CURRICULUM OF

PLANT PATHOLOGY
BSc (Hons) MSc (Hons) & PhD

(Revised 2014)

HIGHER EDUCATION COMMISSION
ISLAMABAD
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CURRICULUM DIVISION, HEC

Prof. Dr. Mukhtar Ahmed  
Chairman, HEC

Mr. Fida Hussain  
Director General (Acad)

Mr. Rizwan Shoukat  
Deputy Director (Curr)

Mr. Abid Wahab  
Assistant Director (Curr)

Mr. Riaz-ul-Haque  
Assistant Director (Curr)
The curriculum, with varying definitions, is said to be a plan of the teaching-learning process that students of an academic programme are required to undergo. It includes objectives & learning outcomes, course contents, scheme of studies, teaching methodologies and methods of assessment of learning. Since knowledge in all disciplines and fields is expanding at a fast pace and new disciplines are also emerging; it is imperative that curricula be developed and revised accordingly.

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

In compliance with the above provisions, the Curriculum Division of HEC undertakes the revision of curricula after every three years through respective National Curriculum Revision Committees (NCRCs) which consist of eminent professors and researchers of relevant fields from public and private sector universities, R&D organizations, councils, industry and civil society by seeking nominations from their organizations.

In order to impart quality education which is at par with international standards, HEC NCRCs have developed unified templates as guidelines for the development and revision of curricula in the disciplines of Basic Sciences, Applied Sciences, Social Sciences, Agriculture and Engineering in 2007 and 2009.

It is hoped that this curriculum document, prepared by the respective NCRC’s, would serve the purpose of meeting our national, social and economic needs, and it would also provide the level of competency specified in Pakistan Qualification Framework to make it compatible with international educational standards. The curriculum is also placed on the website of HEC (www.hec.gov.pk).

(Fida Hussain)
Director General (Academics)
CURRICULUM DEVELOPMENT PROCESS

STAGE-I

STAGE-II

STAGE-III

STAGE-IV

CURRI. UNDER CONSIDERATION

CURRI. IN DRAFT STAGE

FINAL STAGE

FOLLOW UP STUDY

COLLECTION OF REC

APPRASIAL OF 1ST DRAFT BY EXP OF COL/UNIV

PREP. OF FINAL CURRI

QUESTIONNAIRE

CONS. OF CRC.

FINALIZATION OF DRAFT BY CRC

INCORPORATION OF REC OF V.C.C

COMMENTS

PREP. OF DRAFT BY CRC

APPROVAL OF CURRI. BY V.C.C.

PRINTING OF CURRI

REVIEW

IMPLE. OF CURRI

BACK TO STAGE-I

ORIENTATION COURSES

Abbreviations Used:
CRC. Curriculum Revision Committee
VCC. Vice Chancellor’s Committee
EXP. Experts
COL. Colleges
UNI. Universities
PREP. Preparation
REC. Recommendations
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 gradate degree programs. The NCRC on Plant Pathology developed frame work and revised the curriculum in two different meetings. The Preliminary meeting of NCRC in the discipline of Plant Pathology was held from December 16-18, 2014 at HEC Regional Centre, Lahore to review and prepare draft curriculum of Plant Pathology for BSc (Hons), MSc. (Hons) & PhD Programs. The Committee also approved recommendations for the implementation of new curriculum and further strengthening of the degree programs in Plant Pathology at both under-graduate and post-graduates levels in Pakistan.

Proceeding of the Preliminary NCRC meeting:

The following members attended the meeting:

1. Dr. Muhammad Arif  
   Convener  
   Professor  
   Department of Plant Pathology  
   The University of Agriculture, Peshawar

2. Dr. Saleem Shehzad  
   Member  
   Professor/Chairman  
   Department of Agriculture and Agribusiness Management, University of Karachi  
   Karachi

3. Dr. Ch. Abdul Rauf  
   Member  
   Professor/Chairman  
   Department of Plant Pathology  
   PMAS, Arid Agriculture University, Rawalpindi

4. Dr. Shahbaz Talib Sahi  
   Member  
   Professor/Chairman  
   Department of Plant Pathology  
   University of Agriculture, Faisalabad
5. Dr. Shaukat Hussain  
Professor  
Department of Plant Pathology,  
The University of Agriculture, Peshawar

6. Dr. Syed Riaz Ali Gardezi  
Professor  
Department of Plant Pathology, University of Poonch, Rawalakot

7. Dr. Abdul Rauf Bhutta  
Director  
Federal Seed Certification and Registration Department, Mauve area, Sector G-9, Islamabad

8. Dr. Muhammad Abid  
Associate Professor  
Department of Botany, Federal Urdu University of Arts, Science and Technology, Abdul Haq Campus, Karachi

9. Dr. Muhammad Mushtaq  
Associate Professor  
Department of Plant Sciences, Faculty of Life Sciences, Balochistan University of Information Technology and Management Sciences, Airport road, Baleli, Quetta

10. Dr. Ahmad Ali Shahid  
Assistant Professor  
Institute of Agricultural Sciences, University of the Punjab, Quaid-e-Azam Campus, Lahore

11. Dr. Samiya Mahmood Khan  
Assistant Professor  
Department of Plant Pathology, University College of Agriculture, Bahauddin Zakaria University, Multan

12. Dr. Rehana Naz Syed  
Assistant Professor  
Plant Pathology Department, Sindh Agriculture University, Tandojam
The meeting started with recitation from the Holy Quran by Mr. Riaz-ul-Haque, Assistant Director (Curriculum), HEC while Prof. Dr. Naeem Khalid, Adviser (Academics), presided over the inaugural session. He welcomed the participants on behalf of the Executive Director, HEC and thanked the participants for attending the meeting for this cause of national importance. He asserted the need of bringing curriculum at par with International standards. Prof. Khalid also presented Semester System implementation in Pakistan. Mr. Fida Hussain, Director General (Academics), also joined the session and asserted the need to address learning outcomes of course load of students. D.G (Acad) requested the participants to prepare their proposals for HEC to provide opportunities to the stakeholders. He also encouraged the participants to feel free to submit their recommendations in the document to be drafted at the end of the meeting.

The committee members unanimously elected Prof. Dr. Muhammad Arif as Convener and Dr. Zafar Iqbal as Secretary of the NCRC in Plant Pathology 2014. 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 committees suggested improvements in almost all the courses,
replacement and addition of new courses at undergraduate and graduate levels.

**Proceeding of the final NCRC meeting:**

The final meeting of National Curriculum Revision Committee (NCRC) in the discipline of Plant Pathology was held during May 26-28, 2014 at HEJ Research Institute of Chemistry, University of Karachi, Karachi, to review and finalize the curriculum of Plant Pathology for BSc (Hons), MSc (Hons) and PhD degree programmes. The committee also approved recommendations for the implementation of the new curriculum and further strengthening of the degree programmes in Plant Pathology at both undergraduate and post-graduate levels in Pakistan. The following members attended the meeting:

1. Dr. Muhammad Arif  
   Convener  
   Professor,  
   Department of Plant Pathology  
   The University of Agriculture, Peshawar

2. Dr. Saleem Shehzad  
   Member  
   Professor/Chairman,  
   Department of Agriculture and Agribusiness Management, University of Karachi, Karachi

3. Dr. Shahina Fayyaz  
   Member  
   Director/Professor,  
   National Nematological Research Centre,  
   University of Karachi, Karachi

4. Dr. Zahir Shah  
   Member  
   Professor/Chairman,  
   Department of Botany,  
   Islamia College University, Peshawar

5. Dr. Shahbaz Talib Sahi  
   Member  
   Professor/Chairman,  
   Department of Plant Pathology  
   University of Agriculture, Faisalabad

6. Dr. Shaukat Hussain  
   Member  
   Professor,  
   Department of Plant Pathology,  
   The University of Agriculture, Peshawar
7. Dr. Ch. Abdul Rauf  
   Professor/Chairman,  
   Department of Plant Pathology,  
   PMAS University of Arid Agriculture,  
   Rawalpindi  

8. Dr. Syed Riaz Ali Gardezi  
   Professor/Chairman,  
   Department of Plant Pathology, University of  
   Poonch, Rawalakot  

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

10. Dr. Nighat Sarwar,  
    Deputy Chief Scientist/Head Plant  
    Protection Division,  
    Nuclear Institute for Agriculture and  
    Biology, Faisalabad  

11. Dr. Ahmad Ali Shahid  
    Associate Professor  
    Institute of Agricultural Sciences,  
    University of the Punjab, Lahore  

12. Dr. Muhammad Abid  
    Associate Professor  
    Department of Botany, Federal Urdu  
    University of Arts, Science and Technology  
    Karachi  

13. Dr. Muhammad Mushtaq  
    Associate Professor,  
    Department of Plant Sciences,  
    Balochistan University of Information  
    Technology and Management Sciences,  
    Baleli, Quetta  

14. Dr. Rashida Atiq  
    Associate Professor  
    Department of Plant Pathology,  
    Faculty of Agricultural Sciences & Technology,  
    B.Z.U., Multan  

15. Dr. Rehana Naz Syed  
    Assistant Professor,  
    Department of Plant Pathology, Sindh
Agriculture University, Tandojam.

16. Mr. Tamoor Khan
   Assistant Professor,
   Plant Pathology Department, Lasbella
   University of Agriculture,
   Water and Marine Sciences, Uthal, Balochistan

17. Mr. Ahmad Khan
   Assistant Professor,
   Department of Plant Pathology, Balochistan
   Agriculture College, Quetta

18. Mr. Rizwan Shoukat
   Deputy Director (Curriculum),
   Higher Education Commission, Islamabad

19. Dr. Zafar Iqbal
   Principal/Chairman,
   Department of Plant Pathology
   University College of Agriculture,
   University of Sargodha, Sargodha

The meeting started with recitation from the Holy Quran. Mr. Rizwan Shoukat, Deputy Director (Curriculum), Higher Education Commission (HEC), Islamabad, briefed the participants on importance of National Curriculum Revision Committee (NCRC) and obligation of HEC for the development of curricula as per international standard. Mr. Ghulam Hyder Khan and Mr. Mubashar Ahmad Memon, Director and Deputy Director, respectively, at HEC Regional Center, Karachi, welcomed the participants on behalf of Executive Director and HEC, Regional Centre, Karachi.

The Committee members unanimously approved the decision of Preliminary meeting and endorsed Prof. Dr. Muhammad Arif as Convener and Dr. Zafar Iqbal as Secretary of NCRC in Plant Pathology 2014. The Convener briefed the committee on the draft curriculum and appreciated the contribution of various sub-committees (27 sub-committees for the review of courses at undergraduate and 23 for post-graduate levels) for the development of the curriculum in Plant Pathology as per national and international requirements.

The Secretary of the committee presented the preliminary draft of the curriculum in Plant Pathology. The Committee thoroughly reviewed and discussed the draft curriculum for under-graduate and post-graduate
programmes in Plant Pathology. After detailed discussion during various technical sessions, a number of courses were further improved and additions/deletions were made in existing courses both at undergraduate and post-graduate levels. Advanced and recent literature was included in the curricula.

To apprise the students of recent trends in Plant Pathology, a list of new courses was included at undergraduate and post graduate levels such as: Biotechnology and its Application in Plant Pathology, Plant Pathology and International Obligations and Bioinformatics in Plant Pathology etc.

Keeping in view the health hazards of pesticides and pollutants and significance of eco-friendly disease management, a new course entitled, “Plant Pathology and Environmental Concerns” was also included unanimously in the scheme of studies at post-graduate level.

After detailed discussion, the committee approved the suggestion to make compulsory at least two courses (Advances in Plant Pathology and Molecular Plant-Microbe Interactions) at PhD degree program in Universities and Degree awarding institutions. The committee finalized curriculum for BSc (Hons), MSc (Hons) and PhD programs in Plant Pathology and approved a total of 50 courses for undergraduate and post-graduate degree programmes (27 courses for undergraduate and 23 at post-graduate programs). The committee also finalized the recommendations for the implementation of the new curriculum and further strengthening of the degree programs in Plant Pathology at both undergraduate and post-graduates levels in Pakistan.
# FRAMEWORK / TEMPLATE FOR BSc (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%

<table>
<thead>
<tr>
<th>Knowledge Area</th>
<th>Subject Area</th>
<th>Name of Course</th>
<th>CR</th>
<th>Total Courses</th>
<th>Total Credits</th>
<th>% Area</th>
<th>% overall</th>
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<td></td>
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<td>4.44</td>
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<tr>
<td></td>
<td></td>
<td>Marketing &amp; Agri. Business</td>
<td>3</td>
<td>2</td>
<td>6</td>
<td>19.35</td>
<td>4.44</td>
</tr>
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<td>Intro to Comm. Technology</td>
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<td>19.35</td>
<td>4.44</td>
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<td>2</td>
<td>6</td>
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<td>100</td>
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<th>Agriculture Domain</th>
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<tr>
<td>Basic Agriculture</td>
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<tr>
<td>Agronomy</td>
</tr>
<tr>
<td>Plant Breeding &amp; Genetics</td>
</tr>
<tr>
<td>Entomology</td>
</tr>
<tr>
<td>Introductory Plant Pathology</td>
</tr>
<tr>
<td>Food Technology</td>
</tr>
<tr>
<td>Horticulture</td>
</tr>
<tr>
<td>Soil Sciences</td>
</tr>
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<td>Agricultural Eco.</td>
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<td>Agriculture Exten.</td>
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<td>Forestry &amp; Range Management</td>
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<td>11.0</td>
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Agriculture Domain: 11  
Non-Agriculture Domain: 31  
Total: 100  
Percentage: 23%
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<tr>
<th>Knowledge Area</th>
<th>Subject Area</th>
<th>Name of Course</th>
<th>CR</th>
<th>Total Courses</th>
<th>Total Credits</th>
<th>% Area</th>
<th>% over all</th>
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<td></td>
<td>Water Management</td>
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<td></td>
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</tr>
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<td></td>
<td>Any other recommended by University</td>
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<td>Major Courses (18-20 Courses)</td>
<td>Major Based Core (Depth)</td>
<td>Major</td>
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<td>18-20</td>
<td>56-60</td>
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<td>Project / Internship</td>
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<td>100</td>
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<tr>
<td>Total</td>
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<td></td>
<td>-</td>
<td>31-35</td>
<td>99-109</td>
<td>100</td>
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<td>Grand-Total</td>
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<td>42-46</td>
<td>130-140</td>
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</table>

**Template for 4-Year BSc (Hons) in Agricultural Disciplines**

1. **Compulsory Courses**

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits Hours</th>
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<tbody>
<tr>
<td>Mathematics / Biology (2 courses)</td>
<td>6 (3-0) (2-1)</td>
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<tr>
<td>Statistics 1 &amp; 2</td>
<td>6 (3-0) (3-0)</td>
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<tr>
<td>Computers / IT</td>
<td>3 (2-1)</td>
</tr>
<tr>
<td>Pakistan Studies</td>
<td>2 (2-0)</td>
</tr>
<tr>
<td>Islamic Studies</td>
<td>2 (2-0)</td>
</tr>
<tr>
<td>Communications Skills</td>
<td>3 (3-0)</td>
</tr>
<tr>
<td>English</td>
<td>3 (3-0)</td>
</tr>
<tr>
<td>Basic Agriculture</td>
<td>3 (2-1)</td>
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</tbody>
</table>

**Sub-Total 28**

2. **Interdisciplinary Foundation Courses**

<table>
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<tr>
<th>Course</th>
<th>Credits Hours</th>
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</thead>
<tbody>
<tr>
<td>Agronomy</td>
<td>3 (2-1)</td>
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<tr>
<td>Plant Breeding &amp; Genetics</td>
<td>3 (2-1)</td>
</tr>
<tr>
<td>Entomology</td>
<td>3 (2-1)</td>
</tr>
<tr>
<td>Introductory Plant</td>
<td>3 (2-1)</td>
</tr>
<tr>
<td>Pathology</td>
<td>3 (2-1)</td>
</tr>
<tr>
<td>Food Technology</td>
<td>3 (2-1)</td>
</tr>
<tr>
<td>Horticulture</td>
<td>3 (2-1)</td>
</tr>
<tr>
<td>Soil Sciences</td>
<td>3 (2-1)</td>
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<tr>
<td>Agriculture Economics</td>
<td>3 (2-1)</td>
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</table>

**Sub-Total 24**
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**

<table>
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<th>Sub-Total during the first four semesters</th>
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<td>Semester 5, 6, 7 &amp; 8</td>
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<td>Project / Internship</td>
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<td>Grand Total</td>
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</table>

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 PROGRAMME IN
PLANT PATHOLOGY
LIST OF COURSES

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Title of Courses</th>
<th>Credit Hours</th>
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</thead>
<tbody>
<tr>
<td>1.</td>
<td>Introduction to Plant Pathogens</td>
<td>3(2-1)</td>
</tr>
<tr>
<td>2.</td>
<td>Introductory Plant Pathology</td>
<td>3(2-1)</td>
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<tr>
<td>3.</td>
<td>Introduction to Plant Viruses</td>
<td>3(2-1)</td>
</tr>
<tr>
<td>4.</td>
<td>Introduction to Plant Prokaryotes</td>
<td>3(2-1)</td>
</tr>
<tr>
<td>5.</td>
<td>Introductory Mycology</td>
<td>3(2-1)</td>
</tr>
<tr>
<td>6.</td>
<td>Introduction to Plant Parasitic Nematodes</td>
<td>3(2-1)</td>
</tr>
<tr>
<td>7.</td>
<td>Beneficial Microorganisms for sustainable agriculture</td>
<td>3(2-1)</td>
</tr>
<tr>
<td>8.</td>
<td>Diseases of Field Crops</td>
<td>3(2-1)</td>
</tr>
<tr>
<td>9.</td>
<td>Introductory Range and Forest Pathology</td>
<td>3(2-1)</td>
</tr>
<tr>
<td>10.</td>
<td>Diseases of Vegetable Crops</td>
<td>3(2-1)</td>
</tr>
<tr>
<td>11.</td>
<td>Plant Resistance to Diseases</td>
<td>3(2-1)</td>
</tr>
<tr>
<td>12.</td>
<td>Soil-borne Plant Pathogens</td>
<td>3(2-1)</td>
</tr>
<tr>
<td>13.</td>
<td>Methods and Techniques in Plant Pathology</td>
<td>3(1-2)</td>
</tr>
<tr>
<td>14.</td>
<td>Diseases of Fruits and Ornamentals</td>
<td>3(2-1)</td>
</tr>
<tr>
<td>15.</td>
<td>Seed and Postharvest Pathology</td>
<td>3(2-1)</td>
</tr>
<tr>
<td>16.</td>
<td>Plant Disease Management</td>
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<tr>
<td>17.</td>
<td>Introductory Molecular Plant Pathology</td>
<td>3(2-1)</td>
</tr>
<tr>
<td>18.</td>
<td>Plant Disease Epidemiology</td>
<td>3(2-1)</td>
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<tr>
<td>19.</td>
<td>Histopathology of Diseased Plants</td>
<td>3(2-1)</td>
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<td>20.</td>
<td>Pesticides, their Action and Application</td>
<td>3(2-1)</td>
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<td>21.</td>
<td>Abiotic Diseases of Plants</td>
<td>3(2-1)</td>
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<td>22.</td>
<td>Biotechnology and its Application in Plant Pathology</td>
<td>3(2-1)</td>
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<td>23.</td>
<td>Biology and Cultivation of Edible Fungi</td>
<td>3(2-1)</td>
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<td>24.</td>
<td>Plant Quarantine and SPS measures</td>
<td>3(2-1)</td>
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<td>25.</td>
<td>Internship / Project Study</td>
<td>4(0-4)</td>
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</tbody>
</table>

Total = 76*

*Minimum course requirement for the degree: 56-60 + Internship.
DETAIL OF COURSES FOR UNDER GRADUATE PROGRAMME IN PLANT PATHOLOGY

1. Title of the Course: INTRODUCTION TO PLANT PATHOGENS
   Credit Hours: 3(2-1)
   Prerequisites: Biology (Higher Secondary level)
   Learning Objectives: To acquaint students with basic concepts and identification of plant pathogens
   Course Contents:
   Introduction; economic importance; general characteristics (morphology, reproduction and ecology); Identification of plant pathogens including fungi, prokaryotes, viruses, viroids, nematodes, fungus like organisms and phane rogamic parasites, taxonomic position of economically important plant pathogens.

Practical
Orientation of laboratory equipments; sterilization of glassware, 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:
2. Title of the Course: INTRODUCTORY PLANT PATHOLOGY  
Credit Hours: 3(2-1)  
Prerequisites: Biology (Higher Secondary level)  
Learning Objectives: To acquaint students with basic concepts of Plant Pathology  

Course Contents:  
Theory  
Introduction and history of plant pathology; basic characteristics of fungi, bacteria, viruses and nematodes; concept of disease in plants; economic importance of plant diseases; nature and cause of (biotic and abiotic) diseases; components of plant disease development; diagnosis of plant diseases; principles of plant disease management; Introduction to IDM and IPM; symptoms, etiology, mode of infection, disease cycle and management of representative diseases of agricultural and horticultural crops.  

Practical  
Demonstration of lab equipments and reagents; collection, preservation and identification of plant diseases based on symptoms; isolation and inoculation techniques; demonstration of Koch’s postulates.  

Recommended Books:  
3. **Title of the Course:** INTRODUCTION TO PLANT VIRUSES  
   **Credit Hours:** 3(2-1)  
   **Prerequisites:** Introductory Plant Pathology  

**Learning Objectives:**  
To introduce students to the basic and applied concepts of plant viruses

**Course Contents:**

**Theory**  
Introduction, history and importance, morphology, composition and structure; classification of plant viruses, their replication, 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) and molecular methods (polymerase chain reaction).

**Recommended Books:**
4. Title of the Course: INTRODUCTION TO PLANT PROKARYOTES

Credit Hours: 3 (2-1)

Prerequisites: Introductory Plant Pathology

Learning 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:
5. **Title of the Course:** INTRODUCTORY MYCOLOGY  
   **Credit Hours:** 3(2-1)  
   **Prerequisites:** Introductory Plant Pathology  

**Learning Objectives:**  
To study the basic and applied aspects of fungi and fungi-like organisms  

**Course Contents:**  

**Theory**  
History and significance of fungi; methods of reproduction; anamorph, teleomorph and holomorph; evolution of classification of fungi and fungi-like organisms; ecology, genetics and dissemination of fungi; interaction of fungi with hosts/ vectors; general characters; economic importance of various phyla; study of morphology and classification of economically important fungi and fungi-like organisms belonging to Plasmodiophoromycota, Oomycota, Chytridiomycota, Zygomycota, Glomeromycota, Ascomycota, Basidiomycota and Mitosporic fungi; study of life histories of fungi of agricultural, scientific and industrial importance.  

**Practical**  
Collection, isolation, mounting, 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:**  
6. **Title of the Course:** INTRODUCTION TO PLANT PARASITIC NEMATODES

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

**Prerequisites:** Introductory Plant Pathology

**Learning Objectives:**
To acquaint the students with basic and applied aspects of plant parasitic nematodes

**Course Contents:**

**Theory**
Introduction to phylum nematoda and related phyla; abundance and importance of plant parasitic nematodes; nematode morphology and anatomy including study of their various systems viz. digestive, reproductive and nervous; taxonomy of plant parasitic nematodes according to feeding habits, fungivores, omnivores, predators and parasites including cellular changes brought during feeding; study of important nematode diseases, symptoms, etiology 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:**
7. Title of the Course: BENEFICIAL MICROORGANISMS FOR SUSTAINABLE AGRICULTURE  
Credit Hours: 3(2-1)  
Prerequisites: Introductory Plant Pathology  
Learning 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 bioccontrol of plant diseases; cultivation of edible fungi and yeasts; classification of soils based on their microbiological properties; principles and strategies for controlling the soil microflora for optimum crop production and protection; application of beneficial microorganisms; functions of microorganisms: putrefaction, fermentation, and synthesis; Introduction to use of cellulose decomposing fungi in paper and textile industry; use of fungi such as Penicillium and Aspergillus species in food processing including cheese ripening, pickle production etc; organisms as experimental tools and supplements of human food and animal feed (single cell protein, fodder yeast etc.); bacteriophages.  
Practical  
Isolation and identification of microorganisms from various substrates and screening and mass multiplication of industrially important
microbes; demonstration of antagonism, competition and antibiosis; isolation and identification of nitrogen fixing bacteria.

**Recommended Books:**

8. **Title of the Course:** DISEASES OF FIELD CROPS  
   **Credit Hours:** 3(2-1)  
   **Prerequisites:** Introductory Plant Pathology  
   **Learning Objectives:** To study 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 cereals, pulses, fodder, oil seed, fiber, tobacco 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; isolation of major pathogens of above mentioned crops.

Recommended Books:

9. Title of the Course: INTRODUCTORY RANGE AND FOREST PATHOLOGY

Credit Hours: 3(2-1)
Prerequisites: Introductory Plant Pathology

Learning Objectives:
To introduce students to 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 diseased samples and identification based on symptoms; identification of causal agents of important diseases of tree; deterioration of timber and other forest trees; preservation of specimens of tree diseases; seed health testing of forest and shade tree seeds; seed treatments and their effect on nursery seedlings/plants.

**Recommended Books:**

10. **Title of the Course:** DISEASES OF VEGETABLE CROPS
**Credit Hours:** 3(2-1)
**Prerequisites:** Introductory Plant Pathology

**Learning 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:**
2. Compendia of cucurbits, onion and garlic, potato, tomato and pea diseases. American Phytopathological Society, St. Paul, Minnesota, USA.

**11. Title of the Course:** PLANT RESISTANCE TO DISEASES  
**Credit Hours:** 3(2-1)  
**Prerequisites:** Introductory Plant Pathology  
**Learning Objectives:**
To introduce students to disease resistance mechanisms in plants.  
**Course Contents:**

**Theory:**
Introduction, historical development and importance of plant resistance against various pathogens; types and mechanisms of resistance against pathogens such as fungi, bacteria, nematodes and viruses; mechanism and genetic basis of resistance towards plant pathogens; gene centers as a source of resistance; host defense system; strategies for gene deployment; transgenic approaches for crop protection; screening of germplasm and resistance mitigation by using
different rating scales/parameters and disease modeling; mechanism and genetic basis of plant resistance towards plant pathogens.

**Practical**
Preparation of inoculum; 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; detection of resistance genes using molecular markers.

**Recommended Books:**
12. **Title of the Course:** SOIL-BORNE PLANT PATHOGENS  
**Credit Hours:** 3(2-1)  
**Prerequisites:** Introductory Plant Pathology

**Learning 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; molecular methods for detecting soil-borne pathogens; conventional, nested and real time PCR.

**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:**

13. **Title of the Course:** METHODS AND TECHNIQUES IN PLANT PATHOLOGY  
**Credit Hours:** 3(1-2)  
**Prerequisites:** Introductory Plant Pathology
Learning Objectives:
To impart knowledge about methodologies and techniques used in Plant Pathology

Course Contents:

Theory
Plant disease clinic and its requirements; expert client interaction; diagnostic protocols; problem identification; hypothesizing; defining objectives; collection, handling, transport, processing and preservation of diseased specimens; protocols and procedures used for the isolation, identification, purification, multiplication and preservation of plant pathogens; Koch’s postulates; microscopic, histo-pathological, serological and molecular techniques; experimental layout, data collection, statistical analysis interpretation and report writing; pre- and postharvest handling to reduce losses in vegetables and fruits.

Practical
Methods of collection and preservation of plant disease specimens; media preparation; equipments, glassware, chemicals and reagents for plant disease clinic; isolation and identification of different plant pathogens; maintenance and preservation of cultures; preparation of temporary and permanent slides; macro and micro-photography and micrometry of plant pathogens; use of haemocytometer; preparation of questionnaire; designing of survey performa; maintenance and preservation of cultures; histo-pathological, serological and molecular methods; experimental layout, data collection, statistical analysis interpretation; recommendation and report writing for clients.

Recommended Books:
14. Title of the Course: DISEASES OF FRUITS AND ORNAMENTALS

Credit Hours: 3 (2-1)

Prerequisites: Introductory Plant Pathology

Learning Objectives:
To study basic and applied aspects of economically important diseases of fruits and ornamental plants and their management.

Course Contents:

Theory
Importance, symptoms, disease cycle, causal agent, methods of perpetuation; management of major diseases of tropical (banana, papaya, guava, mango and citrus), subtropical 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 of management practices.

Recommended Books:
2. Compendia of apple and pear, citrus, grapes, stone fruits and
tropical fruits diseases. American Phytopathological Society, St. Paul, Minnesota, USA.

15. Title of the Course: SEED AND POST-HARVEST PATHOLOGY
Credit Hours: 3(2-1)
Prerequisites: Introductory Plant Pathology

Learning Objectives:
To study seed borne and post-harvest diseases and their management.

Course Contents:

Theory
Introduction, importance and significant losses due to seed and postharvest diseases;
Morphology and anatomy of healthy and infected seed; seed-borne diseases and their effect on seed germination and planting value; histopathology of infected seed and transmission of seed-borne pathogens; effect of biotic and abiotic diseases during storage/ transit and on shelf life of seeds and perishables; epidemiology of seed-borne diseases; seed health testing; mycotoxins and their hazards; economic importance of post harvest losses in seeds, fruits and vegetables during processing; factors affecting postharvest losses (physical, physiological, biochemical and pathological); management of seed and postharvest diseases; methods and structure of storage at farm and public level.

Practical
Seed health testing; different techniques for isolation and identification of microorganisms associated with seeds and their effect on
germination; postharvest losses estimation/ assessment; visits to grains, fruits and vegetables store houses; collection and identification of biotic and abiotic diseased specimens/samples of perishables; use of safe chemicals/fumigants for management of seed and post harvest diseases.

**Recommended Books:**

16. **Title of the Course:** PLANT DISEASE MANAGEMENT  
**Credit Hours:** 3(2-1)  
**Prerequisites:** Introductory Plant Pathology  
**Learning Objectives:**  
To introduce the students to 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; induced systemic resistance; 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; equipments 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:**
17. Title of the Course: INTRODUCTORY MOLECULAR PLANT PATHOLOGY

Credit Hours: 3(2-1)
Prerequisites: Introductory Plant Pathology

Learning 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; genes and diseases, gene variability in hosts and pathogens; genetics of virulence in pathogens and resistance in host plants; co-evolution of hosts and pathogens; signaling in plant disease development; functional analysis of MYB transcription factors in Gibberella zeae; molecular mechanisms of fungicide resistance in plant pathogenic fungi; Pre-existing structural and chemical defenses; defense through lack of essential factors; induced structural and biochemical defenses; resistance gene engineering; vectors for gene engineering; delivering genes to the plant, the use of cloned resistance genes; quorum sensing; programmed cell death; transgenic plants, RNA silencing.

Practical
Methods in molecular plant pathology including the use of molecular approaches to investigate plant diseases; primer design; BLAST search; alignment of sequences, sequence editing; open reading frames; 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, use of degenerated PCR for the detection of plant disease resistance in crop plants.

Recommended Books:
18. **Title of the Course:** PLANT DISEASE EPIDEMIOLOGY  
**Credit Hours:** 3(2-1)  
**Prerequisites:** Introductory Plant Pathology  
**Learning 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; global climate change and relationship between climate variation and plant disease epidemics; monitoring of plant disease epidemics; epidemic growth curve and growth rate; forecasting of epidemics and their modeling; disease warning systems.

**Practical**  
Determination of meteorological parameters and their correlation with plant diseases; development of disease prediction models; use of
expert systems for monitoring epidemic development; crop loss assessment methods.

**Recommended Books:**

19. **Title of the Course:** HISTOPATHOLOGY OF DISEASED PLANTS
   **Credit Hours:** 3(2-1)
   **Prerequisites:** Introductory Plant Pathology
   **Learning Objectives:** To study histo-pathological changes in diseased plants

**Course Contents:**

**Theory:**
Introduction to histopathology of diseased plants; water-soaking, pre-necrotic, necrotic, blighted tissues, abnormal coloration such as yellowing, chlorosis, of leaves; histopathology of affected stem showing wilting, die-back, rust, streak or stripe; histopathology of pitting, scald, scorch and shot hole of leaves and stem; Histopathology of tissues showing hypertrophic, hyperplastic, hypoblastic or abnormal growth including gall, knot, tumefaction, callus, canker; histopathology of russetting, scab, rotting, tissue softening and leaking; histopathology of special symptoms such as witches’ broom, bunchy top, epinasty etc.

**Practical:**
Study and collection of different plant disease symptoms in field and their observation in laboratory by section cutting and slide mounting of infected tissues; preservation of infected parts of diseased plants

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in formalin for future study and presentations; preparation of permanent mounts of infected tissues by section cutting and double staining method; small scale inoculation of pathogens on selected crop plants to study their specific symptoms.

**Recommended Books:**


**20. Title of the Course: PESTICIDES, THEIR ACTION AND APPLICATION**

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

**Prerequisites:** Introductory Plant Pathology

**Learning Objectives:**

To study 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, bactericides, and nematicides etc.); equipments and different methods of application; FAO code of conduct for pesticide use and handling
(codex alementerious; pesticide regulation, registration and distribution in Pakistan; major hazards of pesticides and their safety measures; pesticides compatibility and selectivity; pre-harvest safety intervals.

**Practical**
Demonstration of different groups of pesticides used to control plant diseases; preparation, formulation and doses; use of various equipments and calibration and measurement of droplet size; *In vitro* comparison of systemic and protectant pesticides; visits to pesticides testing labs and warehouses; protective measures and first aid.

**Recommended Books:**

21. **Title of the Course: ABIOTIC DISEASES OF PLANTS**
**Credit Hours:** 3(2-1)
**Prerequisites:** Introductory Plant Pathology

**Learning Objectives:**
To acquaint students with the basic concepts of abiotic plant diseases and their management

**Course Contents:**

**Theory**
Abiotic stresses and their types (temperature, soil moisture and light conditions, lack of oxygen, pollution, mineral deficiencies and toxicities; soil salinity problems; 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:

22. Title of the Course: BIOTECHNOLOGY AND ITS APPLICATION IN PLANT PATHOLOGY

Credit Hours: 3(2-1)
Prerequisites: Introductory Plant Pathology
Learning Objectives: To apprise the students of various techniques of biotechnology and their application in Plant Pathology.

Course Contents:

Theory
Concept, history and development of biotechnology in relation to agriculture and plant pathology; plant cell and tissue culture techniques and production of disease free plants; plant transformation; genetic selection and screening of mutants; host pathogen interactions; recombinant DNA technique to produce disease free plants and to induce resistance in selected cultivars; construction and screening of DNA libraries; DNA sequencing; molecular biology techniques for diagnosis of plant pathogens; bioinformatics & its applications in plant diseases diagnosis and epidemiology; nucleic acid analysis; transgenic plant disease management against viral, bacterial and fungal resistance; plant transformation and genetic markers, selectable marker genes, screenable marker genes, analysis of GUS expression, production of GM plants for disease management.
Practical

Introduction to standard techniques and instruments used in biotechnology laboratories (tissue culture and molecular biology labs); methods to produce disease free cultivars using tissue culture techniques; methods to induce resistance in crop plants against pathogens by gene manipulation (genetic engineering techniques); production of cDNA libraries of selected genes in appropriate expression systems; use of Blotting techniques (Southern, Northern and Western blots); visit to biotechnology labs.

Recommended Books:

23. Title of the Course: BIOLOGY AND CULTIVATION OF EDIBLE FUNGI

Credit Hours: 3(2-1)
Prerequisites: Introductory Plant Pathology
Learning 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; technical aspects of cultivation of button, oyster, straw, Chinese, shiitake, and medicinal edible fungi: growth rooms, pasteurization methods; national and international markets and commercial value of edible fungi; spawn types and processing techniques; pests and diseases of edible fungi and their management.

Practical
Taxonomic studies of wild and cultivated 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:

24. Title of the Course: PLANT QUARANTINE AND SPS MEASURES
Credit Hours: 3(2-1)
Prerequisites: Introductory Plant Pathology
Learning Objectives: To acquaint the students about plant quarantine rules and Sanitary and phytosanitary measures (SPS) measures
Course Contents:

Theory
Plant quarantine concepts and principles; plant and seed related issues of domestic and exotic quarantine object; domestic and International quarantine standards; plant quarantine Act 1976 (Rules, 1967) and Seed Act, 1976 (Seed Amendment Bill-2014) and their implementation in plant and seed import/export; outbreak of some important diseases introduced into Pakistan and elsewhere during import of plant, seed and food items; introduction to SPS measure under WTO regime and its relation to bio-security; inspection procedures and measures adopted under IPC and NAPHIS in Pakistan during import/export of agricultural commodities.

Practical
Visit to port of entry (dry, air and sea ports); practical demonstration of inspection of import/export consignments and collection of samples for analysis of various plants and seed/planting material against various diseases; identification of diseases, inspection procedures and measures adopted under IPC and NAPHIS in Pakistan during import/export consignments; visit to seed testing station of Federal Seed Certification & Registration Department and Department of Plant Protection.

Recommended Books:

25. Title of the Course: INTERNSHIP / PROJECT STUDY
Credit Hours: 4(0-4)
Prerequisites: Introductory Plant Pathology
Learning Objectives:
It is intended to apprise students of the basics of how to design and conduct research, data analysis 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 into the basic principles and techniques of Plant Pathology.

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

Recommended Books:
Relevant latest literature on target issues
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<tr>
<th>S.NO.</th>
<th>TITLE OF COURSE</th>
<th>Cr. Hr.</th>
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<tbody>
<tr>
<td>1.</td>
<td>Mycology-I</td>
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<td>2.</td>
<td>Mycology-II</td>
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<td>3.</td>
<td>Fungal systematics</td>
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<td>4.</td>
<td>Fungal Plant Pathology*</td>
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<td>5.</td>
<td>Plant Virology*</td>
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<td>6.</td>
<td>Plant Bacteriology*</td>
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<td>7.</td>
<td>Plant Nematology*</td>
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<td>8.</td>
<td>Ecology and Epidemiology of Plant Diseases</td>
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<td>9.</td>
<td>Biochemistry and Physiology of Diseased Plants</td>
<td>3(2-1)</td>
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<td>10.</td>
<td>Genetics of Plant Pathogens</td>
<td>3(3-0)</td>
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<td>11.</td>
<td>Seed Pathology</td>
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<td>12.</td>
<td>Integrated Plant Disease Management</td>
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<td>13.</td>
<td>Post-harvest Pathology</td>
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<td>14.</td>
<td>Vector Transmission of Plant Diseases</td>
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<td>15.</td>
<td>Forest and Shade Tree Pathology</td>
<td>3(2-1)</td>
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<td>16.</td>
<td>Advances in Plant Pathology **</td>
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<td>17.</td>
<td>Molecular Plant Virology</td>
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<td>18.</td>
<td>Molecular Plant Microbe Interactions **</td>
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<td>Biological Control of Plant Pathogens</td>
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<td>20.</td>
<td>Plant Pathology and International Obligations</td>
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<td>21.</td>
<td>Bioinformatics for Plant Pathology</td>
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<td>22.</td>
<td>Plant Pathology and Environmental Concerns</td>
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<td>23.</td>
<td>Seminar-I (MSc (H) Thesis)</td>
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<td>Special Problem</td>
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<td>25.</td>
<td>Research Thesis (MSc (H))</td>
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<td>Seminar-II (PhD Synopsis)</td>
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<td>27.</td>
<td>Seminar -III (PhD Thesis)</td>
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<td>28.</td>
<td>Research Thesis (PhD)</td>
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*Core courses for MSc (Hons) Specialization in Plant Pathology
**Core courses for PhD.
DETAIL OF COURSES
FOR POST-GRADUATE PROGRAMMES MSc (HONS)/
PHD IN PLANT PATHOLOGY

1. Title of the Course: MYCOLOGY-I (Straminopila, Protista & Chytridiomycota)

Credit Hours: 3(2-1)
Prerequisites: Introductory Mycology

Learning Objectives:
To study taxonomy and nomenclature of fungi and fungi-like organisms of agricultural importance

Course Contents:

Theory
Evolution of classification of Fungi and Fungi-like organisms: the Six Kingdom System;

Kingdom Protista: Significance, general characteristics and systematic position of Myxomycota, Plasmodiophoromycota, Acrasiomycota and Dictyosteliumycota. Distinguishing characters of the genera of Plasmodiophoromycota; Life cycles of Plasmodiophora and Spongospora.

Kingdom Straminopila: Importance, morphology, biology, taxonomy and nomenclature of Hyphochytridiomycota, Labyrinthulomycota and Oomycota; important characters and classification of Oomycota up to orders and families level; Importance and life cycles of plant pathogens in Peronosporales, Sclerosporales and Pythiales.

Kingdom Fungi: General characters, importance and classification up to phyla. Chytridiomycota: General Characteristics and classification up to orders level; Biology of Synchytrium. Evolution of orders into new phyla.

Practical
Collection, preservation, culturing and identification of mycological specimens with special reference to taxa of agricultural importance; use of keys for identification.

Recommended Books:
2. **Title of the Course: MYCOLOGY-II (Zygomycota, Glomeromycota, Ascomycota, Basidiomycota and Mitosporic fungi)**

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

   **Prerequisites:** Introductory Mycology

**Learning Objectives:**
To study taxonomy and nomenclature of fungi of agricultural importance

**Course Contents:**

**Theory**

**Zygomycota:** General characters, various types of asexual reproductive structures; Zygosporogenesis; role of hormones in sexual reproduction; classification up to order level; Classification of Mucorales and Endogonales up to families and characteristics of important genera; evolution of Glomeromycota.


**Practical**

Collection, preservation, culturing and identification of mycological specimens with special reference to taxa of agricultural importance; use of keys for identification.
Recommended Books:

3. **Title of the Course:** FUNGAL SYSTEMATICS  
   **Credit Hours:** 3(2-1)  
   **Prerequisites:** Introductory Mycology  

**Learning 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:**  
Title of the Course: FUNGAL PLANT PATHOLOGY
Credit Hours: 3(2-1)
Prerequisites: B. Sc. (Hons) Agriculture specialization in Plant Pathology
Learning 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, sub-culturing 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:

5. Title of the Course: PLANT VIROLOGY
Credit Hours: 3(2-1)
Prerequisites: B. Sc. (Hons) Agriculture specialization in Plant Pathology
Learning Objectives: To study basic and advanced concepts of plant viruses and the diseases they cause

Course Contents:
Theory
History and 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; natural and acquired 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.
Virus Disease Control. American Phytopathological Society, St Paul, Minnesota, USA.

6. Title of the Course: PLANT BACTERIOLOGY
Credit Hours: 3(2-1)
Prerequisites: B. Sc. (Hons) Agriculture specialization in Plant Pathology
Learning Objectives: To study basic and applied concepts of plant pathogenic and allied bacteria

Course Contents:
Theory
History of phytobacteriology; economic importance and characteristics of plant pathogenic bacteria; taxonomy and nomenclature, morphology, nutrition, growth and reproduction; survival mechanism in bacteria; bacterial pathogenesis and symptomology; hypersensitive reaction and host-specificity; ecology and spread of plant pathogenic bacteria; bacteriophages and bacteriocins; 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:

7. Title of the Course: PLANT NEMATOLOGY
Credit Hours: 3(2-1)
Prerequisites: B. Sc. (Hons) Agriculture specialization in Plant Pathology

Learning Objectives:
To acquaint students with the basic and applied concepts of plant parasitic nematodes

Course Contents:

Theory
Importance of plant parasitic nematodes; plant response to nematodes; environmental factors affecting survival and pathogenicity; morphology, anatomy, and reproduction; mode and mechanism of infection; concepts and principles of population dynamics; ecology of soil nematodes; estimation of crop losses; nematode-microbe interactions; molecular techniques for taxonomy; advances in phyto-nematological research with emphasis on nematode density/plant yield relationships; study of specific nematode diseases of Pakistan; management of plant parasitic nematodes; identification and propagation of entomopathogenic nematodes.

Practical
Isolation, identification and permanent mounting of important plant parasitic nematodes; pathogenicity tests; collection, handling and diagnosis of diseased plants by symptomatology; integrated management of plant parasitic nematodes.

Recommended Books:
International Distributors, India.


8. Title of the Course: ECOLOGY AND EPIDEMIOLOGY OF PLANT DISEASES

Credit Hours: 3(2-1)

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

Learning Objectives:
To acquaint students with the 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 growth, reproduction and spread of plant pathogens; ecological and population dynamic studies of different plant pathogens; influence of meteorological factors, host resistance and human interceptions 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; pathometry; pre-requisites, visual assessment methods, descriptive and logarithmic scales, standard diagrams, incidence severity relationship, remote sensing, video image analysis.

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 agrimeteorological equipments and information.

**Recommended Books:**

9. **Title of the Course:** BIOCHEMISTRY AND PHYSIOLOGY OF DISEASED PLANTS

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

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

**Learning Objectives:** To study biochemical and physiological changes in diseased plants

**Course Contents:**

**Theory**

Infection process of 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, membrane alterations; growth regulators phytoalexins and toxins; lectin degrading enzymes affecting host cell and cell wall; cutin and suberin degrading enzymes; effect of pathogens on trans-cellular and vascular transport; nature of morphological and biochemical resistance in host plants; energy use and metabolic
regulation in plant-pathogen interactions; effects of root infecting fungi on structure and function of cereal roots; effects of disease on plant water relations; alterations in secondary metabolism; gene activation and interaction.

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:

10. Title of the Course: GENETICS OF PLANT PATHOGENS
Credit Hours: 3(3-0)
Prerequisites: B. Sc. (Hons) Agriculture specialization in Plant Pathology
Learning Objectives: To study the genetics of plant pathogens
Course Contents:

Theory
Mechanisms responsible for variation in plant pathogens including mutation, hybridization, heterokaryosis, paraseuxality, 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; speciation (species concepts), and population genetics of pathogen (Microevolution); study of pathogenicity of fungi, bacteria, viruses and nematodes; study of infection on differential hosts; recognition, colonization and virulence of plant pathogens; evolutionary biology of pathogens; phylogenetics (Macroevolution); genetic drift; gene flow; mating types/systems.

**Recommended Books:**


11. **Title of the Course:** SEED PATHOLOGY  
**Credit Hours:** 3(2-1)  
**Prerequisites:** B. Sc. (Hons) Agriculture specialization in Plant Pathology  
**Learning Objectives:**  
To study the effects of plant pathogens on seed health and their management
Course Contents:

Theory
Introduction to seed pathology; importance of seed-borne fungal, bacterial, viral and nematode diseases; histopathology of healthy and infected seeds/planting materials; mechanism of seed infection and disease transmission; factors affecting establishment of pathogens in seed; seed abnormalities and losses; seed quality control system for disease free seed production, processing and certification with special reference to Pakistan; seed crops and seed standards; seed treatment and equipments; seed processing and storage; seed health testing of consignment during export/import and testing of germplasm material; seed borne pathogens and their health hazards; description of important seed-borne diseases, forecasting of seed-borne diseases; accreditation of seed health testing/seed pathology labs; seed borne diseases and bioterrorism.

Practical
Seed-borne pathogens: identification, preservation, incidence and mode of seed transmission; effect of different chemicals and antagonistic microorganisms 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; maintenance of culture collection of identified seed-borne pathogens.

Recommended Books:

12. **Title of the Course: INTEGRATED PLANT DISEASE MANAGEMENT**

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

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

**Learning 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 management strategies, their integration and application; biological and environmental monitoring for sustainable disease management; role of biotechnology, remote sensing and information technology in IPDM; disinfection and pesticides application; resistance problems; production and evaluation of biocontrol 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:**
13. **Title of the Course:** POST-HARVEST PATHOLOGY  
**Credit Hours:** 3(2-1)  
**Prerequisites:** B. Sc. (Hons) Agriculture specialization in Plant Pathology  
**Learning Objectives:** To study diseases affecting plants in transit and storage  
**Course Contents:**  
**Theory**  
Importance of post-harvest problems and economic losses; damage due to biotic and abiotic factors associated with grains and perishables during harvesting, transit and storage; physiological and biochemical changes in transit and storage due to diseases; mycotoxicoses of grains and perishables originating from field and storage fungi; 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; introduction and significance of commercial treatment including Vapor Heat Treatment (VHT) and Hot Water Treatment of perishable fruits for export to various countries; certification system of grains, fruits and vegetables; study of important postharvest diseases.  
**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; visits of VHT Treatment Plant and Hot Water Treatment Systems; visits of grains, fruits and vegetables storage houses.  
**Recommended Books:**  
14. **Title of the Course:** VECTOR TRANSMISSION OF PLANT DISEASES  
**Credit Hours:** 3(2-1)  
**Prerequisites:** B. Sc. (Hons) Agriculture specialization in Plant Pathology  
**Learning Objectives:** To study the role of insects in plant disease transmission  
**Course Contents:**  
**Theory**  
Insects, nematodes and fungus-like organisms as vectors of plant diseases; modes of transmission and dissemination of plant pathogens by vectors; ecology and vector-plant relationship; factors affecting vector transmission; symptomatology, etiology, epidemiology and management of major fungal, bacterial and viral plant diseases transmitted by vectors.  
**Practical**  
Identification of nematodes and fungus-like organisms 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 vectors.  
**Recommended Books:**  
5. Recent books, journals, reviews, proceedings, etc.
15. **Title of the Course:** FOREST AND SHADE TREE PATHOLOGY  
**Credit Hours:** 3(2-1)  
**Prerequisites:** B. Sc. (Hons) Agriculture specialization in Plant Pathology  
**Learning 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 trees; 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:**

16. **Title of the Course:** ADVANCES IN PLANT PATHOLOGY  
**Credit Hours:** 3(3-0)  
**Prerequisites:** B. Sc. (Hons) Agriculture specialization in Plant Pathology  
**Learning 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 and epidemiological studies of plant pathogens such as survival of pathogens and tracking of isolates; mechanism of genetic variability in pathogens; structure of genomes; allele specific and touch down PCR; molecular markers; molecular resistance; Review/Special Assignment/Presentation.

Recommended Books:
Recent books, journals, reviews, proceedings, reports in Plant Pathology.

17. Title of the Course: 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
Learning Objective: To study advances in virus research

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; study of viruses using 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:
18. Title of the Course: MOLECULAR PLANT-MICROBE INTERACTIONS

Credit Hours: 3(2-1)
Prerequisites: BSc (Hons) Agriculture specialization in Plant Pathology

Learning Objectives:
To study various molecular interactions of plants and associated microbes

Course Contents:

Theory
Theory of co-existence 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 resistance; gene silencing; hypo-virulence; disease management 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 based on molecular approaches.

Recommended Books:


7. Recent books, journals, reviews, proceedings, reports in Plant Pathology.

19. **Title of the Course:** BIOLOGICAL CONTROL OF PLANT PATHOGENS

   **Credit Hours:** 3(2-1)
   **Prerequisites:** B. Sc. (Hons) Agriculture specialization in Plant Pathology
   **Learning Objectives:** To manage plant pathogens through biological approaches

**Course Contents:**

**Theory**
History and importance of biological control; biological control and types of biological interaction; factors involved in biological control; different biocontrol approaches like antagonistic microorganisms, allelopathy, plant and pathogen-derived resistance; methods for stimulation of indigenous biocontrol agents; mass production and commercialization of biocontrol agents; study of different biological agents, mechanism of biocontrol at macro and molecular level.

**Practical**
Isolation, identification, purification and application of biocontrol agents under laboratory and field conditions; preparation of plant products and their evaluation against various plant pathogens; demonstration of mechanisms of biocontrol.

**Recommended Books:**

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20. **Title of the Course:** PLANT PATHOLOGY AND INTERNATIONAL OBLIGATIONS

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

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

**Learning Objectives:** To educate the students on international obligations and agreements with special reference to Plant Pathology

**Course Contents:**

**Theory:**
International treaties, agreements and their relevance to Plant Pathology; an overview of Cartagena protocol on bio-safety; Codex Alimentarius commission (CAC); Intellectual property right (IPR); International plant protection convention (IPPC); Sanitary and phytosanitary measures (SPS) and their working; Food and agriculture organization (FAO) and its working related to World Trade Organization (WTO); issues and problems in import/export relating to phytosanitary aspects of agricultural commodities; impact of major agreements on economy of Pakistan; requirement of material transfer agreement (MTA) regarding movement of plant genetic materials and their testing for health status; worldwide major risks of plant diseases; Introduction to approved ISPMs by IPPC 1997; Framework for Pest Risk Analysis; ISO certification of Plant Pathology Technical Laboratories version 17025; introduction, importance and significance of alien species in international trade; biosecurity and measures to encounter bioterrorism; Review/Special Assignment/Presentation.

**Recommended Books:**
4. Mosoti, V. and A. Gobena. 2007. International Trade Rules and
the Agriculture Sector: Selected implementation issues. FAO Legislative Study, For the Development Law service, FAO Legal Office FAO. 429 pp.

21. **Title of the Course:** BIOINFORMATICS IN PLANT PATHOLOGY  
**Credit Hours:** 3(2-1)  
**Prerequisites:** B. Sc. (Hons) Agriculture specialization in Plant Pathology

**Learning Objectives:**
To study basic and applied aspects of Bioinformatics tools in Plant Pathology

**Course Contents:**

**Theory**
Significance of bioinformatics in Plant Pathology; molecular evolution and goals of molecular phylogeny; properties and types of trees; stages of phylogenetic analysis; phylogenetic methods; access to biological sequence databases; basic local alignment search tool (BLAST); pairwise and multiple sequence alignment; microarray data analysis: pre-processing, scatter plots and micro array plots, global and local normalization, ratios and other parameters; gene, promoter and regulatory element prediction in prokaryotes and eukaryotes; plant resistance genes database (PRGdb); ribosomal data bank project (RDBP); protein domains and motifs, protein sequence and structure, the protein data bank, protein structure, prediction and interaction.

**Practical**
Demonstration of bioinformatics tools; primer designing, sequence alignment, editing and molecular phylogeny of plant pathogens; construction and analysis of phylogenetic trees.

**Recommended Books:**
8. Latest Bioinformatics Software.

22. **Title of the Course:** PLANT PATHOLOGY AND ENVIRONMENTAL CONCERNS

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

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

**Learning Objectives:** To acquaint the students about the environmental issues relevant to Plant Pathology

**Course Contents:**

**Theory**
Introduction to environmental complex; role of anthropogenic activities in degradation of natural resources; environmental pollution caused by use of pesticides and agricultural/industrial wastes; Environmental impact assessment (EIA) as instrument of environmental management; global climate change and its impact on distribution of plant diseases with special emphasis on disease outbreak; environmental and biosafety hazards of genetically modified organisms (GMOs) and risk assessment studies; biosensors as environmental Monitors; Microorganisms as bio-indicators of environmental pollution; bioremediation. Review/Special Assignment/Presentation.

**Recommended Books:**
5. Saleem, M.A and M. Ashfaq. 2004. Environmental Pollution and
23. **Title of the Course: SEMINAR-I (M. Sc (H) Thesis)**  
   **Credit Hours:** 1(1-0)  
   **Prerequisites:** B. Sc. (Hons) Agriculture specialization in Plant Pathology  
   **Learning Objectives:** To present research work carried out for M. Sc (H) Thesis

24. **Title of the Course: SPECIAL PROBLEM**  
   **Credit Hours:** 1(1-0)  
   **Prerequisites:** B. Sc. (Hons) Agriculture specialization in Plant Pathology  
   **Learning Objectives:** To conduct a pilot study determining feasibility of certain aspects of Ph. D research

25. **Title of the Course: Research Thesis (MSc (H))**  
   **Credit Hours:** 10(0-10)  
   **Prerequisites:** Completion of M. Sc research work in Plant Pathology and submission of thesis  
   **Learning Objectives:** To present research work carried out for MSc (H) in thesis format

26. **Title of the Course: SEMINAR-II (PhD Synopsis)**  
   **Credit Hours:** 1(1-0)  
   **Prerequisites:** M. Sc. (Hons) Agriculture specialization in Plant Pathology  
   **Learning Objectives:** To present proposed research work for Ph. D

27. **Title of the Course: SEMINAR-III (PhD Thesis)**  
   **Credit Hours:** 1(1-0)  
   **Prerequisites:** Completion of courses and research work for Ph. D  
   **Learning Objectives:** To present research work carried out for PhD

28. **Title of the Course: Research Thesis (PhD)**  
   **Credit Hours:** 20(0-20)  
   **Prerequisites:** Completion of courses, research work and submission of PhD thesis  
   **Learning Objectives:** To present research work carried out for PhD in thesis format
DETAIL OF COMPULSORY COURSES
IN ENGLISH FOR
UNDERGRADUATE LEVEL

English I (Functional English)  Credit Hrs. 3

Objective:  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

b) Writing

c) Reading/Comprehension

d) Speaking

English II (Communication Skills) Credit Hrs. 3

Objective
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

b) Writing

c) Reading
2. Reading and Study Skills by John Langan

English III (Technical Writing and Presentation Skills) Crh. 3

Objective
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
discursive, descriptive, argumentative and report writing).


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).
Annexure – B

ISLAMIC STUDIES
(COMPULSORY)

Objective:
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 Holy 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 Holy 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) Quran & 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,”
6) Ahmad Hasan, “Principles of Islamic Jurisprudence” Islamic Research Institute, International Islamic University, Islamabad (1993)
9) Dr. Muhammad Zia-ul-Haq, “Introduction to Al Sharia Al Islamia” Allama Iqbal Open University, Islamabad (2001)
Annexure - C

PAKISTAN STUDIES
(COMPULSORY)

Introduction/Objective
- 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
   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:
Annexure – D

COMPULSORY MATHEMATICS COURSES FOR BSC (HONS) AGRICULTURE

1. MATHEMATICS I (ALGEBRA)

Prerequisite(s): Mathematics at secondary level
Credit Hours: 3 + 0

Specific Objective 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,
Kaufmann JE, College Algebra and Trigonometry, 1987, PWS-Kent Company, Boston
2. MATHEMATICS II (CALCULUS)

Prerequisite(s): Mathematics I (Algebra)
Credit Hours: 3 + 0

Specific Objective 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:
Thomas GB, Finney AR, Calculus (11th edition), 2005, Addison-Wesley, Reading, Ma, USA

1. MATHEMATICS III (GEOMETRY)

Prerequisite(s): Mathematics II (Calculus)
Credit Hours: 3 + 0

Specific Objective 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:**

Kaufmann JE, College *Algebra and Trigonometry*, 1987, 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.*
Annexure – E

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 diagram, 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 un-grouped 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 diagram
  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 kenosis

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
4. Basic Statistics an Inferential Approach 2nd Ed. (1986) Fran II. Dietrich-Ill and Thomas J. Kean

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 X2 (chi-square) Testing hypothesis about variance.

Practical
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

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Annexure – F

Course Name:

INTRODUCTION TO INFORMATION AND COMMUNICATION TECHNOLOGIES

Course Structure: Lectures: 2 Labs: 1 Credit Hours: 3
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:


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


Functional Biology-II

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


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

1. Plant Pathology books should be made available at affordable prices to the students of all kind. HEC should collaborate with National Book Foundation to publish the recent recommended books with the permission of original publishers and make them available to universities/colleges along with revised curricula.

2. HEC should facilitate the scientists to participate in conferences within the country through allocation of funds. It will help in exchange of information and ideas that invariably takes place at such fora.

3. Short trainings/workshops should be arranged for faculty members in national and international institutions to update their knowledge in Plant Pathology.

4. Refresher courses should be organized with the assistance of HEC on new courses.

5. Workshops should be organized with the assistance of HEC on emerging disease problems.

6. Expert and student exchange programmes within universities and research organizations in different disciplines of Plant Pathology should be further encouraged.

7. Panel of experts in Plant Pathology from professional societies (e.g. Pakistan Phytopathological society etc.) should be involved in the HEC/Government policy decisions regarding discipline of Plant Pathology.

8. Online access to the recommended research journals and latest books should be provided to all institutions by HEC.

9. HEC should increase research funds for MSc (H)/PhD. students.

10. HEC should provide funds for student internship programmes.

11. HEC needs to formulate a policy for credit hours sharing amongst the universities/institutions.

12. There should be a follow up meeting of conveners and secretaries of all NCRCs to review the actions taken by the HEC and other stakeholders in connection with the implementation of the new curricula.

13. HEC should encourage the local scientists to write reference books. Remuneration for authors and reviewers may be revised and enhanced reasonably.
14. HEC should coordinate to strengthen University-industry linkages seeking funding from industry for research projects.

15. Members of supervisory committees including co-supervisors of research students from R & D organizations should be honored with due remuneration.

16. NCRC recommends following journals to be made available to the Departments country-wide:

**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. Australasian Plant Pathology, APPS, Australia
8. Physiological & Molecular Plant Pathology, UK
9. European Journal of Plant Pathology
10. Journal of Phytopathology

**National Scientific Research Journals**
4. Pakistan Journal of Nematology, Karachi
5. Mycopath, Lahore.
6. Sarhad Journal of Agriculture
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