CURRICULUM
OF
PLANT PROTECTION
BS/BSc (Hons)/MS/MSc (Hons)
& PhD

(Revised 2015)

HIGHER EDUCATION COMMISSION
ISLAMABAD
CURRICULUM DIVISION, HEC

Prof. Dr. Mukhtar Ahmad  Chairman, HEC
Mr. Fida Hussain  Director General (Acad)
Ms. Ghayyur Fatima  Director (Academics)
Mr. Muhammad Arif  Deputy Director (Curr)
Mr. Riaz-ul-Haque  Assistant Director (Curr)
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PREFACE

The curriculum, with varying definitions, is a plan of the teaching-learning process that students of an academic programme are required to undergo. It includes objectives and learning outcomes, course contents, scheme of studies, teaching methodologies and methods of assessment of learning. Knowledge in all academic disciplines is expanding and even new disciplines are also emerging, it is imperative that curriculum are developed and revised regularly.

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 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 nominated by their organizations.

In order to impart education at par with quality 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
- CURRI. UNDER CONSIDERATION
- COLLECTION OF REC
- CONS. OF CRC.
- PREP. OF DRAFT BY CRC
- IMPLE. OF CURRI.

STAGE-II
- CURRI. IN DRAFT STAGE
- APPRAISAL OF 1ST DRAFT BY EXP. OF COL./UNIV
- FINALIZATION OF DRAFT BY CRC
- APPROVAL OF CURRI. BY V.C.C.

STAGE-III
- FINAL SAGE
- PREP. OF FINAL CURRI.
- INCORPORATION OF REC. OF V.C.C.
- PRINTING OF CURRI.

STAGE-IV
- FOLLOW UP STUDY
- QUESTIONNAIRE
- COMMENTS
- REVIEW
- ORIENTATION COURSES
- BACK TO STAGE-I

Abbreviations Used:
CRC. Curriculum Revision Committee
VCC. Vice Chancellor’s Committee
EXP. Experts
COL. Colleges
UNI. Universities
PREP. Preparation
REC. Recommendations
INTRODUCTION

The final meeting of the National Curriculum Revision Committee to review/revise the curriculum of BSc (Hons.), MSc (Hons.) and PhD in Plant Protection was held from April 28-30, 2015 at The Agriculture University of Faisalabad. Following experts attended:

Prof. Dr. Ghulam Jilani
Dean,
Faculty of Agriculture
Department of Entomology/Plant Protection
Lasbela University of Agriculture, water & Marine Sciences,
Uthal Balochistan.
drjilani@gmail.com

Dr. Ahmad-Ur-Rahman Saljoqi,
Professor & Ex-Chairman,
Department of Plant Protection,
The University of Agriculture, Peshawar.
drsaljoqi@yahoo.com
drsaljoqi@aup.edu.pk

Dr. Javed Iqbal
Director (Technical)
Pakistan Agricultural Research Council
Plot 20, Sector G-5/1, Islamabad
linkjaved@gmail.com

Dr. Javaid Iqbal
Head of Department/Assistant professor
Department of Entomology
University College of Agriculture
&Environmental Sciences,
The Islamia University of Bahawalpur,
Bahawalpur.
javaidiqbal@iub.edu.pk

Dr. Inamullah Khan
Professor,
Department of Plant Protection,
The University of Agriculture, Peshawar.

dr.inam@aup.edu.pk
Dr. Rashida Atiq  
Associate Professor,  
Department of Plant Pathology,  
Bahauddin Zakariya University, Multan.  
rashida133@hotmail.com

Dr. Shahbaz Talib Sahi,  
Professor and Chairman,  
Department of Plant Pathology,  
University of Agriculture, Faisalabad.  
shahbzsahi@uaf.edu.pk

Dr. Muhammad Mushtaq  
Professor  
Department of Plant Sciences,  
Faculty of Life Sciences  
BUITMS, Quetta.  
mmushtaq72@gmail.com

Dr. Salik Nawaz Khan  
Assistant Professor,  
Institute of Agricultural Sciences,  
University of the Punjab, Lahore.  
salik_nawaz@yahoo.com

Dr. M. Fareed Khan  
Professor/Chairman  
Department of Plant Breeding & Molecular Genetics,  
University of Poonch, Rawalakot, AJK  
muhammadfareed@upr.edu.pk

Dr. Farman Ali  
Assistant Professor  
Department of Agriculture,  
Abdul Wali Khan University,  
Mardan.  
drfarman@gmail.com

Prof. Dr. Zafar Iqbal  
Principal,  
University College of Agriculture,  
University of Sargodha,  
Lahore-Khushab Bypass Road, Sargodha.  
zaffarohils@yahoo.com
Meeting started with recitation from the Holy Quran by Prof. Dr. Ahmad-Ur-Rahman Saljoqi. Ms. Ghayyur Fatima Director (Curri), HEC welcomed the participants and briefed about the obligations of the Commission for review/revision of curriculum. He briefed the participants about on-going activities of HEC for uplift of Higher Education in the Country.

The committee considered the existing curriculum and expatriate Pakistani expert’s comments.

The committee agreed to recommend BSc (Hons) Plant Protection courses comprising core and supporting courses as compulsory for all students majoring in Plant Protection and relevant elective courses for their proper training in the subject. More emphasis has been given to the major courses in Plant Protection and Research at post graduate level. Sufficient flexibility has also been incorporated in the curriculum for giving more emphasis to the courses to cater the needs of the area where university/college is located.

The Committee agreed to recommend the Plant Protection courses for BSc (Hons) and MSc (Hons.)/PhD The committee agreed to incorporate Plant Protection subject in the interdisciplinary Foundation Courses like all other major courses.
Template for 4-Year BSc (Hons) in Agricultural Disciplines

1. Compulsory Courses

<table>
<thead>
<tr>
<th>Course</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mathematics / Biology</td>
<td>6 (3-0) (2-1)</td>
</tr>
<tr>
<td>Statistics</td>
<td>6 (3-0) (3-0)</td>
</tr>
<tr>
<td>Computer/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>Communication 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>
</tr>
</tbody>
</table>

**Sub-Total: 28**

2. Interdisciplinary Foundation Courses

<table>
<thead>
<tr>
<th>Course</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agronomy</td>
<td>3 (2-1)</td>
</tr>
<tr>
<td>Plant Breeding &amp; Genetics</td>
<td>3 (2-1)</td>
</tr>
<tr>
<td>Plant Protection</td>
<td>3 (2-1)</td>
</tr>
<tr>
<td>Entomology</td>
<td>3 (2-1)</td>
</tr>
<tr>
<td>Plant 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 Science</td>
<td>3 (2-1)</td>
</tr>
<tr>
<td>Agriculture economics</td>
<td>3 (2-1)</td>
</tr>
</tbody>
</table>

**Sub-Total: 27**

3. Supporting courses (6-7 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: 18-21**

Sub-Total during the first four semesters: 70-76
Semester 5, 6, 7 & 8: 56-60
Project/Internship: 04
Grand Total: 130-140
- 1 credit of theory = one contact hour per week for 16-18 weeks and 1 practical/lab hour = 3 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 BS/BSc (HONS)
## PLANT PROTECTION

### I or II year 1st Semester - 4th Semester

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Course Name</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Fundamentals of Plant Protection</td>
<td>3 (2-1)</td>
</tr>
</tbody>
</table>

### III Year 5th Semester

| 1.    | Principles of Plant Protection                  | 3 (2-1)      |
| 2.    | Pest Ecology                                    | 3 (2-1)      |
| 3.    | Pesticides and their Application Techniques     | 3(2-1)       |
| 4.    | Introductory Acarology                          | 3 (2-1)      |
| 5.    | Elective                                        | 3 (2-1)      |
| **Total** |                                             | **15**       |

### III Year 6th Semester

| 6.    | Plant Nematology                                | 3 (2-1)      |
| 7.    | Pests of Field Crops                            | 3 (2-1)      |
| 8.    | Principles of Plant Disease Management          | 3 (2-1)      |
| 9.    | Identification and Biology of Pests             | 3(2-1)       |
| 10.   | Elective                                        | 3 (2-1)      |
| **Total** |                                             | **15**       |

### IV Year 7th Semester

| 11.   | Introduction to Weeds and Phanerogamic Parasites| 3 (2-1)      |
| 12.   | Pests of Fruits, Vegetables and Ornamentals     | 3 (2-1)      |
| 13.   | Vertebrate Pest Management                      | 3 (2-1)      |
| 14.   | Post-Harvest Pest Management                    | 3 (2-1)      |
| 15.   | Elective                                        | 3 (2-1)      |
| **Total** |                                             | **15**       |

### IV Year 8th Semester

| 16.   | Range and Forest Pest Management                | 3 (2-1)      |
| 17.   | Biological Control                              | 3 (2-1)      |
| 18.   | Scientific Writing and Presentation             | 3(3-0)       |
| 19.   | Project/Internship                              | 4(0-4)       |
| **Total** |                                             | **13**       |

**Grand Total 130 – 140**
Note: The University may re-adjust the above semester-wise scheme and can incorporate even some other elective courses apart from the list mentioned below as decided by the Board of Studies.

List of Undergraduate Elective Courses

<table>
<thead>
<tr>
<th></th>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Pest Scouting and Forecasting</td>
<td>3 (2-1)</td>
</tr>
<tr>
<td>2</td>
<td>Pollinators and Plant Protection</td>
<td>3 (2-1)</td>
</tr>
<tr>
<td>3</td>
<td>Plant Biosecurity and Biosafety</td>
<td>3 (2-1)</td>
</tr>
<tr>
<td>4</td>
<td>Urban Pest management</td>
<td>3 (2-1)</td>
</tr>
<tr>
<td>5</td>
<td>Molecular Diagnosis in Plant Protection</td>
<td>3 (2-1)</td>
</tr>
</tbody>
</table>
DETAIL OF COURSES FOR BS/BSc (Hons) IN
PLANT PROTECTION

A- BASIC COURSES

FUNDAMENTALS OF PLANT PROTECTION 3(2-1)

Objectives:
To acquaint the students with the basics of plant protection.

Theory:

Practical:
Collection, preservation and identification of pests of field crops, fruits, vegetables and their natural enemies. Field/labs demonstration of damages and losses caused by major pests .Use of plant protection equipments.

Recommended Books:
B. SPECIALIZATION IN PLANT PROTECTION

The committee has proposed the following "TITLES" with credit hours for specialization in Plant Protection during III year (5th and 6th semesters) and 4th year (7th and 8th semester). These are the “CORE” courses, comprising 56-60 credit hours including elective courses, internship, writing and presentation. To fulfill minimum requirements for the completion of the degree, each university may incorporate more courses according to their needs into their schemes of studies (Curricula).

5th SEMESTER

PRINCIPLES OF PLANT PROTECTION 3(2-1)

Objective:
To acquaint the students with the principles of plant protection.

Theory:

Practical:
Study of nature and extent of major pest damage. Demonstration of various methods of pest management and use of equipments. Demonstration of communication/facilitation skills. Field visits.

Recommended Books:


PEST ECOLOGY

Objective:
To acquaint the students with the basics of pest Ecology.

Theory:

Practical:
Study of the relationship of the abiotic factors with the pests. Population estimation and construction of life-tables. Calculations of degree days.

Recommended Books:


PESTICIDES AND THEIR APPLICATION TECHNIQUES 3(2-1)

Objectives:
To acquaint the students with the nature and safe use of pesticides.

Theory:

Practical:

Recommended Books:
INTRODUCTORY ACAROLOGY

Objective:
To acquaint the students regarding mites, their mode of damage and control.

Theory:

Practical:
Collection, sampling, preservation, identification, and rearing techniques of phytophagous, predatory, parasitic and stored grain mites. Preparation of temporary and permanent slides. Population estimation, losses in crop plants and stored grain products.
Recommended Books:

6th SEMESTER

PLANT NEMATOLOGY 3(2-1)

Objective:
To educate the students about nematodes and their management.

Theory:
Practical:
Sampling and extraction techniques of nematodes from soil and plant materials. Staining and preparation for microscopic studies. Identification and culture of nematodes. Preparation of temporary and permanent slides of nematodes. Demonstration of nematode management.

Recommended Books:

PESTS OF FIELD CROPS

Objective:
To educate the students about pest of field crops.
Theory:
Introduction, identification, classification, distribution of pests (insect pest, pathogens, weeds and vertebrates) of economic importance and their symptoms. Mode of damage, life history and management techniques of pests of major field crops according to specific location/region (Cereals, legumes, fiber, oil seed, tobacco and sugarcane crop).

Practical:
Field visits, collection and identification of pests of major crops. Symptoms, mode of damage, loss assessment and management.

Recommended Books:
3. Hill. 2005. Pests Of Stored Products And Their Control (Pb)
6. Horowitz 2004. Insect Pest Management: Field And Protected Crops (Hb)

PRINCIPLES OF PLANT DISEASE MANAGEMENT 3(2-1)

Objective:
To acquaint the students with plant diseases and their management.

Theory:
Introduction to integrated management of plant diseases. Symptoms and disease-index of important diseases of field crops, fruits and vegetables. Principles and methods of plant disease management. Role of environmental factors and nutrition in relation to plant disease development. Host plant resistance in disease management. Epidemiological basis of disease management strategies, such as plant disease forecasting, regulatory procedures, pathogen exclusion and
eradication. Seed health certification and good agricultural practices (GAP).

Practical:
Collection, identification and diagnosis of different plant diseases. Sampling techniques and assessment of disease index. Demonstration of different disease control methods including seed treatment.

Recommended Books:

IDENTIFICATION AND BIOLOGY OF PESTS

Objective:
To educate the students regarding principles of insect classification.

Theory:
Introduction: Ontogeny and phylogeny, types of classification. Classification of insect orders up to family level with particular reference to insects of Pakistan.

Practical:
Study of representative types regarding phylogenetic arrangement of insect orders. Collection and identification of insects up to family level with the help of taxonomic keys.
Recommended Books:

7th SEMESTER

INTRODUCTION TO WEEDS AND PHANEROGAMIC PARASITES

3(2-1)

Objective:
To enable the students to know the basics of weeds, Phanerogamic parasites and their management.

Theory:
Practical:
Collection, preservation and identification of weeds and phanerogamic parasites. Sampling techniques, methods and determination of population density of weeds. Herbicide application, equipments and calibration.

Recommended Books:

PESTS OF FRUITS, VEGETABLES AND ORNAMENTALS 3(2-1)

Objective:
To acquaint the students with the pests of fruits, vegetables and ornamentals.
**Theory:**
Identification, distribution, host plants, economic importance of insect pests of fruits, vegetables and ornamentals. Extent and nature of damage, life history and integrated management of fruits, vegetables and ornamental pests. Evaluation of pest management options for having best IPM protocols.

**Practical:**
Field visit, collection, identification and nature of damage by pests of various fruits, vegetables and ornamentals. Collection and identification of parasitoids and predators of fruits, vegetables and ornamental pests.

**Recommended Books:**

**VERTEBRATE PESTS AND THEIR MANAGEMENT 3(2-1)**

**Objective:**
To educate students on vertebrate pests and their management.

**Theory:**
Introduction to vertebrate pests and their impact on agricultural economy. Principles of Vertebrate Pest Management. Major vertebrate pest species of Pakistan (commercial and field rodents, porcupine, wild boar and birds): their ecology, distribution, biology and behaviour. Damage pattern and damage assessment methods (pre-harvest and post-harvest). Economical impact of vertebrate pests (damage & diseases etc.). Causes and prevention of damage by vertebrate pest species to:
food and fiber plants and structures. Management of vertebrate pests; ecologically based management, physical, mechanical, cultural, biological and chemical control methods. Rodenticides/pesticides for control of vertebrate pests: their classification, modes of actions and related issues. Rodenticide bait formulations and methods of their application for control of various vertebrate pest species.

**Practical:**

**Recommended Books:**
Objective:
To acquaint students with the management of pests and post-harvest losses.

Theory:

Practical:

Recommended Books:
2. Rajaratram,S. 2011. Advances in preservation and processing technologies of fruits and vegetables. (nipa)
8th SEMESTER

RANGE AND FOREST PEST MANAGEMENT 3(2-1)

Objective:
To educate the students regarding range and forest pest management.

Theory:
Introduction. Pests of range and forest plantation. Identification, distribution, economic importance, life history of range and forest pests. Extent and nature of damage. Pest management in range, forest trees and nurseries.

Practical:
Collection and identification of forest pests; insects, mammals, diseased specimens and parasitic plants in range and forest. Demonstration of management techniques of range and forest pests.
Recommended Books:

BIOLOGICAL CONTROL

Objective:
To educate the students on principles and practices of biological control of insect pests

Theory:

Practical:
Collection, preservation and identification of predators, parasitoids, and antagonists. Laboratory culture of important natural enemies. Extent of parasitism and predation of different bio-control agents. Visit to public/private bio-control labs.
Recommended Books:

SCIENTIFIC WRITING AND PRESENTATION 3(3-0)

Objective:
To familiarize the students with research methods, handling of experimental data and writing research papers & reports.

Theory:

Books Recommended:

PROJECT/INTERNSHIP

Assessment by the Host organization (public / private)

UNDERGRADUATE ELECTIVE COURSES

PEST SCOUTING AND FORECASTING

Objective:
To provide the concept of pest sampling, fluctuation; its measurement, and principles.

Theory:
Introduction; population sampling; population fluctuation and its measurement; population models, different methods of pest scouting and forecasting; losses caused by pests to different crops; economics and decision making for pest management concept of integrated pest management (IPM).

Practical:
Demonstration of different methods of pest scouting and forecasting; nature and extent of damage; assessment of crop losses by different methods; determination of economic threshold levels of different crop pests; identification of important bio-control agents; installation of light and pheromone traps; computation, preparation and field application of pesticide formulations; familiarity with irradiation techniques. Designing of IPM modules of important selected crops.

Recommended Books:
POLLINATORS AND PLANT PROTECTION

Objectives:

To educate basic concepts and benefits of pollination

Theory:

Structure of plant flower, Sexual reproduction, Role of insects or other external agents in sexual reproduction, Self and cross-pollination. Taxonomic procedures, diversity & density of insect pollinators, importance & scope of apiculture.

Habitat and niche; intra and interspecific interactions; natural and agro-ecosystems; Nesting sites, Introduction, history and concepts of IPM. Agro-ecosystem analysis, Scope of biological control with special reference to Pakistan; Toxicity and insecticides formulations suitable for pollinators. Habitat degradation, effect of pesticides, mixed cropping, weeding, role of natural flora, rearing of pollinators. Study of both wild and managed pollinators disappearing at alarming rates owing to habitat loss, pesticide poisoning, diseases and pests.
Practical:
Structure of flower and fruit, reproductive organs, process of fertilization. Methods of collection, preservation and labeling of insects; Practical demonstration of wild and domesticated bee colonies, observation of colonies; Effect of pesticides on pollinators, rearing of pollinators (bees and syrphids). Investigate pollination decline. Investigate economic impact.

Recommended Books:

PLANT BIOSECURITY AND BIOSAFETY 3(2-1)

Objective
To facilitate deeper understanding on plant biosecurity and biosafety issues in agriculture.

Theory
History of biosecurity, concept of biosecurity, components of biosecurity, biosafety risks of GMOs and invasive species, Biosafety rules and levels, biowarfare, emergence/resurgence of pests and diseases. Pest information system, use of Global Positioning System (GPS) and Geographic Information System (GIS) for plant biosecurity, pest/disease and epidemic management, strategies for combating risks and costs associated with agroterrorism event, mitigation planning, integrated approach for biosecurity. Biosafety, policies and regulatory mechanism, Cartagena Protocol on Biosafety and its implications.

Practical:
Risk assessment models, pest information system, early warning and forecasting system, use of Global Positioning System (GPS) and Geographic Information System (GIS) for plant biosecurity, pest/disease and epidemic management.
Recommended Books:
2. Seed Act (amended) 2014, Govt. of Pakistan.

MOLECULAR DIAGNOSIS IN PLANT PROTECTION 3(2-1)

Objective:

To educate and train the students on the basic concepts, techniques and new advancement in Plant Protection.
Theory:
Introduction to the molecular and immunological tools used in plant pest diagnosis and identification. Brief introduction to molecular techniques such as PCR, ELISA, RIA, hybridization techniques for the identification of pests. Application of molecular techniques in plant quarantine.

Practical:
Nucleic acid (DNA/ RNA) extraction, PCR and hybridisation techniques, serological techniques such as ELISA and RIA.

Recommended Books:
URBAN PEST MANAGEMENT 3(2-1)

Objective:
To educate the students on urban pest management.

Theory:

Practical:
Survey, collection, identification and preservation of important pests. Demonstration of fumigation techniques, dosimetry and control methodologies.

Recommended Books:
PART-II
POSTGRADUATE COURSES
PLANT PROTECTION

A. MSc (Hons.)

<table>
<thead>
<tr>
<th>Contents</th>
<th>Credit hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Course work</td>
<td>24</td>
</tr>
<tr>
<td>a. Major/Core</td>
<td>12</td>
</tr>
<tr>
<td>b. Minor</td>
<td>6</td>
</tr>
<tr>
<td>c. *Compulsory</td>
<td>6</td>
</tr>
<tr>
<td>2. Thesis</td>
<td>6-10</td>
</tr>
<tr>
<td>Grand total</td>
<td>30-34</td>
</tr>
</tbody>
</table>

* Biochemistry and Statistics

The committee drafted the following postgraduate courses for the scheme of studies of Plant Protection.

<table>
<thead>
<tr>
<th>Number</th>
<th>Course</th>
<th>Credit hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Insect Pathology</td>
<td>3(2-1)</td>
</tr>
<tr>
<td>2</td>
<td>*Advanced Biological Control</td>
<td>3(2-1)</td>
</tr>
<tr>
<td>3</td>
<td>Biotechnology in Plant Protection</td>
<td>3(2-1)</td>
</tr>
<tr>
<td>4</td>
<td>Host Plant Resistance</td>
<td>3(2-1)</td>
</tr>
<tr>
<td>5</td>
<td>Vectors of Plant Diseases</td>
<td>3(2-1)</td>
</tr>
<tr>
<td>6</td>
<td>*Advanced Integrated Pest Management</td>
<td>3(2-1)</td>
</tr>
<tr>
<td>7</td>
<td>Pesticide Toxicology</td>
<td>3(2-1)</td>
</tr>
<tr>
<td>8</td>
<td>Pesticide Residue Analysis</td>
<td>3(2-1)</td>
</tr>
<tr>
<td>9</td>
<td>Research Methods in Plant Protection</td>
<td>3(2-1)</td>
</tr>
<tr>
<td>10</td>
<td>Microbial Control of pests.</td>
<td>3(2-1)</td>
</tr>
<tr>
<td>11</td>
<td>Plant Protection and Environment</td>
<td>3(2-1)</td>
</tr>
<tr>
<td>12</td>
<td>*Advanced Ecology</td>
<td>3(2-1)</td>
</tr>
<tr>
<td>13</td>
<td>Pesticide Resistance Management</td>
<td>3(2-1)</td>
</tr>
<tr>
<td>14</td>
<td>SPS Measure and Quarantine</td>
<td>3(2-1)</td>
</tr>
<tr>
<td>15</td>
<td>Community Integrated Pest Management</td>
<td>3(2-1)</td>
</tr>
<tr>
<td>16</td>
<td>Pest Management Informatics</td>
<td>3(2-1)</td>
</tr>
<tr>
<td>17</td>
<td>International Agreements and Plant Protection</td>
<td>3(2-1)</td>
</tr>
<tr>
<td>18</td>
<td>*Advanced biochemical methods</td>
<td>3(2-1)</td>
</tr>
<tr>
<td>19</td>
<td>*Advanced Acarology</td>
<td>3(2-1)</td>
</tr>
<tr>
<td>20</td>
<td>*Advanced host plant resistance</td>
<td>3(2-1)</td>
</tr>
<tr>
<td>21</td>
<td>Entomopathogenic Nematology</td>
<td>3(2-1)</td>
</tr>
<tr>
<td>22</td>
<td>*Advanced Nematological Techniques</td>
<td>3(2-1)</td>
</tr>
</tbody>
</table>
Courses taken in MSc (Hons.) will not be taken again in PhD degree program as per HEC rule.
* The courses are designed only for PhD degree program.

**MAJOR/CORE COURSES**
The following shall be the core courses in Plant protection at M.Sc. (Hons.) level.

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Research Methods in Plant Protection</td>
<td>3(2-1)</td>
</tr>
<tr>
<td>2. Community Integrated Pest Management</td>
<td>3(2-1)</td>
</tr>
<tr>
<td>3. Plant Protection and Environment</td>
<td>3(2-1)</td>
</tr>
<tr>
<td>4. Host Plant Resistance</td>
<td>3(2-1)</td>
</tr>
</tbody>
</table>

**PhD**
The committee recommended that course work should be compulsory pre-requisite for the PhD degree. It was further decided that for a PhD degree, a student shall have to complete minimum of 18 credit hours, out of which 2/3 credit hours shall be from major courses and 1/3 from minor courses and a comprehensive examination (written and oral) shall follow.

**CORE COURSES**

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Advanced Integrated Pest Management</td>
<td>3 (2-1)</td>
</tr>
<tr>
<td>2. Advanced Biological Control</td>
<td>3 (2-1)</td>
</tr>
</tbody>
</table>

**INSECT PATHOLOGY**

**Objective:**
To educate the students on the injuries and methods of infection by pathogens in insects.

**Theory:**

Practical:

Recommended Books:

ADVANCED BIOLOGICAL CONTROL

Objective:
To educate the students on advances in biological control.
Theory:

Practical:

Recommended Books
BIOTECHNOLOGY IN PLANT PROTECTION 3(2-1)

Objectives:
To educate the students on the role of biotechnology in plant protection.

Theory:

Practical:
Plant tissue culture, DNA isolation from plant/pests, agrobacterium mediated transformation of plant cells, ELISA, PCR, Nucleic acid and protein quantification, gel electrophoresis. Visits to biotechnology labs.

Recommended Books:

HOST PLANT RESISTANCE

Objective:
To educate students on the mechanism of host plant resistance.

Theory:

Practical:
Testing and measurement of relative plant resistance to pests. Determination of factors and mechanisms of resistance. Preparation of mass inocula of various plant pathogens and methods of application to host plants. Screening of crop germplasm for the detection of sources of resistance.
Recommended Books:


VECTORS OF PLANT DISEASES

3(2-1)

Objective:
To educate the students on vectors of plant diseases.

Theory:

Practical:
Recommended Books:

ADVANCED INTEGRATED PEST MANAGEMENT 3(2-1)

Objectives:
To educate the students on advanced techniques of integrated pest management.

Theory:

Practical:
Methods of pest scouting, monitoring and forecasting. Estimation of losses by different sampling techniques. Losses caused by insects, mites, pathogens, and weeds. Determination of economic levels. Visit to Training of facilitators (TOF) , farmer field school (FFS) and woman open school (WOS).

Recommended Books:


PESTICIDE TOXICOLOGY 3(2-1)

Objective:
To educate the students on toxicity and poisoning of pesticide.

Theory:

Practical:
Instructions regarding laboratory equipment used in the toxicological experiments. Gross symptoms produced by representative pesticides in insects and rodents. Determination of Concentration x Time product in comparing relative toxicity of pesticides. Bio-assay of pesticides and probit analysis. Visit to pesticide industries/field visits

Recommended Books:

**PESTICIDE RESIDUE ANALYSIS**

**Objective:**
To educate the students on residual effects of pesticides and their analysis.

**Theory:**
Theoretical and practical aspects of modern analytical techniques used in the qualitative and quantitative analysis of pesticides and their residues. Separation and quantification techniques: gas chromatography, high performance liquid chromatography (HPLC), affinity chromatography, electrophoresis, and immuno-chemistry. Identification of pesticides and their metabolites through mass spectroscopy.
techniques, infrared, nuclear magnetic resonance, and ultraviolet spectroscopy. International food security standards.

Practical:
Use of laboratory equipment for the above mentioned techniques. Interpretation of spectra of pesticide chemicals. Use of TLC, GLC, HPLC and other chromatographic & spectrometric equipment in pesticides residue analysis.

Recommended Books
   http://www.cfsan.fda.gov/~download/pami-all.exe

RESEARCH METHODS IN PLANT PROTECTION 3(2-1)

Objective:
To acquaint students with the research techniques used in plant protection.

Theory:
Introduction to Research, principles of research; Research Ethics and Integrity. Quantitative and qualitative research methods. Challenges in research. Art of scientific investigation, identification of problems, aims and objectives of work plan. Scientific background of research plan, techniques including experimental designs and apparatus employed in plant protection research. Scientific photography and digital image processing. Online information collection, digital library search, bibliographic and other software in plant protection. Data collection,
analysis, interpretation and presentation. Project planning, execution and report writing. Plagiarism and similarity index test

**Practical:**
Lab exercises based on the matters described above.

**Recommended Books:**

**MICROBIAL CONTROL OF PESTS**

**Objective:**
To educate the students on microbes as source of management.

**Theory:**

**Practical:**

**Recommended Books:**

**PLANT PROTECTION AND ENVIRONMENT** 3(2-1)

**Objective:**
To educate students on plant protection with reference to environment.

**Theory:**
Introduction, concept with environmental perspective. Classification and management of environmental pollution (Air, Water, Soil and Noise Pollution). Diversity of pests in different environments. Interactions of
various groups of pests with biological, chemical and physical parameters of their environments. Impact of air, water, soil pollutants and agrochemicals on pests and non-target organisms. Biological responses to pollutants and biogeochemical cycles. Insects as bio-indicators of environmental pollution. Pesticide pollution. Sources of organic contaminants in the soil environment. Key processes affecting pesticides fate and behavior in soil. Transport and off-site migration of organic compounds.

Practical:
Underground water testing, Human blood sampling, hospital visits to know the patients status, Air and soil pollutions. Pollutants effects on useful fauna.

Recommended Books:
12. Terry, R. 2000. Metabolism of agrochemicals in plants. John Willey and Sons, USA.
Objective:
To educate the students on the principles and advances in ecology.

Theory:
Population growth theories, life-tables, key factor analysis, regression, co-existence, co-habitation, competition & mutual displacement, variation, speciation and diversity. A mathematical approach to the dynamics of single and multi-species populations and communities with analytical and simulation model techniques: mathematical and statistical techniques applied to population dynamics and community ecologies. Critical survey of models of population growth, niche matrices, competition, predation, ecological genetics, species diversity & distribution and ecological succession.

Practical:
Use of computer simulations in population of agricultural pests. Computer modeling used by ecologists to clarify and interpret large field data by clustering, transforming, matrices and multivariate analysis. Life table in selective environments.

Recommended Books:

PESTICIDE RESISTANCE MANAGEMENT 3(2-1)

Objective:
To educate the students on development and management of resistance in pests.

Theory:

Practical:

Recommended Books:

SPS MEASURES AND QUARANTINE

Objective:
To educate the students on Sanitary and Phytosanitary (SPS) Measures and quarantine regulations.

Theory:

Practical.
Analysis of various plants and planting material from exportable & importable consignments. Visit of port of entry, dry port and quarantine facilities. Demonstration of quarantine procedures and inspection. Seed sampling, testing procedure and Registration by Federal Seed Certification and Registration Department (FSCRD) and Department of Plant Protection, Government of Pakistan.
Recommended Books:
5. Plant Quarantine Act 1976, Govt. of Pakistan.
7. WTO Publications.

Web sites:

COMMUNITY INTEGRATED PEST MANAGEMENT 3(2-1)

Objective:
To educate the students on integrated pest management approach at community level.

Theory:
Community IPM basics; Community IPM at farmer’s fields, homes, schools, industrial work places, office buildings, parks and recreational areas and public property etc. Agro-ecosystem analysis. Field base diagnostics. Biodiversity conservation. Educational foundations of the farmer field schools Farmer field experimentation & research. Participatory approach in Community IPM. Non-formal education, group dynamics and community IPM in Asia. Government policies and their impacts on community IPM. Curriculum development of training of facilitators (TOF). Women Open School (WOS) and Children Ecological Clubs(CEC).
Practical:
visits to Farmer Field School and Insectariums. Farmers field experiments. Collection, identification and preservation of pests, natural enemies and diseased specimens.

Recommended Books:
11. CABI Bioscience. 2000 Learning to cut the chemicals in cotton. CABI-Bioscience & PAN UK.

PEST MANAGEMENT INFORMATICS 3(2-1)

Objective:
To educate the students on pest management informatics and internet-based computer application of IPM.
Theory:

Practical
Visits to Data Visualization Laboratories. Projects, assignments and presentations Use of bioinformatics software for data analysis. Access to relevant databases

Recommended Books:
INTERNATIONAL AGREEMENTS AND PLANT PROTECTION  3(3-0)

Objective:
To educate the students on international obligations and agreements with reference to plant protection.

Theory:

Recommended Book:
3. WTO Publications

ADVANCED BIOCHEMICAL METHODS  3(2-1)

Objective:
To educate the students on the advanced biochemical techniques.

Theory:

**Practical:**
Preparation of samples, extraction and analyses. Isolation, purification and characterization of major enzymes with the help of chromatographic technique. Research techniques based on the topics discussed in theory sessions. Fluorescent and Confocal microscopy.

**Recommended Books:**
6. Methods of Biochemical Analysis (Multi-voluminous treatise, issued each year) Advances in Enzymology and Related Areas of Molecular Biology, (Multi-voluminous treatise, issued each year)

**ADVANCED ACAROLOGY** 3(2-1)

**Objectives:**
To educate the students on destructive and useful Acarina

**Theory:**
important pest mites through biologicals agents, resistant plants and chemicals. Integrated programs for some noxious mite pests.

**Practical:**

Sampling techniques, population elements. Sampling frequency, habitat and distributions. Estimation of population size, Numerical sampling and data analysis. Sampling and pest management decision. Mounting techniques, preservation, clearing, mounting of the pest and predatory mites.

**Recommended Books:**


ADVANCED HOST PLANT RESISTANCE 3(2-1)

Objective:
To familiarize the students with recent advances in resistance of plants to pests and acquaint with the techniques for assessment and evaluation of resistance in crop plants.

Theory:
Historical perspective, desirable morphological, anatomical and biochemical adaptations of resistance; assembly of plant species - gene pool. Physical and chemical environment conferring resistance in plants, role of trypsin inhibitors and protease inhibitors in plant resistance; Biotechnological approaches in host plant resistance-genetic manipulation of secondary plant substances; incorporation of resistant gene in crop varieties; marker-aided selection in resistance breeding. Estimation of plant resistance based on plant damage-screening and damage rating; evaluation based on pest responses; techniques and determination of categories of plant resistance; breakdown of resistance in crop varieties.

Practical:
Understanding mechanisms of resistance for orientation, feeding, oviposition etc., allelochemical bases of insect pests resistance; macroculturing of test insects like aphids, leaf/plant hoppers, mites and stored grain pests; determination of antixenosis index, antibiosis index, tolerance index, plant resistance index.

Recommended Books:
ENTOMOPATHOGENIC NEMATOLOGY

3(2-1)

Objectives:
To educate the students about the basic and applied aspects of entomopathogenic nematodes (EPN), and to realize them the importance of the use of EPN as a bio-insecticide.

Theory:
Introduction, history of entomopathogenic nematology, taxonomy and systematics of EPN, biogeography, generalized life cycle, host range, tripartite interaction between symbiotically associated entomopathogenic bacteria, nematodes and their insect hosts. Biology and taxonomy of the symbiotic bacteria of EPN, physiology and biochemistry of EPN. Survival biology and behavioral ecology. Use of EPN in IPM. Production technology, formulation and application technology of EPN. Safety regulations.

Practical:
Identification of entomopathogenic nematodes both inside and outside the host. Microscopic studies for identification of dauer and adult stages. Isolation of EPN from soil samples: techniques and field visits. In vivo rearing techniques of EPN. Bioassays for biocontrol with EPN. Microscopic observation of endotokia matricida. Demonstration of EPN application.

Recommended Books:
Integrated Control of Noxious Animals and Plants, West Palearctic Regional Section


ADVANCED NEMATOLOGY TECHNIQUES
3(2-1)

Objectives:
To educate the students about the advanced nematology techniques to make them able to process nematodes and perform nematological research after their training, regardless of their situation (laboratory conditions and taxa of free-living, plant-parasitic or Entomopathogenic nematodes).

Theory:
Knowledge of the biology of the major groups of plant and soil inhabiting nematodes. Sampling and quantification of nematodes (introduction to the theory and practice). Habitats of nematodes. Diagnosis of nematode problems in the field considering all aspects involved in sampling. Identification principles. Recent articles on specific techniques.

Practical:
Recommended Books:

ADVANCES IN PLANT PROTECTION 3(3-0)

Objectives:
To educate the students regarding the emerging issues, new techniques and advancement in Plant Protection.

Theory:

Recommended Books:
1. Rajinder Peshin, David Pimentel. 2014. Integrated Pest


Websites:

3. KEGG: http://www.genome.jp/kegg/
5. BGI WEUG: http://wego.genomics.org.cn/cgi-bin/wego/index.pl
English I (Functional English)

Objectives: Enhance language skills and develop critical thinking.

Course Contents:
Basics of grammar
Parts of speech and use of articles
Sentence structure, active and passive voice
Practice in unified sentence
Analysis of phrase, clause and sentence structure
Transitive and intransitive verbs
Punctuation and spelling
Comprehension
Answers to questions on a given text

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

Listening
To be improved by showing documentaries/films carefully selected by subject teachers
Translation skills
Urdu to English
Paragraph writing
Topics to be chosen at the discretion of the teacher
Presentation skills
Introduction

Note: Extensive reading is required for vocabulary building
Recommended Books:

1. **Functional English**
   
a) Grammar
   
   

   b) Writing
   

   c) Reading/Comprehension
   

   d) Speaking

   **English II (Communication Skills)**

   **Objectives:** Enable the students to meet their real life communication needs.

   **Course Contents:**

   **Paragraph writing**
   
   Practice in writing a good, unified and coherent paragraph

   **Essay writing**
   
   Introduction

   **CV and job application**
Translation skills
Urdu to English

Study skills
Skimming and scanning, intensive and extensive, and speed reading, summary and precise 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)**

**Objectives:** Enhance language skills and develop critical thinking

**Course Contents:**

**Presentation skills**

**Essay writing**
Descriptive, narrative, discursive, argumentative

**Academic writing**
How to write a proposal for research paper/term paper
How to write a research paper/term paper (emphasis on style, content, language, form, clarity, consistency)

**Technical Report writing**

**Progress report writing**

*Note: Extensive reading is required for vocabulary building*

**Recommended Books:**

Technical Writing and Presentation Skills

a) **Essay Writing and Academic Writing**


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

Pakistan Studies (Compulsory)

Introduction/Objectives

- 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 - C

ISLAMIC STUDIES
(Compulsory)

Objectives

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-Baqara 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 Ikhaim (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 of 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) Ulom –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

**Recommended Books**

1) Hameedullah Muhammad, “Emergence of Islam”, IRI, Islamabad
2) Hameedullah Muhammad, “Muslim Conduct of State”
3) Hameedullah 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 - D

COMPULSORY MATHEMATICS COURSES FOR BS (4 YEAR) (FOR STUDENTS NOT MAJORING IN MATHEMATICS)

1. MATHEMATICS I (ALGEBRA)

Prerequisite(s): Mathematics at secondary level

Credit Hours: 3 + 0

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

Course Outline:

Preliminaries: Real-number system, complex numbers, introduction to sets, set operations, functions, types of functions. Matrices: Introduction to matrices, types, matrix inverse, determinants, system of linear equations, Cramer’s rule.

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


Recommended Books:

2. MATHEMATICS II (CALCULUS)

Prerequisite(s): Mathematics I (Algebra)

Credit Hours: 3 + 0

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

Course Outline:

Preliminaries: Real-number line, functions and their graphs, solution of equations involving absolute values, inequalities. Limits and Continuity: Limit of a function, left-hand and right-hand limits, continuity, continuous functions.

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

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

Recommended Books:

4. Thomas GB, Finney AR, Calculus (11th ed.), 2005, Addison-Wesley, Reading, Ma, USA

3. MATHEMATICS III (GEOMETRY)

Prerequisite(s): Mathematics II (Calculus)

Credit Hours: 3 + 0
Specific Objectives of the Course: To prepare the students, not majoring in mathematics, with the essential tools of geometry to apply the concepts and the techniques in their respective disciplines.

Course Outline

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

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

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

Recommended Books:

4. COURSE FOR NON-MATHEMATICS MAJORS IN SOCIAL SCIENCES

Title of subject: MATHEMATICS
Discipline: BS (Social Sciences).
Pre-requisites: SSC (Metric) level Mathematics
Credit Hours: 03 + 00
Minimum Contact Hours: 40
Assessment: written examination;
Effective: 2008 and onward

Aims: To give the basic knowledge of Mathematics and prepare the students not majoring in mathematics.

Objectives: After completion of this course the student will be able to:
• Understand the use of the essential tools of basic mathematics;
• Apply the concepts and the techniques in their respective disciplines;
• Model the effects non-isothermal problems through different domains;

Contents:

1. **Algebra**

2. **Statistics**

**Recommended Books:**

5. MATHEMATICS FOR CHEMISTRY

Credit Hours: 3

Prerequisites: Mathematics at Secondary level

Course Objectives

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


Recommended Books:

6. MATHEMATICS FOR PHYSICS

Contents

1. Preliminary calculus
   - Differentiation
     Differentiation from first principles; products; the chain rule; quotients; implicit differentiation; logarithmic differentiation; Leibnitz' theorem; special points of a function; theorems of differentiation.
   - Integration
     Integration from first principles; the inverse of differentiation; integration by inspection; sinusoidal function; logarithmic integration; integration using partial fractions; substitution method; integration by parts; reduction formulae; infinite and improper integrals; plane polar coordinates; integral inequalities; applications of integration.

2. Complex numbers and hyperbolic functions
   - The need for complex numbers
   - Manipulation of complex numbers
     Additions and subtraction; modulus and argument; multiplication; complex conjugate; division
   - Polar representation of complex numbers multiplication and division in polar form
   - de Moivre's theorem
     Trigonometrical identities; finding the nth roots of unity; solving polynomial equations
   - Complex logarithms and complex powers
   - Applications to differentiation and integration
   - Hyperbolic functions
     Definitions; hyperbolic-trigonometric analogies; identities of hyperbolic functions; solving hyperbolic equations; inverses of hyperbolic functions; calculus of hyperbolic functions
3. **Series and limits**

- **Series**
- **Summation of series**
  Arithmetic series; geometric series; arithmetico-geometric series; the difference method; series involving natural numbers; transformation of series
- **Convergence of infinite series**
  Absolute and conditional convergence; convergence of a series containing only real positive terms; alternating series test
- **Operations with series**
- **Power series**
  Convergence of power series; operations with power series
- **Taylor series**
  Taylor's theorem; approximation errors in Taylor series; standard McLaurin series
- **Evaluation of limits**

4. **Partial differentiation**

- **Definition of the partial derivative**
- **The total differential and total derivative**
- **Exact and inexact differentials**
- **Useful theorems of partial differentiation**
- **The chain rule**
- **Change of variables**
- **Taylor's theorem for many-variable functions**
- **Stationary values of many-variable functions**
- **Stationary values under constraints**

5. **Multiple integrals**

- **Double integrals**
- **Triple integrals**
- **Applications of multiple integrals**
  areas and volumes; masses, centers of mass and cen
troi Pappus’
  theorems; moments of inertia; mean values of functions
- **Change of variables in multiple integrals**
  change of variables in double integ
6. **Vector algebra**

- Scalars and vectors
- Addition and subtraction of vectors
- Multiplication by a scalar
- Basis vectors and components
- Magnitude of a vectors
- Multiplication of vectors
  Scalar product; vector product; scalar triple product; vector triple product
- Equations of lines and planes
  Equation of a line; equation of a plane
- Using vectors to find distances
  Point to line; point to plane; line to line; line to plane
- Reciprocal vectors

7. **Matrices and vector spaces**

- Vectors spaces
  Basic vectors; the inner product; some useful inequalities
- Matrices
- The complex and Hermitian conjugates of a matrix
- The determinant of a matrix
  Properties of determinants
- The inverse of a matrix
- The rank of a matrix
- Simultaneous linear equations
  N simultaneous linear equations in N unknowns
- Special square matrices
  Diagonal; symmetric and antisymmetric; orthogonal; Hermitian; unitary normal
- Eigen vectors and eigen values
  of a normal matrix; of Hermitian and anti-Hermitian matrices; of a unitary matrix; of a general square matrix
- Determination of eigen values and eigen vectors
  Degenerate eigen values
8. **Vector calculus**

- Differentiation of vectors composite vector expressions; differential of a vector
- Integration of vectors
- Space curves
- Vector functions of several arguments
- Surfaces
- Scalar and vector fields
- Vector operators
- Gradient of a scalar field; divergence of a vector field; curl of a vector field
- Vector operator formulae
- Vector operators acting on sums and products; combinations of grad, div and curl
- Cylindrical and spherical polar coordinates
- Cylindrical polar coordinates; spherical polar coordinates
Statistics-I

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.

Practical
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 Books
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-II and Thomas J. Kears
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 Books:

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
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**

3. *Computers, Communications & information: A user's introduction* by Sarah E. Hutchinson, Stacey C. Sawyer
   
ANNEXURE - G

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 Credit Hours 3+0

Myths and realities of evolution
Microevolution
Speciation
Macroevolution
Level of organization
Plants
Tissues
Nutrition and transport
Reproduction
Growth and development
Animals
Tissue, organ system and homeostasis
Information flow and neuron
Nervous system
Circulation and immunity
Nutrition and respiration
Reproduction and development

Ecology and behavior
Ecosystems
Biosphere
Social interactions
Community interactions
Human impact on biosphere
Environment conservation

**Reading**


**Note**

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

**Functional Biology-II Credit Hours 3+0**

Myths and realities of evolution
Microevolution
Speciation
Macroevolution
Level of organization
Plants
Tissues
Nutrition and transport
Reproduction
Growth and development
Animals
Tissue, organ system and homeostasis
Information flow and neuron
Nervous system
Circulation and immunity

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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.
GENERAL RECOMMENDATIONS

1. All the universities should implement the revised curriculum (2015) of Plant Protection in its true spirit.

2. University should ensure that all recommended books in the HEC curriculum are made available in the university/departmental libraries.

3. It is strongly recommended by the committee members that refresher courses/workshops/training/seminars be arranged inland/abroad and funded by the HEC in Plant Protection and relevant fields.

4. HEC should provide opportunities/resources to the teachers to visit International/National universities/institutions to update their knowledge in their respective fields.

5. The universities should arrange to provide sufficient number of faculty to teach courses at various degree programs, keeping in view the student teacher ratio per University rules as recommended by HEC.

6. It is highly recommended that HEC should provide funds to equip laboratories with apparatus and chemicals especially to the universities where these are not available. The process involved in funding should be simplified.

7. Adequately qualified and trained technicians/engineers, Lab assistants and Lab attendants be employed by Universities for the processing of samples and maintenance of sophisticated laboratory equipment. The in-service technicians/ engineers should also be provided training facilities to update their knowledge.

8. HEC should provide initial startup financial support to local MSc/PhD students in the Universities.

9. It is recommended that the universities should follow uniform thesis examination policy.

10. The committee members realized that three days allocated to discuss curriculum were not sufficient. It is recommended that at least four working days should be
11. It is highly recommended that Plant Protection as a major subject should be introduced in all Agricultural Colleges/Faculties at undergraduate and post graduate levels.

12. In every Plant Protection curricula meeting, there should be at least two representatives from stakeholders/concerned Universities.

13. There should be the representation of other organizations like as Federal Seed certification and Registration Department, Federal Plant Protection Department, Various Plant Protection Research Institutes etc.