Text book of Introductory Seed Pathology. HEC, Pakistan.
5. Gadewarr, A.V. 2006. Plant protection in new millennium. Vol.1. Hardcover Publisher.
6. Helyer, N., K. Brown and N.A. Cattlin. 2003. Biological Control in Plant Protection (A Colour Hand Book). Manson Publication Ltd, London, UK.
7. Narayanasamy, P. 2008. Molecular Biology in Plant Pathogenesis and Disease Management: Disease Management. Volume 3. Springer.
8. Singh, R.S. 2001. Plant Disease Management. Science Pub. Inc. India.

## 17. INTRODUCTORY MOLECULAR PLANT PATHOLOGY

**Credit Hours:** 3(2-1)

**Prerequisites:** Introductory Plant Pathology

### **Objectives:**

To acquaint the students with basic concepts and techniques of molecular plant pathology

### **Course Contents:**

#### **Theory**

Introduction to molecular techniques and their application; Molecular mechanisms of pathogenesis with a focus on plant diseases; Molecular biology of host parasite interaction and biochemical mechanisms of pathogenesis; Molecular approaches to control pathogens.

#### **Practical**

Methods in molecular plant pathology including the use of molecular approaches to investigate plant diseases; Familiarization to common molecular techniques used in plant pathology including DNA/ RNA isolation, hybridization, sequence analysis, various PCR reactions, library construction and screening, protein isolation and plant transformation.

#### **Recommended Books:**

1. Ansari, T.M. 2008. Molecular Plant Pathology. Pearl Books, India.
2. De Roberties, E.D.P. and E.M.T. DeRoberties, Jr. 1992. Cell and Molecular Biology. 8th ed. John Willey & Sons, USA.
3. Desi, L. 2007. Molecular Plant Pathology. Paragon International.
4. Devi, P. 2005. Principles and Methods of Plant Molecular Biology, Biochemistry, Biotechnology and Genetics. Student Edition, India.
5. Gurr, S.J., M.J. Pherson and D.J. Bowles. 1991. Molecular Plant Pathology: A Practical Approach. Oxford University Press.
6. Hafeez, F., Y. Zafar and A. M. Khalid. 2005. Modern Techniques in Biotechnology. A Theoretical Manual. NIBGE, Faisalabad.
7. Lakshman, D. 2007. Molecular Plant Pathology. Paragon, International Publishers.
8. Mathew, J.D. 2003. Molecular Plant Pathology. Bios Scientific Publishers, Ltd., UK.
9. Pena, L. 2005. Transgenic Plants. Methods and Protocol. Humana, USA.
10. Rastogi, S.C. 2006. Cell and Molecular Biology. New Age Publications (Academic).

## **18. PLANT DISEASE EPIDEMIOLOGY**

**Credit Hours: 3(2-1)**

**Prerequisites:** Introductory Plant Pathology

### **Objectives:**

To study the development of plant disease epidemics

### **Course Contents:**

#### **Theory**

Introduction, history, importance and types of plant disease epidemics; Principles and components of epidemics; factors influencing dynamics of epidemics; Monitoring of plant disease epidemics; Epidemic growth curve and growth rate; Forecasting of Epidemics and their modeling; Disease warning systems.

#### **Practical**

Recording temperature, humidity and rain. Use of expert systems for monitoring epidemic development; Crop loss assessment methods.

### **Recommended Books:**

1. Agrios. G.N. 2005. Plant Pathology. 5<sup>th</sup> Ed. Academic Press N.Y. USA.
2. Campbell, C.L. and L.V. Modden. 1990. Introduction to Plant Disease Epidemiology. John Wiley & Sons, Inc. New York, USA.
3. Kranz, J. 2002. Comparative Epidemiology of Plant Diseases. Springer;
4. Kranz, J., 1990. Epidemics of Plant Diseases: Mathematical Analysis and Modeling. Springe Publ. London, UK.
5. Leonard, J.F. and D.A. Neher. 1997. Exercises in Plant disease Epidemiology. American Phytopathological Society Press, St. Paul, Minnesota, USA.
6. Savary, S. and B.M. Cooke. 2006. Plant Disease Epidemiology: Facing Challenges of the 21<sup>st</sup> Century: Under the aegis of an International Plant Disease Epidemiology Workshop held at Landernau, France, 10-15th April, 2005. Springer.

## **19. PESTICIDES - THEIR APPLICATION AND ACTION**

**Credit Hours: 3(2-1)**

**Prerequisites:** Introductory Plant Pathology

### **Objectives:**

To study the pesticides - their application and mode of action in plants

### **Course Contents:**

#### **Theory**

Introduction and history of pesticides; major groups of pesticides and their



classification; Formulation and mode of action; Residues, resistance and phytotoxicity problems of pesticides (fungicides, bactericide, and nematicides, etc.); Equipment and different methods of application; FAO code of conduct for pesticide use and handling; Pesticide regulation in Pakistan; Major hazards of pesticides and their safety measures.

### **Practical**

Demonstration of different groups of pesticides used for control of plant diseases; Preparation and formulation; Use of various equipment and their calibration; *In vitro* comparison of systemic and protectant pesticides; Visits of pesticides testing labs and warehouses; Protective measures and first aid.

### **Recommended Books:**

1. Biddle, A. 2001. Seed Treatment, Challenges and Opportunities. The BCPC Publications, UK.
2. Harris, J. 2000. Chemical Pesticide Markets, Health Risks and Residues. CABI, UK.
3. Jorgen, S. 2004. Chemical Pesticide. Mode of action and Toxicology. CRC Press, London.
4. Mathews, G.A. and M.A. Meladen. 2000. Pesticides Application Methods. 3<sup>rd</sup> ed. Blackwell Science Publication, New York.
5. Parmar, B.S. and S.S. Tomar. 2003. Pesticides Formulation. Theory and Practices. CBS Publ. Co. India.
6. Robert, T. 2000. Metabolism of Agro-chemicals in Plants. John Willey & Sons. USA.
7. Thompson, W.T. 1993. Agricultural Chemicals. Book IV. Fungicide. California, USA.
8. Tomlin, C. 2003. The Pesticide Manual. 13<sup>th</sup> Edition. BCPC – UK.

## **20. ABIOTIC DISEASES OF PLANTS**

**Credit Hours: 3(2-1)**

**Prerequisites:** Introductory Plant Pathology

### **Objectives:**

To acquaint students with the basic concepts of abiotic plant diseases and their management

### **Course Contents:**

#### **Theory**

Types of abiotic stresses (temperature, soil moisture and light conditions, lack of oxygen, pollution, mineral deficiencies and toxicities, soil pH and improper cultural practices, etc.); Symptomatology (differentiating features from biotic diseases); Macro and micro nutrients and their effect on plants; Management of major abiotic diseases.

## **Practical**

Collection of samples of abiotic diseased plants, identification and preservation. Studies on effect of abiotic factors on plants and their management.

## **Recommended Books:**

1. Bergstron, L. and H. Kirchmann. 1998. Carbon and nutrient dynamics in natural and agricultural tropical ecosystem. CAB Inc. UK.
2. Haard, N.F. and D.K. Salunkle. 1980. Symptoms on post harvest biology and handling of fruits and vegetables. The AUI Publishing Co. Inc. West Post Connecticut, USA.
3. Hill, M.K. 2004. Understanding Environmental Pollution, 2<sup>nd</sup> Ed., Cambridge Press, UK.
4. Shurtleff, M.C. and C.W. Averre. 1997. The Plant Disease Clinic and Field Diagnosis of Abiotic Diseases. American Phytopathological Society Press, St. Paul, Minnesota, USA.
5. Tandov, H.L.S and R.N. Roy. 2004. Integrated Nutrient Management. A Glossary of Terms. FAO, UN, Rome.

## **21. METHODS AND TECHNIQUES IN PLANT PATHOLOGY**

**Credit Hours: 3(1-2)**

**Prerequisites:** Introductory Plant Pathology

### **Objectives:**

To acquaint students with different plant pathological research techniques

### **Course Contents:**

#### **Theory**

Problem identification; hypothesizing; defining objectives; Collection, handling, transport, processing and preservation of disease specimens; Protocols and procedures used for the isolation, identification, purification, multiplication and preservation of plant pathogens; Demonstration of Koch's postulates; Microscopic, histo-pathological, serological and molecular techniques; Experimental layout, data collection, statistical analysis interpretation and report writing.

#### **Practical**

Methods of collection and preservation of plant disease specimens; Media Preparation; Isolation and identification of different plant pathogens; preparation of temporary and permanent slides; microphotography and micrometry of plant pathogens; Maintenance and preservation of cultures; Histo-pathological, serological and molecular methods; Experimental layout, data collection, statistical analysis interpretation.

## **Recommended Books:**

1. Ahmad, I., M. Aslam and A. Munir. 1992. Phytopathological Diagnostic Techniques. Pakistan Agricultural Research Council, Islamabad, Pakistan.
2. Aneja, K.R. 2003. Experiments in Microbiology, Plant Pathology and Biotechnology. New Age International (Pvt.) Ltd. New Delhi. India.
3. Bashir, M. and S. Hassan. 1998. Diagnostic Methods for Plant Viruses, PARC, Islamabad.
4. Bhutta, A.R. and I. Ahmad. 2001. Seed Pathological Techniques and their Application. National Book Foundation, Islamabad, Pakistan.
5. Burns. R. 2008. Plant Pathology; Techniques and Protocols (Methods in Molecular Biology). Humana Press
6. Foster, G.D., I.E., Johansen, Y. Hong and P.D. Nagy. (Ed). 2008. Plant Virology Protocols - From Viral Sequence to Protein Function (2nd edition). Humana Press
7. Malcolm C.S. and W.A. Charles. 2000. Diagnosing Plant Diseases Caused by Nematodes. American Phytopathological Society Press, St. Paul, Minnesota, USA.
8. Narayanasamy, P. 2001. Plant Pathogen Detection and Disease Diagnosis (2<sup>nd</sup> ed.). Marcel Dekker.
9. Schaad, N.W., J.B. Jones and W. Chun. 2001. Laboratory Guide for Identification of Plant Pathogenic Bacteria, Third Edition. American Phytopathological Society Press, St. Paul, Minnesota, USA.
10. Sinclair, J. B., & Dhingra, O. D. 1995. Basic Plant Pathology Methods. CRC Press USA.
11. Trigiano, R.N., M.T. Windham and A.S. Windham. 2007. Plant Pathology Concepts and Laboratory Exercises, Second Edition

## **22. INTERNSHIP / PROJECT STUDY**

**Credit Hours: 4(0-4)**

**Prerequisites:** Introductory Plant Pathology

### **Objectives:**

It is intended to apprise students of the basis of how to conduct research as well as technical report writing and presentation. Further, it covers a wide spectrum of experiments designed for students at undergraduate level. The experiments are selected to provide insight to the students into the basic principles and techniques of plant pathology.

### **Course Contents:**

#### **Theory**

Proposal development, on spot field training and report writing and project presentation. (Format as per thesis manual of the university concerned).

### **Recommended Books:**

Relevant latest literature on target issues.

**SCHEME OF STUDIES  
FOR POSTGRADUATE PROGRAMS  
(M.S & Ph. D)**

**LIST OF COURSES**

<b>S.NO.</b>	<b>TITLE OF COURSES</b>	<b>Cr. Hr.</b>
1.	Fungal Systematics	3(2-1)
2.	Fungal Plant Pathology*	3(2-1)
3.	Plant Virology*	3(2-1)
4.	Plant Bacteriology*	3(2-1)
5.	Plant Nematology*	3(2-1)
6.	Ecology and Epidemiology of Plant Diseases	3(2-1)
7.	Biochemistry and Physiology of Diseased Plants	3(2-1)
8.	Genetics of Plant Pathogens	3(3-0)
9.	Seed Pathology	3(2-1)
10.	Integrated Plant Disease Management	3(2-1)
11.	Post Harvest Pathology	3(2-1)
12.	Biology and Cultivation of Edible Fungi	3(2-1)
13.	Insects in Relation to Plant Diseases	3(2-1)
14.	Forest and Shade Tree Pathology	3(2-1)
15.	Urban Plant Pathology	3(2-1)
16.	Plant Quarantine and SPS measures	3(2-1)
17.	Advances in Plant Pathology	3(2-1)
18.	Molecular Plant Virology	3(2-1)
19.	Molecular Plant Microbe Interactions	3(2-1)
20.	Biological Control of Plant Pathogens	3(2-1)
21.	Special Problem	1(1-0)
22.	Seminar-I (M. Sc (H) Thesis)	1(1-0)
23.	Research Thesis (M. Sc (H))	10 (0-
24.	Seminar-II (Ph. D Synopsis)	1(1-0)
25.	Seminar -III (Ph. D Thesis)	1(1-0)
26.	Research Thesis (Ph. D)	20(0-20)

\*Core courses for M. Sc (Hons) Specialization in Plant Pathology

# **DETAIL OF COURSES FOR POST-GRADUATE PROGRAMS M.S (HONS) / PH. D IN PLANT PATHOLOGY**

## **1. FUNGAL SYSTEMATICS**

**Credit Hours: 3(2-1)**

Prerequisites: B. Sc. (Hons) Agriculture specialization in Plant Pathology

### **Objectives:**

To study taxonomy and nomenclature of fungi of agricultural importance

### **Course Contents:**

#### **Theory**

Introduction to fungal systematics; Diversity of Fungi and Fungi-like organisms; Concept of speciation in fungi; Rules for fungal nomenclature; Morphological, physiological and chemical characters as criteria for fungal classification; Morphology-based systems for classification of fungi and fungi-like organisms; Application of DNA Sequence Analysis to Phylogenetic Studies; Different Tree-Making Methods for Molecular Data; Weighted Parsimony; Parsimony and Phylogenetic Inference using DNA sequences; Statistical Methods for Testing Molecular Phylogenies; Recent classification of fungi and fungi-like organisms on the basis of molecular phylogeny.

#### **Practical**

Use of diagnostic keys for the identification of various groups of fungi up to species level; Speciation on the basis of molecular techniques; Homology and Phylogenetic Weighting; Use and Comparison of Different Tree-Making Methods for Molecular Data.

#### **Recommended Books:**

1. Alexopoulos, C.J., C.W. Mims and M. Blackwell. 1996. Introductory Mycology. 4th edition, John Wiley & Sons, Inc. New York, USA.
2. Cannon, P.F., P.M. Kirk, D.W. Minter and J.A. Stalpers. 2008. Dictionary of Fungi. 10<sup>th</sup> ed. CABI. England.
3. Dilip K., P.D. Arora, P.D. Bridge and D. Bhatnagar. 2004. Handbook of fungal biotechnology, Volume 20. Marcel Dekker.
4. Frisvad, J.C., D.K. Arora and P.D. Bridge. 1998. Chemical Fungal Taxonomy. Marcel Dekker
5. Jacobs, P.H. and N. Lexie. 1997. Fungal disease: biology, immunology, and diagnosis. CABI, U.K.
6. Miyamoto, M.M. and J. Craft. 1991. Phylogenetic Analysis of DNA Sequences. Oxford University Press.
7. Rai, M. and P.D. Bridge. 2009. Applied Mycology. CABI, England.
8. Reynolds, D.R. and J.W. Taylor. 1993. The Fungal Holomorph: Mitotic, Meiotic and Pleomorphic Speciation in Fungal Systematics. CABI, UK.

9. Swanton, E.W. 2004. Hand Book of Fungi. Reprint Publication, India.
10. Webster, J. and R. Weber. 2007. Introduction to Fungi. Cambridge University Press.

## **2. FUNGAL PLANT PATHOLOGY**

**Credit Hours: 3(2-1)**

**Prerequisites:** B. Sc. (Hons) Agriculture specialization in Plant Pathology

### **Objectives:**

To study the fungal pathogens, pathogenesis and their management

### **Course Contents:**

#### **Theory**

History of fungal Plant Diseases; Losses Caused by plant pathogenic fungi; Survival and dissemination of plant pathogenic fungi; Stages in Establishment of infection by fungal pathogens; Mechanisms of host defense; Effects of pathogens on plant physiological functions; Symptoms caused by fungal pathogens; Relationships between Disease Cycles and Epidemics; Mechanisms and stages of Variation in fungal Pathogens; Genetics of Virulence in fungal Pathogens and Resistance in Host Plants; Chemical and non-chemical methods for disease management; Study and management of important diseases caused by various groups of fungi and fungi-like organisms.

#### **Practical**

Symptomatology of fungal plant diseases; Techniques for Isolation, identification, purification and preservation of fungal plant pathogens; Methods for confirmation of pathogenicity of various groups of plant pathogenic fungi; In vitro evaluation of fungicides and bio-control agents against fungal pathogens; Demonstration of chemical and non-chemical methods of plant disease management.

#### **Recommended Books:**

1. Agrios, G.N. 2005. Plant Pathology (5<sup>th</sup> ed.). Elsevier Academic Press Inc., New York.
2. Burns, R. 2008. Plant Pathology; Techniques and protocols (Methods in Molecular Biology). Humana Press
3. Calderone, R.A. and R.L. Cihlar. 2001. Fungal Pathogenesis - Principles and Clinical Applications Marcel Dekker October 2001
4. Hawksworth, D.L. 2000. Plant Pathologist's Pocket Book. 3rd edition, CMI Kew, Surrey, England.
5. Narayanasamy, P. 2008. Molecular Biology in Plant Pathogenesis and Disease Management. Springer.
6. Prell, H.H. and P. Day. 2001. Plant-Fungal Pathogen Interaction - A Classical and Molecular View. Springer Verlag.

7. Schumann, G. and C. D'Arcy. 2006. Essential Plant Pathology. APS Press.
8. Trigiano, R.N., M.T. Windham and A.S. Windham. 2007. Plant Pathology Concepts and Laboratory Exercises, Second Edition. CRC Press.
9. Warren, J.K. 2000. Fungal Pathology. Kluwer Academic Publishers.

### **3. PLANT VIROLOGY**

**Credit Hours: 3(2-1)**

**Prerequisites:** B. Sc. (Hons) Agriculture specialization in Plant Pathology

#### **Objectives:**

To study basic and advanced concepts of plant viruses and the diseases these produce

#### **Course Contents:**

##### **Theory**

History, scope of plant virology; taxonomy and nomenclature; effects of viruses on plants; Recent trends in virus transmission and movement in plants; structure of plant viruses; virus purification, replication, gene organization; Physiology of virus infected plants; virus-vector-host interactions; Host resistance to virus infection; Management of plant viruses; study of economically important viral diseases in Pakistan.

##### **Practical**

Field diagnosis of plant virus diseases; isolation and purification of plant viruses; Basic virus characterization; Serological techniques; Electron microscopy; Molecular techniques in virus detection.

#### **Recommended Books:**

1. Compendia of different crops, American Phytopathological Society, St Paul, Minnesota, USA.
2. Foster, G.D., I.E. Johansen, Y. Hong and P.D. Nagy. (Eds.). 2008. Plant Virology Protocols – From Viral Sequence to Protein Function 2<sup>nd</sup> Ed. Humana Press
3. Hadidi, A., R.K. Khetarpal and H. Koganezawa (Eds). 1998. Plant Virus Disease Control. American Phytopathological Society, St Paul, Minnesota, USA.
4. Hull, R. 2009. Comparative Plant Virology, 2<sup>nd</sup> Ed. Academic Press
5. Hull, R. 2002. Matthews' Plant Virology, Fourth Ed. Elsevier Ltd.
6. Loebenstein, G. and G. Thottappilly. (Eds.) 2004. Virus and Virus-like Diseases of Major Crops in Developing Countries. Springer
7. Matthews. R.E.F. 1991. Plant Virology. 3<sup>rd</sup> revised edition. Academic Press.

## **4. PLANT BACTERIOLOGY**

**Credit Hours: 3(2-1)**

**Prerequisites:** B. Sc. (Hons) Agriculture specialization in Plant Pathology

### **Objectives:**

To study basic and applied concepts of plant pathogenic and allied bacteria

### **Course Contents:**

#### **Theory**

Economic importance and characteristics of plant pathogenic bacteria; taxonomy and nomenclature, morphology, nutrition, growth and reproduction; Bacterial pathogenesis and symptomology; hypersensitive reaction and host-specificity; Ecology and spread of plant pathogenic bacteria; Study of important bacterial diseases in Pakistan and their management. Nitrogen fixing and nitrifying bacteria; Plant growth promoting rhizobacteria (PGPR); Effective microorganisms (EM)

#### **Practical**

Isolation, purification and identification of plant pathogenic bacteria on the basis of morphological, biochemical and molecular techniques; Inoculation techniques and pathogenicity tests; Demonstration of plant disease symptoms exhibited by bacteria/fastidious bacteria and mollicutes; Sensitivity tests; Characterization of bacteria using phages.

#### **Recommended Books:**

1. De Boer, S.H. 2001. Plant Pathogenic Bacteria. Kluwer Academic Publishers.
2. Fahy, P.C. and G.J. Persley. (eds.). 1983. Plant Bacterial Diseases: A Diagnostic Guide. Academic Press, New York, USA.
3. Goto, M. 1992. Fundamentals of Bacterial Plant Pathology. Academic Press Inc., USA.
4. Hampton, R., E. Ball and S. DeBoer. 1990. Serological Methods for Detection and Identification of viral and bacterial plant pathogens. A Laboratory Manual. American Phytopathological Society Press, Saint Paul, Minnesota, USA.
5. Jayarman, J. and J.P. Verma. 2002. Fundamentals of Plant Bacteriology. Kalyani Publishers, Ludhiana, India.
6. Janse, J.D. 2008. Phytobacteriology: Principles and Practice. CABI Publishing.
7. Klement, Z., K. Rudolph and D.C. Sands. 1990. Methods in Phytobacteriology. Akademiai Kiado, Budapest, Hungary.
8. Misra, R.S. 2003. Bacterial Plant Diseases. Discovery Publishers and Distributors, India.
9. Srivastava, M. 2006. Introductory Phytobacteriology. Advance Publishing Concept, New Delhi India.



## **5. PLANT NEMATOLOGY**

**Credit Hours: 3(2-1)**

**Prerequisites:** B. Sc. (Hons) Agriculture specialization in Plant Pathology

### **Objectives:**

To acquaint students with basic and applied concepts of plant parasitic nematodes

### **Course Contents:**

#### **Theory**

Importance of plant parasitic nematodes and threat to agriculture; Plant response to nematode; Environmental factors effecting survival and pathogenicity; Morphology, anatomy, and reproduction; Mode and mechanism of infection; Concepts and principles of population dynamics, genetics; estimation of crop losses; Nematode- microbe interactions; Management of plant parasitic nematodes.

#### **Practical**

Isolation, identification and permanent mounting of important plant parasitic nematodes; Pathogenicity tests; Collection handling and diagnosis of diseased plants by symptomology; Integrated management of plant parasitic nematodes.

#### **Recommended Books:**

1. Alam, M.M. and N. Sharma. 2002. Nematode Control in Crops. International Distributors, India.
2. Dropkin, V.H. 1989. Introduction to Plant Nematology. John Wiley & Sons, Inc., New York, USA
3. Ferraz, L.C. and D.J.F. Brown. 2002. An Introduction to Nematodes: Plant Nematology. Pensoft Publishers. Sofia Bulgaria
4. Luc, M., R.A. Sikora and J. Bridge. (Eds.) 2005. Plant Parasitic Nematodes in Subtropical and Tropical Agriculture. (2<sup>nd</sup> Ed.). CABI, London, UK.
5. Maqbool, M.A. and F. Shahina. 2001. Biodiversity of Nematode. Fauna in Pakistan. National Nematological Research Centre University of Karachi Pakistan.
6. Perry, R.N. and M. Moens. 2006. Plant Nematology. CABI London, UK.
7. Perry, R.N. and D.T. Wright. 1998. The Physiology and biotechnology of free living and plant parasitic nematode. Wallingford, CAB, Inc. UK.
8. Siddiqui, M.R. 2000. Tylenchida: Parasites of Plants and Insects. 2nd ed. Wallingford, CABI Publishing.
9. Trivedi, P.C. 1998. Recent Advances in Plant Nematology. CGS Publishers and Distributors, India

## **6. ECOLOGY AND EPIDEMIOLOGY OF PLANT DISEASES**

**Credit Hours: 3(2-1)**

**Prerequisites:** B. Sc. (Hons) Agriculture specialization in Plant Pathology

### **Objectives:**

To acquaint students with concepts of ecology and plant disease epidemics

### **Course Contents:**

#### **Theory**

Definition, history and development of epidemiology, principles and concepts; Effect of different environmental factors on plant pathogens; Ecological studies of different plant pathogens; Population dynamic studies of different plant pathogens; Influence of meteorological factors, host resistance and man-made hurdles on the development of epidemics; Survival and propagation of plant pathogens; Mapping of epidemic growth, analysis of epidemic growth curve and calculation of growth rate. Disease progression and Pattern of spread in nature (Spatial and Temporal); Loss estimation using prediction models.

#### **Practical**

Studies on the role of factors affecting disease development; Use of different techniques to create artificial epidemics in greenhouse or growth chamber; Calculation of severity of diseases by different procedures to monitor epidemics; plotting the growth curve by using different transformation procedures; monitoring disease; establishing prediction systems and executing control measures; use of agri-meteorological equipment and information.

#### **Recommended Books:**

1. Agrios, G.N. 2005. Plant Pathology. 5<sup>th</sup> Edition. Academic Press, New York.
2. Campbell, C.L. and L.V. Madden.1990.Introduction to Plant Disease Epidemiology. John Wiley Sons, Inc. New York.
3. Camphill, C.L. and L.V. Madden. 1990. Introduction to Plant Disease Epidemiology. John Wiley & Sons, Inc., New York, USA.
4. Cooke, B.M., D.G. Jones and B. Kaye. 2004. The epidemiology of plant diseases. Springer Verlag, New York, USA.
5. Frantzen, J. 2007. Epidemiology and Plant Ecology: Principles and Applications. World Scientific Publishing Company.
6. Kranz, J. 1990. Epidemics of Plant Diseases: Mathematical Analysis and Modeling. Springer Verlag, New York, USA.
7. Leonard, J.F. and D.A. Neher. 1997. Exercises in Plant Disease Epidemiology. American Phytopathological Society Press, Saint Paul, Minnesota, USA.

8. Zadoks, J.C., and R.D. Schein. 1979. *Epidemiology and Plant Disease Management*. Oxford Univ. Press, London and New York, USA.

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## **7. BIOCHEMISTRY AND PHYSIOLOGY OF DISEASED PLANTS**

**Credit Hours: 3(2-1)**

**Prerequisites:** B. Sc. (Hons) Agriculture specialization in Plant Pathology

**Objectives:**

To study biochemical and physiological changes in diseased plants

**Course Contents:**

**Theory**

Infection process by fungi, bacteria, viruses and nematodes; Comparative analysis of biochemical and physiological changes in diseased and healthy plants; influence of plant pathogens on photosynthesis, respiration, translocation, transpiration, cell wall composition and metabolism, nucleic acid and protein metabolism; Changes in secondary metabolites, growth regulators and toxins; Effect of pathogens on trans-cellular and vascular transport; Nature of morphological and biochemical resistance in host plants.

**Practical**

Experiments to illustrate infection processes by plant pathogens; histopathology of infected plant tissue; Biochemical analysis to demonstrate changes induced by biotic and abiotic factors; Bioassay of toxin and selection for host resistance.

**Recommended Books:**

1. Ayres, P.G. 1981. *Effects of Disease on the Physiology of the Growing Plants*. Cambridge University Press
2. Baily, J.A. and B.J. Deverall. 1983. *The Dynamics of Host Defense*. Academic Press, New York, USA.
3. Fritig, B. and M. LeGrand. 1993. *Mechanisms of Plant Defense Responses*. Kluwer, Dordrecht, The Netherlands.
4. Goodman, R.N., Z. Kiraly, and K.R. Wood. 1986. *The Biochemistry and Physiology of Plant Disease*. Univ. of Missouri Press, Columbia, USA
5. Lawlor, W.D. 2001. *Photosynthesis*. 3<sup>rd</sup> Ed. Viva Books (Pvt.) Ltd. India.
6. Misra, J.R. 2004. *Photosynthesis in Plants*. DPH, India.
7. Petrini, O. and G.B. Ouellette. 1994. *Host Wall Alterations by Parasitic Fungi*. American Phytopathology Society Press, St., Paul. Minnesota, USA.
8. Strange, R.N. 2003. *Introduction to Plant Pathology*. John Wiley and Sons Ltd.

## 8. GENETICS OF PLANT PATHOGENS

**Credit Hours: 3(3-0)**

**Prerequisites:** B. Sc. (Hons) Agriculture specialization in Plant Pathology

### **Objectives:**

To study the genetics of plant pathogens

### **Course Contents:**

#### **Theory**

Mechanisms responsible for variation in plant pathogens including mutation, hybridization, heterokaryosis, parasexuality, adaptation, cytoplasmic inheritance and bacterial conjugation, transformation, and transduction; Physiological specialization especially in fungi; Formation of new races and biotypes; The gene-for-gene-concept; Genetics of host-pathogen interaction; Study of pathogenicity of fungi, bacteria, viruses and nematodes; Study of infection on differential hosts.

#### **Practical**

To study genetic variations in plant pathogens; *In-vitro/In-vivo* demonstration of variation in different isolates of pathogens.

#### **Recommended Books:**

1. McDonald, B.A. 2004. Population Genetics of Plant Pathogens. American Phytopathology Society Press, St., Paul. Minnesota, USA.
2. Mills, D., H. Kunoh, N. Keen and S. Mayama. 1996. Molecular Aspects of Pathogenicity and Resistance: Requirements for signal Transduction. American Phytopathology Society Press, St., Paul. Minnesota, USA
3. Moore, D. and L.A.N. Frazer. 2002. Essential Fungal Genetics. Springer-Verlag, N.Y. USA.
4. Nester, E.W. and D.P.S. Verma. 1993. Advances in Molecular Genetics of Plant-Microbe Interaction. Vol. 2. Kluwer Dordrecht, The Netherlands.
5. Sadasivan, S. and B. Thayumana. 2003. Molecular Host Plant Resistance to Pests. Marcel Dekker, USA.
6. Singh, D.P. 2002. Breeding for resistance to biotic stress. International Books Distribution Co. India.
7. Singh, U.S., R.P. Singh and K. Kohmoto. 1995. Pathogenesis and Host Specificity in Plant Disease. Histopathological, Biochemical, Genetic and Molecular Bases. Vols. 1-3. Pergamon/Elsevier, Tarrytown, New York, USA.
8. Young, L. 1999. Genetics and Genetic Engineering. Universities Press. India

## **9. SEED PATHOLOGY**

**Credit Hours: 3(2-1)**

**Prerequisites:** B. Sc. (Hons) Agriculture specialization in Plant Pathology

### **Objectives:**

To study the effects of plant pathogens on seed health and their management

### **Course Contents:**

#### **Theory**

Importance of seed-borne fungal, bacterial, viral and nematode diseases; Morphology of healthy seed; Histopathology of infected seeds and planting materials; Mechanism of infection and disease transmission; Factors affecting establishment of pathogens in seed; Seed quality control systems and disease free seed production, processing and certification with special reference to Pakistan; Seed crops and seed standards; Seed treatment and equipment; seed processing and storage; Seed health testing of consignment during export/import and testing of germplasm material; Seed borne pathogens and its health hazards.

#### **Practical**

Seed-borne pathogens: Identification, preservation, incidence and mode of seed transmission; Effect of different chemicals and antagonistic microorganism on seed-borne pathogens and seed germination; Field crop inspection for disease assessment; Seed sampling according to International Seed Testing Association (ISTA) methods. Preparation of working sample for seed health testing. Visits to seed testing laboratories and seed processing plants.

#### **Recommended Books:**

1. Agarwal, V.K. and J.B. Sinclair, 1993. Principles of Seed Pathology. Vol. I & II. CBS Publishers and Distributors, New Delhi.
2. Albrechtsen, S.E. 2006. Testing Methods for Seed-Transmitted Viruses: Principles and Protocols, CABI UK.
3. Bashir, M., Z. Ahmad and N. Murata. 2000. Seed-borne Viruses, Detection, Identification and Control. PARC, Islamabad.
4. Bhutta, A.R. and I. Ahmad. 2001. Seed Pathological Techniques and their Application. National Book Foundation, Islamabad, Pakistan.
5. Bhutta. A.R. 2010. Text book of Introductory Seed Pathology. HEC, Islamabad, Pakistan.
6. Kruse, M. 2004. ISTA Handbook on Seed Sampling. 2nd Ed. ISTA, Switzerland.
7. Singh, D. 2004 Histopathology of Seed-Borne Infections. CRC Press.

## **11. INTEGRATED PLANT DISEASE MANAGEMENT**

**Credit Hours: 3(2-1)**

**Prerequisites:** B. Sc. (Hons) Agriculture specialization in Plant Pathology

### **Objectives:**

To acquaint the students with integrated plant disease management practices.

### **Course Contents:**

#### **Theory**

Introduction, History, concepts, prospects, principles, components and challenges in Integrated Plant Disease Management (IPDM); Different plant disease control strategies, their integration and application; biological and environmental monitoring for sustainable disease management; Role of biotechnology, microorganism, remote sensing and information technology in IPDM; Disinfection and pesticides application; resistance problems; production and evaluation of bio-control agents; Biosafety regulations regarding release of biocontrol agents; Role of community in IPDM; Technology transfer in IPDM.

#### **Practical**

Integration of different methods for plant disease control; development of IPDM model.

### **Recommended Books:**

1. Arya, A.O. and A.E. Perello. 2010. Management of Fungal Plant Pathogens. CABI, England.
2. Ciancio, A. and K.G. Mukerji. 2008. Integrated Management of Diseases Caused by Fungi, Phytoplasma and Bacteria. Springer.
3. Inderjit and K.G. Mukerji. 2006. Allelochemicals: Biological Control of Plant Pathogens and Diseases. Springer.
4. Kapoor, B.B.S. and N.K. Khatri. 2004. Management of Plant Diseases. Bikaner, Madhu Publications, India.
5. Koul, O. and G.S. Dhaliwal. 2001. Microbial Biopesticides. CRC Press.
6. Nehra, S. 2005. Plant Diseases: Biocontrol Management. Pointer Publishers, India.
7. Razdan, V.K. and M. Sabitha. 2009. Integrated disease management: Concepts and Practices. Springer, Netherland.

## **12. POST HARVEST PATHOLOGY**

**Credit Hours: 3(2-1)**

**Prerequisites:** B. Sc. (Hons) Agriculture specialization in Plant Pathology

### **Objectives:**

To study transit and storage diseases of plants

### **Course Contents:**

#### **Theory**

Biotic and abiotic factors associated with grains and perishables in storage and transit; Physiological and biochemical changes in transit and storage due to diseases; Effect of mycotoxins on human and animal health; Management of post harvest losses; Use of radiation, waxing and other methods and their effect on product health and quality. Grain storage management and fumigation technology.

#### **Practical**

Visit to storages facilities and cargo centers for sampling; Isolation and identification of microorganisms from diseased seeds and perishables; estimation and management of losses.

#### **Recommended Books:**

1. Bhutani, R.C. 2003. Fruits and Vegetables Preservation. Biotech Books, India.
2. Bhutta, A.R., A. Hussain and M.R. Rehman. 2004. Handbook on Seed Processing and Storage, Federal Seed Certification and Registration Department, Islamabad. Pakistan.
3. Burg, S.P. 2004. Postharvest physiology and hypobaric storage of fresh produce. CABI Publishing.
4. Chakraverty, A., A.S. Mujundar, G.S. Raghavan and H.S. Ramaswamy. 2003. Handbook of Post harvest Technology. Marcel Dekker/NC. New York, USA.
5. Dasgupta, M.K. and N.C. Mandal. 1986. Post Harvest Pathology of Perishables. Oxford and IBH Publ. Co., New Delhi, India
6. Dennis, C. 1983. Postharvest pathology of fruits and vegetables. Academic Press, New York, USA.
7. Kader, A. A. 2002. Postharvest technology of horticultural crops. University of California.
8. Naard, N.F. and D.K. Salunkhe. 1980. Postharvest Biology and Handling of Fruits and Vegetables. The AVI Publ. Co., Inc., Connecticut, USA.

### **13. BIOLOGY AND CULTIVATION OF EDIBLE FUNGI**

**Credit Hours: 3(1-2)**

**Prerequisites:** B. Sc. (Hons) Agriculture specialization in Plant Pathology

#### **Objectives:**

To acquaint students with biology and cultivation of edible fungi

#### **Course Contents:**

##### **Theory**

History of mushrooms; taxonomy, biology and cultivation of edible fungi in Pakistan; Identification of edible and poisonous species; nutritional and medicinal importance of edible fungi; cultivation of button, oyster, straw, Chinese, shiitake, and medicinal edible fungi: growth rooms, pasteurization methods, spawn types and processing techniques; Pests and diseases of edible fungi and their management.

##### **Practical**

Taxonomic studies of wild mushrooms; construction of model mushroom houses; Preparation of spawn; Development of compost and beds from different agricultural and industrial wastes; Control of pest and diseases of mushrooms.

#### **Recommended Books:**

1. Alexopoulos, C.J., C.W. Mims and M. Blackwell. 1996. Introductory Mycology. 4<sup>th</sup> ed. John Wiley & Sons, Inc. New York, USA.
2. Bahl, N. 1988. Hand book on mushrooms. 2<sup>nd</sup> ed. Oxford & IBH Publ. Co. New Dhelhi. India.
3. Chang, S.T. and P.G. Miles. 2004. Mushroom cultivation, nutritional value, medicinal effect and environmental impact. CRC Press, NYC, USA.
4. Chang, S.T. and T.H. Quimio. 1982. Tropical mushrooms: biological nature and cultivation methods. Chinese University Press.
5. Khan, S.M. and S.M. Khan. 2005. Mushroom cultivation by SRS Publishers, Faisalabad.
6. Miles, P.G. and S.T. Chang. 1997. Mushroom biology: concise basics and current developments. World Scientific Publishing Company.
7. Nasim, G. and R. Bajwa. 2010. Glomalean spore flora of Pakistan. HEC, Islamabad, Pakistan.



## **14. INSECTS IN RELATION TO PLANT DISEASES**

**Credit Hours: 3(2-1)**

**Prerequisites:** B. Sc. (Hons) Agriculture specialization in Plant Pathology

### **Objectives:**

To study role of insects in plant disease transmission

### **Course Contents:**

#### **Theory**

Insects as vector of plant diseases; Modes of transmission and dissemination of plant pathogens by insects; Ecology and insect-plant relationship; Factors affecting insect transmission; Symptomatology, etiology, epidemiology and management of fungal, bacterial and viral plant diseases transmitted by vectors.

#### **Practical**

Identification of insects as vectors of plant pathogens; methods of rearing and handling insect vectors for plant pathogenic studies; demonstration of modes of transmission of plant pathogens by insects, etc.

### **Recommended Books:**

1. Basu, A.N. and B.K. Giri. 1993. The Essentials of Viruses, Vectors and Plant Diseases. Wiley Eastern Ltd., New Delhi, India
2. Leach, J.G. 2007. Insect transmission of plant diseases. Daya Publishing House, India.
3. Vaishali, J.P. and T.V. Satte. 2003. Insect Predator and Pest Management. Daya Publishing House, Delhi.
4. Vanemden, H.F and M. Service. 2004. Pest and Vector Control. Cambridge University Press, UK.

## **15. FOREST AND SHADE TREE PATHOLOGY**

**Credit Hours: 3(2-1)**

**Prerequisites:** B. Sc. (Hons) Agriculture specialization in Plant Pathology

### **Objectives:**

To study forest and shade tree diseases and their management.

### **Course Contents:**

#### **Theory**

Importance of forest and shade tree diseases; introduction to forest and shade tree diseases and their ecology, epidemiology and quantification of losses; forest operations in relation to development and spread of abiotic and biotic diseases; studies on specific diseases of representative groups;

nursery plants and shade tree diseases; management of important diseases.

### **Practical**

Survey and collection of diseased specimens; study visits to national institutions working in forest and shade tree pathology identification and preservation of causal agents; disease management based on cultural and chemical methods.

### **Recommended Books:**

1. Agrios, G.N. 2005. Plant Pathology, Elsevier Academic Press, New York, USA
2. Bakhshi, E.K. 1976. Forest Pathology. Forest Institute, Dehradun, India.
3. Khan, A.H. 1989. Pathology of Trees. 2<sup>nd</sup> Vol. Univ. Agric. Faisalabad.
4. Manson, P.D. 1991. Tree Disease, concepts. 2<sup>nd</sup> Edition. Prentice Hall Eaglewood Cliffs, New Jersey, USA
5. Strouts, R.G. and T.G. Winter. 1994. Diagnosis of ill-health in trees. H.M.S.O. Publishers, London, UK
6. Zabel, R.A. and J.J. Morell. 1992. Wood Microbiology: Decay and its Prevention. Academic Press, San Diego, California, USA.

## **16. URBAN PLANT PATHOLOGY**

**Credit Hours: 3(2-1)**

**Prerequisites:** B. Sc. (Hons) Agriculture specialization in Plant Pathology

### **Objectives:**

To acquaint students with the major disease problems associated with urban agriculture

### **Course Contents:**

#### **Theory**

Importance of urban plant pathology; status and distinguishing features of diseases in fields and urban agriculture; Detailed studies of symptoms, etiology, nature, distribution, extent of losses, disease perpetuation, epidemiology and management of important diseases; post harvest pathological problems; management of plant diseases in urban ecosystem.

#### **Practical**

Collection of diseased specimens, isolation, identification and preservation of pathogens; Development of potting media; Disease management strategies.

### **Recommended Books:**

1. Chase, A.R. 1997. Foliar Plant Diseases; Diagnosis and Control. American Phytopathological Society, St Paul, Minnesota, USA.
2. Fletcher, J.H. 1984. Diseases of green house plants. John Wiley & Sons. Inc., New York, USA.

3. Mc Maugh, J. 2001. What garden pest or disease is that? New Holland Publishing, Sydney.
4. Nelson, P.Y. 2008. Green house: Operation and Management. Prentice Hall.
5. Pirone, P.P. 1978. Diseases and pests of ornamental plants. John Wiley & Sons. Inc. New York, USA.

## **17. PLANT QUARANTINE AND SANITARY AND PHYTO-SANITARY MEASURES**

**Credit Hours: 3(2-1)**

**Prerequisites:** B. Sc. (Hons) Agriculture specialization in Plant Pathology

### **Objectives:**

To introduce the concepts and principles of plant quarantine and phyto-sanitary measures.

### **Course Contents:**

#### **Theory**

Introduction, concept and principles of plant quarantine and SPS measures; WTO Regime; Plant and seed related issues; International and domestic quarantine standards and rules; seed act 1976 and its implementation in seed import/export; biosecurity; disease reporting; legislative framework; contaminants; outbreaks of some important diseases introduced into Pakistan and elsewhere through import of seed and food items; Impact of SPS and quarantine measures; Quarantine legislations for food and non-food commodities; Detection methodology used for quarantine object pathogens in import/export consignment. Procedure and measure adopted under National Animal and Plant Health Inspection Services in Pakistan; Impact of major international agreements on economy of Pakistan; Measures to encounter agriculture bioterrorism.

#### **Practical**

Analysis of various seed and fruit samples obtained from exportable and importable lots by using modern techniques; Visits to port of entry or dry port; Demonstration of working strategy of Quarantine Department and Federal Seed Certification Agency for seed import/export.

### **Recommended Books:**

1. Bhutta, A.R. and I. Ahmad. 2001. Seed Pathological Techniques and their Application. National Book Foundation, Islamabad. Pakistan.
2. Ebbels, D.L. 2003. Principles of Plant Health and Quarantine. CABI Publishing.
3. FAO. 2000. Multilateral Trade Negotiations on Agriculture - A Resource Manual-III – SPS and TBT Agreement. Publ. FAO-UN Rome.
4. Osmanczyk, E.J. and A. Mango. 2003. Encyclopedia of the United Nations

and International Agreements. 3rd Ed. (4 Vol. Set). Routledge, UK.

5. Rangann, S. 2007. Sanitary and Phytosanitary measures: an Introduction University Press India.

## **18. ADVANCES IN PLANT PATHOLOGY**

**Credit Hours: 3(3-0)**

**Prerequisites:** B. Sc. (Hons) Agriculture specialization in Plant Pathology

### **Objectives:**

To acquaint students with recent trends in plant pathology

### **Course Contents:**

#### **Theory**

Recent trends and developments in different disciplines of plant pathology; review of developments and future prospects of plant pathology; Pathogenesis and host parasite specificity in bacteria, nematodes, fungi and viruses; Molecular and biological techniques for identification of plant pathogens; Mechanism of genetic variability in pathogens.

### **Recommended Literature**

Technical Journals, reviews, proceedings, reports in Plant Pathology

## **19. MOLECULAR PLANT VIROLOGY**

**Credit Hours: 3(2-1)**

**Prerequisites:** B. Sc. (Hons) Agriculture specialization in Plant Pathology and Plant Virology course at M. Sc (H) level

### **Objectives:**

To study viruses on molecular properties and their implication in molecular plant pathology

### **Course Contents:**

#### **Theory**

Current concepts concerning biological, physical, serological and molecular properties of plant viruses and viroids; Organization of virus genome; Structure and *in vitro* assembly of plant viruses; Events in plant virus infection; Molecular mechanisms of viral replication and pathogenesis; Plant virus genome as source of novel function for gene manipulation; Genetics of pathogen-derived resistance; Genetic engineering with viroids. Advances in virus host-cell interactions.

## **Practical**

Plant virus diagnosis; studies of viruses using biological, physical, serological and molecular techniques; Virus nucleic acid isolation and analysis; Polymerase chain reaction for RNA and DNA virus genomes; Production, analysis and field testing of transgenic plants.

## **Recommended Books:**

1. Dijkstra, J. 1998. Practical Plant Virology: Protocols and Exercises. Springer Verlag.
2. Foster, G.D., I.E. Johansen, Y. Hong and P.D. Nagy. (Eds.). 2008. Plant Virology Protocols – From Viral Sequence to Protein Function. Humana Press.
3. Hadidi, A., R.K. Khetarpal and H. Koganezawa (Eds). 1998. Plant Virus Disease Control. American Phytopathological Society, St Paul, Minnesota, USA.
4. Hull, R. 2002. Matthews' Plant Virology. 4<sup>th</sup> Ed. Elsevier Ltd.
5. Hull, R. 2009. Comparative Plant Virology, 2<sup>nd</sup> Edition. Academic Press .
6. Loebenstein, G. and G. Thottappilly. (Eds.). 2004. Virus and Virus-like Diseases of Major Crops in Developing Countries. Springer.
7. Tepfer, M. and E. Balazs. (Eds.). 1997. Virus-Resistant Transgenic Plants: Potential Ecological Impact. Springer Verlag.

## **20. MOLECULAR PLANT-MICROBE INTERACTION**

**Credit Hours: 3(2-1)**

**Prerequisites:** B. Sc. (Hons) Agriculture specialization in Plant Pathology

### **Objectives:**

To study various molecular interactions of plants and associated microbes

### **Course Contents:**

#### **Theory**

Theory of coexistences and co-evolution; plant - microbe associations; gradients of host - microbe interactions; molecular and genomic variability; Pathogenesis: host recognition, signal transduction and compatibility; Programmed cell death; hypersensitivity; production of antimicrobial compounds, enzymes, toxins and hormones; Host and pathogen induced resistance, cross protection versus engineered ; gene silencing; hypovirulence; disease control at molecular level i.e. gene manipulation for disease resistance (horizontal), Systemic and Local Acquired Resistances; Clonal strategy and structural analysis of resistance genes.

#### **Practical**

DNA extraction, purification and quantification; DNA Hybridization; Pathogenic

variability on the basis of molecular approaches.

### **Recommended Books:**

1. Agrios, G.N. 2005. Plant Pathology. Elsevier Academic Press, New York, USA.
2. Boland, G., J.L. David and K. Dall. 1998. Plant Microbe Interaction and Biological Control. Marcel Dekker Inc. USA
3. Bridge, P.D. 1998. Molecular variability of Fungal Pathogens. CAB International, Ferry Lane, Kew, Surrey, England.
4. Davis, H. 1993. *Arabidopsis thaliana* as a model for Plant Pathogen Interaction. American Phytopathological Press, Saint Paul, Minnesota, USA
5. Dickinson, M. 2003. Molecular Plant Pathology. Bios Science Publishers, London, UK.
6. Kosuge, T. and E.W. Nester. 1984. Plant-Microbe Interaction (Vol. 1 & 2). McMillan Publishing Co., New York, USA.
7. Vander Plank. 1982. Host Pathogen Interactions in Plant Diseases. Academic Press, New York, USA.

## **21. BIOLOGICAL CONTROL OF PLANT PATHOGENS**

**Credit Hours: 3(2-1)**

**Prerequisites:** B. Sc. (Hons) Agriculture specialization in Plant Pathology

### **Objectives:**

To manage plant pathogens through biological approaches

### **Course Contents:**

#### **Theory**

Biological control and types of biological interaction; factors involved in biological control; Different biocontrol approaches like antagonistic microorganism, allelopathy, plant and pathogen-derived resistance; Methods for stimulation of indigenous biocontrol agents; Mass production and commercialization of bio-control agents.

#### **Practical**

Isolation, purification, identification and application of bio-control agents under laboratory and field conditions; Preparation of plant products and their evaluation against various plant pathogens.

### **Recommended Books:**

1. Bellows, T.S., T.W. Fisher, L.E. Caltagirone, D.L. Dahlsten, G. Gordh and C.B. Huffaker. 1999. Handbook of Biological Control, Principles and Applications of Biological Control. Academic Press, London.

2. Burge, M.N. 1988. Fungi in Biological Control System Manchester University Press UK.
3. Butt, T.M., C. Jackson and N. Magan. 2001. Fungi as Biocontrol Agents: Progress, Problems and Potential. CABI Publishing, UK.
4. Copping, L.G. 2004. The manual of biocontrol agents. British Crop Protection Council, UK.
5. Gnanamanickam, S.S. (Ed.). 2002. Biological control of crop diseases. Marcel Dekker, New York.
6. Trivedi, P.C. 1998. Plant Nematode Management: A biocontrol Approach. CBS Publishers & Distributors, New Delhi.

## **22. SEMINAR-I (M. Sc (H) Thesis)**

**Credit Hours: 1(1-0)**

**Prerequisites:** B. Sc. (Hons) Agriculture specialization in Plant Pathology

**Objectives:**

To present research work carried out for M. Sc (H) Thesis

## **23. SPECIAL PROBLEM**

**Credit Hours: 1(1-0)**

**Prerequisites:** B. Sc. (Hons) Agriculture specialization in Plant Pathology

**Objectives:**

To conduct a pilot study determining feasibility of certain aspects of Ph. D research

## **24. Research Thesis (M. Sc (H))**

**Credit Hours: 10(0-10)**

**Prerequisites:** Completion of M. Sc research work in Plant Pathology and submission of thesis

**Objectives:**

To present research work carried out for M. Sc (H) in thesis format

**25. SEMINAR-II (Ph. D Synopsis)**

**Credit Hours: 1(1-0)**

**Prerequisites:** M. Sc. (Hons) Agriculture specialization in Plant Pathology

**Objectives:**

To present proposed research work for Ph. D

**25. SEMINAR-III (Ph. D Thesis)**

**Credit Hours: 1(1-0)**

**Prerequisites:** Completion of courses and research work for Ph. D

**Objectives:**

To present research work carried out for Ph. D

**26. Research Thesis (Ph. D)**

**Credit Hours: 20(0-20)**

**Prerequisites:** Completion of courses, research work and submission of Ph. D thesis

**Objectives:**

To present research work carried out for Ph. D in thesis format



## **RECOMMENDATIONS**

1. Plant Pathology as a major subject should be introduced in all Agricultural Colleges/Faculties at graduate and post graduate levels.
2. Short trainings should be arranged for faculty members in foreign universities/institutions to up date their knowledge in Plant Pathology.
3. Refresher courses/workshops should be organized with the assistance of HEC on emerging problems. Individual proposal for said program should be initiated from concerned departments.
4. It was also suggested that the scientists from R&D organizations should also be given the status of major supervisor for M.Phil./Ph.D students wherever necessary.
5. Expert and student exchange programs within Universities and research organizations in different disciplines of Plant Pathology should be further encouraged.
6. For effective teaching and research, Plant Pathology Herbaria should be established at all Universities / Colleges.
7. Involvement of professional societies in the HEC policy decision making regarding discipline of Plant Pathology is also recommended.
8. Data bank of Plant Pathological books should be established and made accessible to all concerned faculty members in order to facilitate the research and teaching in Plant Pathology.
9. The committee recommended that the Ph.D students shall be exempted from course work. However, wherever necessary, the supervisor/supervisory committee may recommend the deficiency courses for individual students but all the credits at this level shall be given to the research Thesis.
10. All Plant Pathology departments should have a uniform course coding such as "PP" for Plant Pathology.
11. Following national and international research journals are recommended for the Plant Pathology departments:

### **International Scientific Research Journals**

1. Phytopathology, APS, USA
2. Plant Disease, APS, USA.
3. Molecular Plant Microbe Interactions, APS, USA

4. Plant Pathology, UK
5. Molecular Plant Pathology, UK
6. Mycologia, USA.
7. Australian Plant Pathology, APPS, Australia
8. Physiological & Molecular Plant Pathology, UK
9. European Journal of Plant Pathology
10. Journal of Phytopathology

### **National Scientific Research Journals**

1. Pakistan Journal of Botany, Karachi.
2. Pakistan Journal of Phytopathology, Faisalabad.
3. Pakistan Journal of Seed Technology, Islamabad.
4. Pakistan Journal of Nematology, Karachi
5. Mycopath, Lahore.
6. Sarhad Journal of Agriculture

## DETAILS OF COMPULSORY COURSES

### COMPULSORY COURSES IN ENGLISH FOR Undergraduate Level

#### English I (Functional English)

Credit Hrs. 3(3-0)

#### **Objectives:**

Enhance language skills and develop critical thinking.

#### **Course Contents**

Basics of Grammar  
Parts of speech and use of articles  
Sentence structure, active and passive voice  
Practice in unified sentence  
Analysis of phrase, clause and sentence structure  
Transitive and intransitive verbs  
Punctuation and spelling

#### **Comprehension**

Answers to questions on a given text

#### **Discussion**

General topics and every-day conversation (topics for discussion to be at the discretion of the teacher keeping in view the level of students)

#### **Listening**

To be improved by showing documentaries/films carefully selected by subject teachers

#### **Translation skills**

#### **Urdu to English**

#### **Paragraph writing**

Topics to be chosen at the discretion of the teacher

#### **Presentation skills**

Introduction

*Note: Extensive reading is required for vocabulary building*

## Recommended books:

### 1. **Functional English**

#### a) Grammar

1. Practical English Grammar by A.J. Thomson and A.V. Martinet. Exercises 1. Third edition. Oxford University Press. 1997. ISBN 0194313492
2. Practical English Grammar by A.J. Thomson and A.V. Martinet. Exercises 2. Third edition. Oxford University Press. 1997. ISBN 0194313506

#### b) Writing

1. Writing. Intermediate by Marie-Christine Boutin, Suzanne Brinand and Françoise Grellet. Oxford Supplementary Skills. Fourth Impression 1993. ISBN 0 19 435405 7 Pages 20-27 and 35-41.

#### c) Reading/Comprehension

1. Reading. Upper Intermediate. Brian Tomlinson and Rod Ellis. Oxford Supplementary Skills. Third Impression 1992. ISBN 0 19 453402 2.

#### d) Speaking

## English II (Communication Skills)

Credit Hrs. 3(3-0)

### Objectives:

Enable the students to meet their real life communication needs.

### Course Contents

#### **Paragraph writing**

Practice in writing a good, unified and coherent paragraph

#### **Essay writing**

Introduction

#### **CV and job application**

Translation skills

Urdu to English

#### **Study skills**

Skimming and scanning, intensive and extensive, and speed reading, summary and précis writing and comprehension

### **Academic skills**

Letter/memo writing, minutes of meetings, use of library and internet

### **Presentation skills**

Personality development (emphasis on content, style and pronunciation)

*Note: documentaries to be shown for discussion and review*

## **Recommended books:**

### **Communication Skills**

#### a) Grammar

1. Practical English Grammar by A.J. Thomson and A.V. Martinet. Exercises 2. Third edition. Oxford University Press 1986. ISBN 0 19 431350 6.

#### b) Writing

1. Writing. Intermediate by Marie-Christine Boutin, Suzanne Brinand and Françoise Grellet. Oxford Supplementary Skills. Fourth Impression 1993. ISBN 0 19 435405 7 Pages 45-53 (note taking).
2. Writing. Upper-Intermediate by Rob Nolasco. Oxford Supplementary Skills. Fourth Impression 1992. ISBN 0 19 435406 5 (particularly good for writing memos, introduction to presentations, descriptive and argumentative writing).

#### c) Reading

1. Reading. Advanced. Brian Tomlinson and Rod Ellis. Oxford Supplementary Skills. Third Impression 1991. ISBN 0 19 453403 0.
2. Reading and Study Skills by John Langan
3. Study Skills by Richard Yorky.

# English III (Technical Writing and Presentation Skills)

Credit Hrs: 3(3-0)

## Objectives:

Enhance language skills and develop critical thinking

## Course Contents

### Presentation skills

### Essay writing

Descriptive, narrative, discursive, argumentative

### Academic writing

How to write a proposal for research paper/term paper

How to write a research paper/term paper (emphasis on style, content, language, form, clarity, consistency)

### Technical Report writing

### Progress report writing

*Note: Extensive reading is required for vocabulary building*

## Recommended books:

### Technical Writing and Presentation Skills

- a) Essay Writing and Academic Writing
  1. Writing. Advanced by Ron White. Oxford Supplementary Skills. Third Impression 1992. ISBN 0 19 435407 3 (particularly suitable for discursive, descriptive, argumentative and report writing).
  2. College Writing Skills by John Langan. Mc=Graw-Hill Higher Education. 2004.
  3. Patterns of College Writing (4<sup>th</sup> edition) by Laurie G. Kirszner and Stephen R. Mandell. St. Martin's Press.
- b) Presentation Skills
- c) Reading  
The Mercury Reader. A Custom Publication. Compiled by northern Illinois University. General Editors: Janice Neulib; Kathleen Shine Cain; Stephen Ruffus and Maurice Scharton. (A

reader which will give students exposure to the best of twentieth century literature, without taxing the taste of engineering students).

**ISLAMIC STUDIES  
(Compulsory)**

**Objectives:**

**Credit Hrs: 2(2-0)**

This course is aimed at:

- 1 To provide Basic information about Islamic Studies
- 2 To enhance understanding of the students regarding Islamic Civilization
- 3 To improve Students skill to perform prayers and other worships
- 4 To enhance the skill of the students for understanding of issues related to faith and religious life.

**Detail of Courses**

**Introduction to Quranic Studies**

- 1) Basic Concepts of Quran
- 2) History of Quran
- 3) Uloom-ul -Quran

**Study of Selected Text of Holly Quran**

- 1) Verses of Surah Al-Baqra Related to Faith(Verse No-284-286)
- 2) Verses of Surah Al-Hujrat Related to Adab Al-Nabi  
(Verse No-1-18)
- 3) Verses of Surah Al-Mumanoon Related to Characteristics of faithful  
(Verse No-1-11)
- 4) Verses of Surah al-Furqan Related to Social Ethics (Verse No.63-77)
- 5) Verses of Surah Al-Inam Related to Ihkam(Verse No-152-154)

**Study of Selected Text of Holly Quran**

- 1) Verses of Surah Al-Ihzab Related to Adab al-Nabi (Verse  
No.6,21,40,56,57,58.)
- 2) Verses of Surah Al-Hashar (18,19,20) Related to thinking, Day of  
Judgment
- 3) Verses of Surah Al-Saf Related to Tafakar,Tadabar (Verse No-1,14)

**Seerat of Holy Prophet (S.A.W) I**

- 1) Life of Muhammad Bin Abdullah ( Before Prophet Hood)
- 2) Life of Holy Prophet (S.A.W) in Makkah
- 3) Important Lessons Derived from the life of Holy Prophet in Makkah



## **Seerat of Holy Prophet (S.A.W) II**

- 1) Life of Holy Prophet (S.A.W) in Madina
- 2) Important Events of Life Holy Prophet in Madina
- 3) Important Lessons Derived from the life of Holy Prophet in Madina

## **Introduction To Sunnah**

- 1) Basic Concepts of Hadith
- 2) History of Hadith
- 3) Kinds of Hadith
- 4) Uloom –ul-Hadith
- 5) Sunnah & Hadith
- 6) Legal Position of Sunnah

## **Selected Study from Text of Hadith**

### **Introduction To Islamic Law & Jurisprudence**

- 1) Basic Concepts of Islamic Law & Jurisprudence
- 2) History & Importance of Islamic Law & Jurisprudence
- 3) Sources of Islamic Law & Jurisprudence
- 4) Nature of Differences in Islamic Law
- 5) Islam and Sectarianism

### **Islamic Culture & Civilization**

- 1) Basic Concepts of Islamic Culture & Civilization
- 2) Historical Development of Islamic Culture & Civilization
- 3) Characteristics of Islamic Culture & Civilization
- 4) Islamic Culture & Civilization and Contemporary Issues

### **Islam & Science**

- 1) Basic Concepts of Islam & Science
- 2) Contributions of Muslims in the Development of Science
- 3) Quranic & Science

### **Islamic Economic System**

- 1) Basic Concepts of Islamic Economic System
- 2) Means of Distribution of wealth in Islamic Economics
- 3) Islamic Concept of Riba
- 4) Islamic Ways of Trade & Commerce

### **Political System of Islam**

- 1) Basic Concepts of Islamic Political System
- 2) Islamic Concept of Sovereignty
- 3) Basic Institutions of Govt. in Islam

### **Islamic History**

- 1) Period of Khlaft-E-Rashida

- 2) Period of Ummayyads
- 3) Period of Abbasids

### **Social System of Islam**

- 1) Basic Concepts of Social System of Islam
- 2) Elements of Family
- 3) Ethical Values of Islam

### **Reference Books:**

- 1) Hameed ullah Muhammad, "Emergence of Islam", IRI, Islamabad
- 2) Hameed ullah Muhammad, "Muslim Conduct of State"
- 3) Hameed ullah Muhammad, 'Introduction to Islam
- 4) Mulana Muhammad Yousaf Islahi,"
- 5) Hussain Hamid Hassan, "An Introduction to the Study of Islamic Law" leaf Publication Islamabad, Pakistan.
- 6) Ahmad Hasan, "Principles of Islamic Jurisprudence" Islamic Research Institute, International Islamic University, Islamabad (1993)
- 7) Mir Waliullah, "Muslim Jrisprudence and the Quranic Law of Crimes" Islamic Book Service (1982)
- 8) H.S. Bhatia, "Studies in Islamic Law, Religion and Society" Deep & Deep Publications New Delhi (1989)
- 9) Dr. Muhammad Zia-ul-Haq, "Introduction to Al Sharia Al Islamia" Allama Iqbal Open University, Islamabad (2001)

## Pakistan Studies (Compulsory)

### Introduction/Objectives

Credit Hrs: 3(3-0)

- Develop vision of historical perspective, government, politics, contemporary Pakistan, ideological background of Pakistan.
- Study the process of governance, national development, issues arising in the modern age and posing challenges to Pakistan.

### Course Outline

#### 1. Historical Perspective

- a. Ideological rationale with special reference to Sir Syed Ahmed Khan, Allama Muhammad Iqbal and Quaid-i-Azam Muhammad Ali Jinnah.
- b. Factors leading to Muslim separatism
- c. People and Land
  - i. Indus Civilization
  - ii. Muslim advent
  - iii. Location and geo-physical features.

#### 2. Government and Politics in Pakistan

Political and constitutional phases:

- a. 1947-58
- b. 1958-71
- c. 1971-77
- d. 1977-88
- e. 1988-99
- f. 1999 onward

#### 3. Contemporary Pakistan

- a. Economic institutions and issues
- b. Society and social structure
- c. Ethnicity
- d. Foreign policy of Pakistan and challenges
- e. Futuristic outlook of Pakistan

### Recommended Books

1. Burki, Shahid Javed. *State & Society in Pakistan*, The Macmillan Press Ltd 1980.
2. Akbar, S. Zaidi. *Issue in Pakistan's Economy*. Karachi: Oxford University Press, 2000.
3. S.M. Burke and Lawrence Ziring. *Pakistan's Foreign policy: An Historical analysis*. Karachi: Oxford University Press, 1993.

4. Mehmood, Safdar. *Pakistan Political Roots & Development*. Lahore, 1994.
5. Wilcox, Wayne. *The Emergence of Banglades.*, Washington: American Enterprise, Institute of Public Policy Research, 1972.
6. Mehmood, Safdar. *Pakistan Kayyun Toota*, Lahore: Idara-e-Saqafat-e-Islamia, Club Road, nd.
7. Amin, Tahir. *Ethno - National Movement in Pakistan*, Islamabad: Institute of Policy Studies, Islamabad.
8. Ziring, Lawrence. *Enigma of Political Development*. Kent England: WmDawson & sons Ltd, 1980.
9. Zahid, Ansar. *History & Culture of Sindh*. Karachi: Royal Book Company, 1980.
10. Afzal, M. Rafique. *Political Parties in Pakistan*, Vol. I, II & III. Islamabad: National Institute of Historical and cultural Research, 1998.
11. Sayeed, Khalid Bin. *The Political System of Pakistan*. Boston: Houghton Mifflin, 1967.
12. Aziz, K.K. *Party, Politics in Pakistan*, Islamabad: National Commission on Historical and Cultural Research, 1976.
13. Muhammad Waseem, *Pakistan Under Martial Law*, Lahore: Vanguard, 1987.
14. Haq, Noor ul. *Making of Pakistan: The Military Perspective*. Islamabad: National Commission on Historical and Cultural Research, 1993.

**COMPULSORY MATHEMATICS  
COURSES FOR B.Sc (Hons) AGRICULTURE**

**1. MATHEMATICS I (ALGEBRA)**

**Prerequisite(s):** Mathematics at secondary level

**Credit Hours:** 3 + 0

**Specific Objectives of the Course:**

To prepare the students, not majoring in mathematics, with the essential tools of algebra to apply the concepts and the techniques in their respective disciplines.

**Course Outline:**

*Preliminaries:* Real-number system, complex numbers, introduction to sets, set operations, functions, types of functions.

*Matrices:* Introduction to matrices, types, matrix inverse, determinants, system of linear equations, Cramer's rule.

*Quadratic Equations:* Solution of quadratic equations, qualitative analysis of roots of a quadratic equations, equations reducible to quadratic equations, cube roots of unity, relation between roots and coefficients of quadratic equations.

*Sequences and Series:* Arithmetic progression, geometric progression, harmonic progression.

*Binomial Theorem:* Introduction to mathematical induction, binomial theorem with rational and irrational indices.

*Trigonometry:* Fundamentals of trigonometry, trigonometric identities.

**Recommended Books:**

Dolciani MP, Wooton W, Beckenback EF, Sharron S, *Algebra 2 and Trigonometry*, 1978, Houghton & Mifflin,

Boston (suggested text)

Kaufmann JE, *College Algebra and Trigonometry*, 1987, PWS-Kent Company, Boston

Swokowski EW, *Fundamentals of Algebra and Trigonometry* (6<sup>th</sup> edition), 1986, PWS-Kent Company, Boston

## 2. MATHEMATICS II (CALCULUS)

**Prerequisite(s):** Mathematics I (Algebra)

**Credit Hours:** 3 + 0

### **Specific Objectives of the Course:**

To prepare the students, not majoring in mathematics, with the essential tools of calculus to apply the concepts and the techniques in their respective disciplines.

### **Course Outline:**

*Preliminaries:* Real-number line, functions and their graphs, solution of equations involving absolute values, inequalities.

*Limits and Continuity:* Limit of a function, left-hand and right-hand limits, continuity, continuous functions.

*Derivatives and their Applications:* Differentiable functions, differentiation of polynomial, rational and transcendental functions, derivatives.

*Integration and Definite Integrals:* Techniques of evaluating indefinite integrals, integration by substitution, integration by parts, change of variables in indefinite integrals.

### **Recommended Books:**

Anton H, Bevens I, Davis S, *Calculus: A New Horizon* (8<sup>th</sup> edition), 2005, John Wiley, New York

Stewart J, *Calculus* (3<sup>rd</sup> edition), 1995, Brooks/Cole (suggested text)

Swokowski EW, *Calculus and Analytic Geometry*, 1983, PWS-Kent Company, Boston

Thomas GB, Finney AR, *Calculus* (11<sup>th</sup> edition), 2005, Addison-Wesley, Reading, Ma, USA

### 3. MATHEMATICS III (GEOMETRY)

**Prerequisite(s):** Mathematics II (Calculus)

**Credit Hrs: 3(3-0)**

#### **Specific Objectives of the Course:**

To prepare the students, not majoring in mathematics, with the essential tools of geometry to apply the concepts and the techniques in their respective disciplines.

#### **Course Outline:**

*Geometry in Two Dimensions:* Cartesian-coördinate mesh, slope of a line, equation of a line, parallel and perpendicular lines, various forms of equation of a line, intersection of two lines, angle between two lines, distance between two points, distance between a point and a line.

*Circle:* Equation of a circle, circles determined by various conditions, intersection of lines and circles, locus of a point in various conditions.

*Conic Sections:* Parabola, ellipse, hyperbola, the general-second-degree equation

#### **Recommended Books:**

Abraham S, *Analytic Geometry*, Scott, Freshman and Company, 1969

Kaufmann JE, *College Algebra and Trigonometry*, 1987, PWS-Kent Company, Boston

Swokowski EW, *Fundamentals of Algebra and Trigonometry* (6<sup>th</sup> edition), 1986, PWS-Kent Company, Boston

#### **Note:**

- 1. Two courses will be selected from the following three courses of Mathematics.**
- 2. Universities may make necessary changes in the courses according to the requirement as decided by the Board of Studies.**

**Statistics-I**

**Credit 3 (2-1)**

Definition and importance of Statistics in Agriculture, Data Different types of data and variables

Classification and Tabulation of data, Frequency distribution, stem-and-Leaf digram, Graphical representation of data Histogram, frequency polygon, frequency curve.

Measure of Central tendency, Definition and calculation of Arithmetic mean, Geometric mean, Harmonic mean, Median quantiles and Mode in grouped and ungrouped data.

Measure of Dispersion, Definition and Calculation of Range, quartile deviation, Mean deviation, Standard deviation and variance, coefficient of variation.

**Practicals**

- a. Frequency Distribution
- b. Stem-and-Leaf digram
- c. Various types of Graphs
- d. Mean, Geometric mean Harmonic Mean,
- e. Median, Quartiles Deviation, mean Deviation.
- f. Standard Deviation, Variance, Coefficient of variation,
- g. Skewness and kinesis

**Recommended Book**

1. Introduction to Statistical Theory Part- I by Sher Muhammad and Dr. Shahid Kamal (Latest Edition)
2. Statistical Methods and Data Analysis by Dr. Faquir Muhammad
3. A. Concise Course in A. Level Statistic with world examples by J. Crawshaw and J. Chambers (1994)
4. Basic Statistics an Inferential Approach 2<sup>nd</sup> Ed. (1986) Fran II. Dietrich-II and Thomes J. Keans



## Statistics-II

**Credit 3 (2-1)**

Sampling Probability and non-Probability Sampling, Simple random sampling stratified random sampling Systematic sampling error, Sampling distribution of mean and difference between two means. Interference Theory: Estimation and testing of hypothesis, Type—I and type-II error, Testing of hypothesis about mean and difference between two means using Z-test and t-test, Paired t-test, Test of association of attributes using X<sup>2</sup> (chi-square) Testing hypothesis about variance.

### Practicals

- a. Sampling random sampling
- b. Stratified random sampling.
- c. Sampling distribution of mean
- d. Testing of hypotheses regarding population mean
- e. Testing of hypotheses about the difference between population means
- f. Chi-square test
- g. Testing of Correlation Coefficient
- h. Fitting of simple linear regression
- i. One-way ANOVA
- j. Two-way ANOVA

### Recommended Book

1. Introduction to Statistical Theory Part-II by Sher Muhammad and Dr. Shahid Kamal (Latest Edition)
2. Statistical Methods and Data Analysis by Dr. Faquir Muhammad
3. Principles and Procedures of Statistics A Bio-metrical approach, 2<sup>nd</sup> Edition, 1980 by R.G.D Steal and James H. Tarric
4. Statistical Procedures for Agricultural Research 2<sup>nd</sup> Edition (1980) by K.A. Gomez and A.A. Gomez

***Note: Universities may make necessary changes in the courses according to the requirement as decided by the Board of Studies.***

Course Name: **Introduction to Information and Communication Technologies**

**Course Structure:** Lectures: 2 Labs: 1

**Credit Hours:** 3(2-1)

**Pre-requisite:** None

**Semester:** 1

**Course Description:**

This is an introductory course on Information and Communication Technologies. Topics include ICT terminologies, hardware and software components, the internet and world wide web, and ICT based applications. After completing this course, a student will be able to:

- Understand different terms associated with ICT
- Identify various components of a computer system
- Identify the various categories of software and their usage
- Define the basic terms associated with communications and networking
- Understand different terms associated with the Internet and World Wide Web.
- Use various web tools including Web Browsers, E-mail clients and search utilities.
- Use text processing, spreadsheets and presentation tools
- Understand the enabling/pervasive features of ICT

**Course Contents:**

- : Basic Definitions & Concepts
- : Hardware: Computer Systems & Components
- : Storage Devices, Number Systems
- : Software: Operating Systems, Programming and Application Software
- : Introduction to Programming, Databases and Information Systems
- : Networks
- : Data Communication
- : The Internet, Browsers and Search Engines
- : The Internet: Email, Collaborative Computing and Social Networking
- : The Internet: E-Commerce
- : IT Security and other issues
- : Project Week
- : Review Week

## **Text Books/Reference Books:**

Introduction to Computers by Peter Norton, 6th International Edition  
(McGraw HILL)

Using Information Technology: A Practical Introduction to Computer &  
Communications by Williams Sawyer, 6th Edition (McGraw HILL)

Computers, Communications & information: A user's introduction by Sarah  
E. Hutchinson, Stacey C. Swayer

Fundamentals of Information Technology by Alexis Leon, Mathewsleon Leon  
Press.

## **Functional Biology-I**

*Credit Hours 3+0*

### **Biological Methods**

Principles of Cellular Life  
Chemical Basis  
Structure and Function  
Principles of Metabolism  
Energy Acquisition

### **Principles of Inheritance**

Mitosis and Meiosis  
Chromosomes  
Observable Inheritance Patterns  
DNA Structure and Function  
RNA and Proteins  
Genes  
Genetic Engineering and Biotechnology

### **Biodiversity**

Fundamental Concept of Biodiversity  
One or two examples of each of the following from commonly found  
organism  
Prions  
Viruses  
Bacteria  
Protistans  
Algae  
Fungi  
Plants  
Crops  
Animals  
Invertebrates

## Vertebrates

### ***Reading***

1. Roberts, M.M., Reiss and G.Monger. 2000. Advanced Biology, Nelson.
2. Starr, C, and R, Taggart, 2001. Biology: The Unity and Diversity of Life Brooks and Cole.
3. Campbell, N.A., J.B, Reece, L.G. Mitchell, M.R, Taylor. 2001. Biology: Concepts and Connections. Prentice-Hall.

# Functional Biology-II

**Credit Hours 3+0**

## **Myths and Realities of Evolution**

Microevolution  
Speciation  
Macroevolution

## **Level of Organization**

### **Plants**

Tissues  
Nutrition and Transport  
Reproduction  
Growth and Development

### **Animals**

Tissue, Organ System and Homeostasis  
Information Flow and Neuron  
Nervous System  
Circulation and Immunity  
Nutrition and Respiration  
Reproduction and Development

### **Ecology and Behavior**

Ecosystems  
Biosphere  
Social Interactions  
Community Interactions  
Human Impact on Biosphere  
Environment Conservation

## **Reading**

1. Roberts, M.M., Reiss and G.Monger. 2000. Advanced Biology, Nelson.
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3. Campbell, N.A., J.B, Reece, L.G. Mitchell, M.R, Taylor. 2001. Biology: Concepts and Connections. Prentice-Hall.

*Note: Universities may make necessary changes in the courses according to the requirement as decided by the Board of Studies.*