

CURRICULUM FOR THE DEGREE OF B.Sc. (Hons.) AGRICULTURE

**MAJOR: PLANT PATHOLOGY
(Four Years Program)**



**INSTITUTE OF AGRICULTURAL SCIENCES
UNIVERSITY OF THE PUNJAB, LAHORE**

SCHEME OF STUDIES FOR B.Sc. (Hons.) AGRICULTURE

MAJOR: PLANT PATHOLOGY

(Four Years Program)

1st Semester B.Sc. (Hons) Agriculture (Major: Plant Pathology)

Course No.	Title of Course	Credit Hours	Type
Agr - 101	Basic Agriculture	3 (2-1)	Comp.*
SS - 101	Introduction to Soil Science	3 (2-1)	FC**
Hort - 101	Introductory Horticulture	3 (2-1)	FC
Eng - 101	Exercise in Reading, Writing & Comprehension	3 (3-0)	Comp.
CS - 101	Introduction to Information and Communication Technologies	3 (2-1)	Comp.
Math - 101	Elementary Mathematics	3 (3-0)	Comp.
IS - 101	Islamic Studies	2 (2-0)	Comp.
	Total Credit Hrs.	20	

*Comp. = Compulsory Course

**FC = Interdisciplinary Foundation Course

2nd Semester B.Sc. (Hons) Agriculture (Major: Plant Pathology)

Course No.	Title of Course	Credit Hours	Type
Hort - 102	Horticultural Crop Production	3 (2-1)	FC
AH - 102	Introduction to Animal Husbandry	3 (2-1)	Supp.*
AE - 102	Introduction to Agricultural Economics	3 (3-0)	FC
Stat -102	Introductory Statistics	3 (3-0)	Comp.

FRW - 102	Introduction to Forest and Watershed Management	2 (1-1)	Supp.
CP - 102	General Crop Physiology	2 (1-1)	Supp.
ID - 102	Irrigation and Drainage Practices	2 (1-1)	Supp.
PS – 102	Pakistan Studies	2 (2-0)	Comp.
	Total Credit Hrs.	20	

*Supp. = Supporting Course

3rd Semester B.Sc (Hons) Agriculture (Major: Plant Pathology)

Course No.	Name of Course	Credit Hours	Type
PBG - 201	Elementary Genetics & Plant Breeding	3 (2-1)	FC
FST - 201	Introduction to Food Science & Technology	3 (2-1)	FC
Ento - 201	Introductory Entomology	3 (2-1)	FC
MAB - 201	Agribusiness Management	3 (3-0)	Supp.
FRW - 201	Introduction to Rangeland and Wildlife Management	2 (1-1)	Supp.
VMD - 201	Introduction to Veterinary Preventive Medicines	2 (1-1)	Supp.
FMP - 201	Farm Mechanization and Practices	2 (1-1)	Supp.
Agr - 201	Field Crop Production – I	2 (1-1)	FC
	Total Credit Hrs.	20	

4th Semester B.Sc. (Hons) Agriculture (Major: Plant Pathology)

Course No.	Title of Course	Credit Hours	Type
PP - 202	Introductory Plant Pathology	3 (2-1)	FC

FST - 202	Food Processing & Preservation	3 (2-1)	FC
Ento - 202	Applied Entomology	3 (2-1)	FC
AEE - 202	Introduction to Agriculture Extension	3 (3-0)	Supp.
Eng - 202	Communication Skills & Leadership Development	3 (3-0)	Comp.
FRW – 202	Introduction to GIS and RS	3 (2-1)	Supp.
Agr - 202	Field Crop Production – II	2 (1-1)	FC
	Total Credit Hrs.	20	

List of additional Supporting Courses*

Course No.	Title of Course	Credit Hours	Type
MB – 102	Basics of Molecular Biology	2 (2-0)	Supp.
RS - 202	Rural Sociology & Development	2 (2-0)	Supp.
FRW – 204	Biodiversity and Climate change	2 (2-0)	Supp.
AE – 201	Economics of Climate Change	3 (3-0)	Supp.
RS – 204	Agriculture and Rural Development	3 (3-0)	Supp.
Biotech – 201	Recombinant DNA Techniques	2 (2-0)	Supp.
Biotech – 202	Biosafety and Bioethics	1 (1-0)	Supp.
Biotech – 204	Introductory Bioinformatics	2 (0-2)	Supp.
Biotech – 206	Agricultural Biotechnology	3 (2-1)	Supp.
SS – 202	Agricultural Chemistry	3 (2-1)	Supp.
FST – 204	Principles of Food Security	2 (2-0)	Supp.
ES – 202	GIS and its Applications	3 (2-1)	Supp.

ES – 204	Ecosystem and environment	3 (2-1)	Supp.
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*Courses to be offered in addition/replacement of existing supporting courses in the scheme of studies.

5th Semester B.Sc. (Hons) Agriculture - Plant Pathology

Course No.	Title of Course	Credit Hours
PP – 301	Introductory Mycology	3 (2-1)
PP – 303	Introduction to Plant Parasitic Nematodes	3 (2-1)
PP – 305	Introduction to Plant Prokaryotes	3 (2-1)
PP – 307	Introduction to Plant Viruses	3 (2-1)
PP – 309	Introduction to Plant Pathogens	3 (2-1)
PP – 311	Abiotic diseases of Plants	3 (2-1)
PP – 313	Methods and Techniques in Plant Pathology	3 (1-2)
PP – 315	Plant Quarantine and SPS Measures	3 (2-1)

Note: Minimum of 18 Credit Hours will be offered in a semester

6th Semester B.Sc. (Hons) Agriculture - Plant Pathology

Course No.	Title of Course	Credit Hours
PP – 302	Beneficial Microorganisms for Sustainable Agriculture	3 (2-1)
PP – 304	Diseases of Field Crops	3 (2-1)
PP – 306	Introductory Range and Forest Pathology	3 (2-1)
PP – 308	Plant Resistance to Diseases	3 (2-1)
PP – 310	Seed & Post Harvest Pathology	3 (2-1)
PP – 312	Plant Disease Epidemiology	3 (2-1)

PP – 314	Biotechnology and its Application in Plant Pathology	3 (2-1)
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Note: Minimum of 18 Credit Hours will be offered in a semester

7th Semester B.Sc. (Hons) Agriculture - Plant Pathology

Course No.	Title of Course	Credit Hours
PP – 401	Soil-Borne Plant Pathogens	3 (2-1)
PP – 403	Diseases of Fruits & Ornamentals	3 (2-1)
PP – 405	Pesticides, their Action & Application	3 (2-1)
PP – 407	Plant Disease Management	3 (2-1)
PP – 409	Diseases of Vegetable Crops	3 (2-1)
PP – 411	Introductory Molecular Plant Pathology	3 (2-1)
PP – 413	Histopathology of Diseased Plants	3 (2-1)
PP – 415	Biology and Cultivation of Edible Fungi	3 (2-1)

Note: Minimum of 18 Credit Hours will be offered in a semester

8th Semester B.Sc. (Hons) Agriculture - Plant Pathology

Course No.	Title of Course	Credit Hours
PP – 422	Internship / Study Project	5 (0-5)
PP – 424	Seminar	1 (1-0)
	Total Credit Hrs	6

DETAIL OF COURSES FOR B.Sc. (Hons.) AGRICULTURE MAJOR: PLANT PATHOLOGY (Four Years Program)

Objective

To provide the basic knowledge and background about Pakistan's Agriculture.

Theory

Agriculture, concept, history and importance; Branches and allied sciences in agriculture; Salient features and problems of Pakistan's agriculture; Climate, weather and seasons of Pakistan, their major characteristics and impact on crop production; Land resources and their utilization; Crop nutrition; Water resources, surface and ground water, canal system; Agro ecological zones of Pakistan; Farming systems; Agro-based industries.

Practical

Land measuring units; Demonstration of hand tools and tillage implements; Identification of meteorological instruments; Identification of crop plants, weeds and seeds; Identification of organic and inorganic fertilizers; Calculation of nutrient-cum-fertilizer unit value; Demonstration of various irrigation methods; Field visits.

Recommended Books

1. Abbas, M. A. 2006. General Agriculture. Emporium Urdu Bazar, Lahore.
2. Balasubramaniyan. 2004. Principles and Practices of Agronomy. Agrobios, Jodhpur, India.
3. Khalil, I.A and A. Jan. 2002. Cropping Technology. National Book Foundation, Islamabad.
4. Khan S.R.A. 2001. Crop Management in Pakistan with Focus on Soil and Water. Directorate of Agricultural Information, Punjab, Lahore.
5. Nazir, M.S., E. Bashir and R. Bantel. (Eds.) 1994. Crop Production. National Book Foundation, Islamabad.
6. Qureshi, M.A. M.A. Zia and M.S. Qureshi. 2006. Pakistan Agriculture Management and Development. A-One Publisher, Urdu Bazar, Lahore.

Objective and Learning Outcome

This course introduces the concepts of soil science for agriculture students at under-graduate level. The students will be able to understand soil properties and their relationship with crop production and environment.

Theory

Definition of earth, geology and soil science; Disciplines of soil science. Factors and processes of soil formation. Soil forming rocks and minerals and types of parent material. Soil profile description. Physical, chemical and biological properties of soil. Soil classification and land use capability classes. Soil organic matter: Sources, composition and decomposition. Soil Fertility: Essential plant nutrients, organic and inorganic sources. Salt-affected and waterlogged soils. Soil and water conservation. Soil and water pollution

Practical

Soil sampling and handling. Preparation of saturated soil paste and measurement of pHs and ECe. Determination of soil water contents. Determination of bulk density and total porosity. Soil texture: feel and hydrometer methods. Irrigation water analysis and interpretation. Identification and calculation of nutrient percentage from fertilizer. Determination of soil organic matter .

Recommended Books

1. Bashir, E. and R. Bantel. 2001. Soil Science. National Book Foundation, Islamabad, Pakistan.
2. Brady, N.C. and R.R. Weil. 2007. The Nature and Properties of Soils. 14th Ed. Pearson Education, Upper Saddle River, NJ, USA.
3. Brady, N.C. and R.R. Weil. 2009. Elements of the Nature and Properties of Soils. 3rd Ed. Pearson Education, Upper Saddle River, NJ, USA.
4. Das, D.K. 2011. Introductory Soil Science. 3rd ed. Kalyani Publ. New Delhi-110002, India.
5. Hillel, D. 2008. Soil in the Environment: Crucible of Terrestrial Life. Elsevier Inc., Burlington, MA, USA.
6. Singer, M.J. and D.N. Munns. 2002. Soils- An Introduction. 5th Ed. Prentice-Hall, Inc., Upper Saddle River, NJ, USA.

Prerequisites

F.Sc. (Pre-Medical)

Specific Objectives

To enable the students to understand the basics of Horticulture.

Learning Outcomes

Students must be able to prepare media, identify and propagate important horticultural plants

Theory

Introduction, history, importance and future scope, Definition and divisions of horticulture, Classification of horticultural crops, Plant parts, their modifications and functions, Plant environment; climate (temperature, light, humidity etc) and soil (structure, texture, fertility etc), Phases of plant growth, Propagation of horticultural plants.

Practical

Visit of nurseries, commercial gardens and public parks. Identification and nomenclature of important fruits, vegetables and ornamental plants; Garden tools and their uses, Media and its preparation. Techniques of propagation.

Books recommended

1. Chadha, K.L. 2006. Handbook of Horticulture (6th Ed.). ICAR, New Delhi, India.
2. Christopher, E. P. 2012. Introductory Horticulture. Biotech books, new Dehli, India.
3. Carrol, L., J.R. Shry and H.E. Reily. 2011. Introductory Horticulture (8th Ed.) Delmar-Thomson Learning, Albany, USA
4. Hartmann, H.T., D.E. Kester, E.T. Davies and R.L. Geneve. 2009. Plant Propagation—Principles and Practices (7th Ed.). Prentice-Hall India Learning Pvt. Ltd., New Delhi, India.
5. Malik, M.N. 1994. Horticulture. National Book Foundations, Islamabad.
6. Peter, K.V. 2009. Basics of Horticulture. New India publishing Agency, New Dehli, India.
7. Reiley, H.E., C.L. Shry (Jr). 2004. Introductory Horticulture (6th Ed.). Delmar- Thomson Learning, Albany, USA.
8. Reddy, R. and Shanker J.P.A. 2008. Horticulture. Commonwealth Publishers.

9. Sharma, R.R. 2002. Propagation of Horticultural Crops: Principles and Practices. Kalyani Publishers, Ludhiana, New Delhi, India.

Eng – 101:

**EXERCISE IN READING, WRITING &
COMPREHENSION**

3 (3-0)

Objectives

Enhance language skills and develop critical thinking.

Course Contents

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

Comprehension: Answers to questions on a given text

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

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

Paragraph writing: Topics to be chosen at the discretion of the teacher

Translation skills: Urdu to English

Presentation skills: Introduction

Note: Extensive reading is required for vocabulary building

Recommended Books

a) Grammar

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

b) Writing

1. Writing. Intermediate by Marie-Christine Boutin, Suzanne Brinand and Francoise Grellet. Oxford Supplementary Skills. Fourth Impression 1993. ISBN 0 19 435405 7 Pages 20-27 and 35-41.
- c) Reading/Comprehension
 1. Reading. Upper Intermediate. Brain Tomlinson and Rod Ellis. Oxford Supplementary Skills. Third Impression 1992. ISBN 0 19 453402 2.
- d) Speaking

CS – 101:

**INTRODUCTION TO INFORMATION AND
COMMUNICATION TECHNOLOGIES**

3 (2-1)

Objectives and Learning outcome

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,

Text Books/Reference Books:

1. Introduction to Computers by Peter Norton, 6th International Edition (McGraw HILL)
2. Using Information Technology: A Practical Introduction to Computer & Communications by Williams Sawyer, 6th Edition (McGraw HILL)
3. Computers, Communications & information: A user's introduction by Sarah E. Hutchinson, Stacey C. Swayer
4. Fundamentals of Information Technology by Alexis Leon, Mathewsleon Leon Press.

Math – 101:

ELEMENTARY MATHEMETICS

3 (3-0)

Prerequisite(s)

Mathematics at secondary level

Objective

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

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.

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:

1. Dolciani MP, Wooton W, Beckenback EF, Sharron S, *Algebra 2 and Trigonometry*, 1978, Houghton & Mifflin, Boston (suggested text)
2. Kaufmann JE, *College Algebra and Trigonometry*, 1987, PWS-Kent Company, Boston
3. Swokowski EW, *Fundamentals of Algebra and Trigonometry* (6th edition), 1986, PWS-Kent Company, Boston
4. Anton H, Bevens I, Davis S, *Calculus: A New Horizon* (8th edition), 2005, John Wiley, New York
5. Stewart J, *Calculus* (3rd edition), 1995, Brooks/Cole (suggested text)
6. Swokowski EW, *Calculus and Analytic Geometry*, 1983, PWS-Kent Company, Boston
7. Thomas GB, Finney AR, *Calculus* (11th edition), 2005, Addison-Wesley, Reading, Ma, USA

IS – 101:

ISLAMIC STUDIES

2 (2-0)

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.

Course outlines

Introduction to Quranic Studies: Basic Concepts of Quran

- 1) History of Quran
- 2) Uloom-ul -Quran

Study of Selected Text of Holly Quran:

- 1) Verses of Surah Al-Baqra Related to Faith (Verse No-284-286)
- 2) Verses of Surah Al-Hujrat Related to Adab Al-Nabi (Verse No-1-18)

- 3) Verses of Surah Al-Mumanoon Related to Characteristics of faithful (Verse No-1-11)
- 4) Verses of Surah al-Furqan Related to Social Ethics (Verse No.63-77)
- 5) Verses of Surah Al-Inam Related to Ihkam(Verse No-152-154)

Study of Selected Text of Holly Quran

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

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

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

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

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

Introduction to Sunnah

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

Selected Study from Text of Hadith

Introduction to Islamic Law & Jurisprudence

- 1) Basic Concepts of Islamic Law & Jurisprudence

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

Islamic Culture & Civilization

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

Islam & Science

- 1) Basic Concepts of Islam & Science
- 2) Contributions of Muslims in the Development of Science
- 3) 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
- 5) Hussain Hamid Hassan, “An Introduction to the Study of Islamic Law” leaf Publication Islamabad, Pakistan.
- 6) Ahmad Hasan, “Principles of Islamic Jurisprudence” Islamic Research Institute, International Islamic University, Islamabad (1993)
- 7) Mir Waliullah, “Muslim Jurisprudence and the Quranic Law of Crimes” Islamic Book Service (1982)
- 8) H.S. Bhatia, “Studies in Islamic Law, Religion and Society” Deep & Deep Publications New Delhi (1989)
- 9) Dr. Muhammad Zia-ul-Haq, “Introduction to Al Sharia Al Islamia” Allama Iqbal Open University, Islamabad (2001)

Hort. 102:

HORTICULTURAL CROP PRODUCTION

3 (2-1)

Prerequisites

Introductory Horticulture

Specific Objectives

To make students familiar with production technology of important horticultural crops.

Learning Outcomes

Students are expected to grow different horticultural crops of the region

Theory

Establishment of orchards, vegetable farms and ornamental gardens; site selection, layout methods, wind breaks and their role. Management practices; irrigation, manures and fertilizers, training and pruning, cultivation and weed control. Climate, soil, propagation, rootstocks, cultivars, important pests, harvesting, post-harvest handling and marketing of important horticultural crops (fruits, vegetables and ornamentals) of the region.

Practical

Practice in layout methods, Selection of plants from nursery, propagation methods. Planting and after care. Production techniques and identification of important cultivars of horticultural crops of the region.

Books recommended

1. Acquaah, G. 2009. Horticulture: Principles and Practices (4th Ed.). Prentice-Hall India Learning Pvt. Ltd. New Delhi, India.
2. Adams, C. R., K.M. Bamford and M. P. Early. 2012. Principles of Horticulture (6th Ed.). Routledge, new yark, USA.
3. Ingles, J. 2009. Ornamental Horticulture. Delmar 5 Maxwell Drive, Cifton, Park, New York.
4. Dhaliwal, M.S. 2008. Handbook of Vegetable Crop. Kalyani Publishers, Ludhiana, New Delhi, India.
5. Malik, M.N. 1994. Horticulture, National Book Foundation, Islamabad.
6. Singh, B. 2007. Horticulture at a Glance. Kalyani Publishers, Ludhiana, New Delhi, India.
7. Chottopadhyay, T.K. 2000. A Textbook on Pomology, Vol: II. Kalyani Publishers, New Delhi.
8. Laurie, A. and V.H. Ries. 2004. Floriculture: Fundamentals and Practices. Agrobios (India), Jodhpur, India.
9. Pradeepkumar, T., B. Suma, Jyothibhaskar, K.N. Satheesan, K.V. Peter. 2008. Management of Horticultural Crops (Part 1). Horticulture Science Series Vol. 11. New India Publishing Agency, New Delhi, India.
10. Yadav, P.K. 2007. Fruit Production Technology. International Book Distributing Co. (Publishing Division), Lucknow, India.

AH - 102:

INTRODUCTION TO ANIMAL HUSBANDRY

3 (2-1)

Pre Requisites

Students should know how to rear pet animals

Objectives

To equip students with the knowledge of livestock/poultry breeds, care and management of different species of livestock, their breeding, selection and reproduction, arrangement of proper housing facilities and balanced feeding for achieving the target of maximum productivity.

Theory

Brief History and Importance of livestock, Livestock population, Livestock and their products, Domestication and Zoological classification, Common terminology, Brief review of principal of livestock Management, Farm records

Livestock of housing, Gross composition of milk of various species, Milk products, Transportation and welfare of farm animals, Poultry industry and its importance, Classes, breeds and varieties of poultry and their characteristics

Selection, care and storage of hatching eggs, Type of incubators and incubation requirements, Type of brooders and brooding requirements, Broiler Management

Layer management, Housing and equipments for poultry birds, Introduction to genetics, Basic concepts and role in animal breeding, Breeds of livestock and Breeds of milch animals , Draught and dual purpose cattle, Breeds of buffalo

Breeds of sheep and goat, Breeding and Breeding season, Reproductive cycle, Age at puberty and Gestation, Fertility, fertility and sterility and artificial breeding, System of breeding and Principle of selection, Biotechnological techniques in animal breeding and genetics, Basic terms in animal nutrition, Common feeds and their classification, Feeding standard and their evaluation, Usefulness and limitations of Nutrients and their functions , Rumen micro flora and factors affecting digestion of cellulose and urea in ruminants, Basic principle of feeding dry, milking and pregnant animals

Practical

Body points of animals, Identification and application of various management tools, Handling and restraining of animals, Grooming and cleaning of animals

Demonstration of various components of livestock farming, various housing plans

Demonstration of various housing plans, Milk quality analysis, Demonstration of different Breeds of livestock, Selection of hatching Eggs, Handling of incubator

and brooders, Handling of various farm equipments, Various managements practices, Male and female reproductive organs, Exercises on topic related to breeding and selection, Identification of feed samples, Formulation of balanced rations, Visit to livestock shows/ farms

Books Recommended

1. Benejee,G.C., 1998. A Textbook of Animal Husbandry. Oxford and IBH Publ, Co., New Delhi, India.
2. Card, L.,E. and M.C. Neshim, 1973. Poultry Production (11th Ed.) Bailliere Tindall, London, UK.
3. Donald, D. B. and W. D. Weaver, 2007. Commerical Chicken , Meat and Egg Production, Springer Pvt. Ltd., India.
4. Haq, A. and M. Akhtar, 2004, Poultry Farming. Higher Education Commission, H-9, Islamabad, Pakistan.
5. Henderson,H.O. and S. Reaves, 1962. Dairy Cattle Feeding and Management. John Wiley and Sons, Inc., New York, USA.
6. Khan,B.B., M. Yaqoob, M. Riaz and M. Younas, and A. Iqbal, 2004. Livestock Management Manual. Dep. Of Livestock Management, University of Agriculture Faislabad.
7. Khan,B.B., M. Younas, M. Riaz and M. Yaqoob, 2005. Breeds of Livestock in Pakistan. Pak T.M. printers, Aminpur Bazar, Faisal Abad, Pakistan.
8. Tamarin, R., 1999. Principles of Genetics (6th Ed.) McGraw Hill Co., Boston, USA.
9. Shah, S.I. (Ed.) 1994., Animal Husbandry. National Book Foundation, Islamabad.
10. McDonald, P., R.A. Edwards, J.F.D. Greenhalf and C.A. Morgan, 2008. Animal Nutrition. (6th Ed.) Longman Scientific and Technical publishers, UK.
11. Lasley, J.F., 1963. Genetics of Livestock Improvement. Prentice Hall Inc. Englewood Cliffs, N.F. USA.

AE – 102:

INTRODUCTION TO AGRICULTURAL ECONOMICS

3 (3-0)

Objectives

After completing the course, students will have understanding of the basic concepts of economics and their application in agriculture.

Course contents

Definitions and overview of economics and related terms; Subject Matter & Scope; Theory of consumer behavior; Scale of preferences; Utility, Indifference Curve & related concepts; Demand & Supply analysis; Elasticity of Demand and Supply; Market Equilibrium. Production, factors of production, laws of return and their significance in agriculture. Concept of

macroeconomics; approaches to national income estimation; Growth, Unemployment & Inflation. Important macroeconomic issues in agriculture sector of Pakistan.

Text books

1. Penson, J. B., Capps O. Rossen C. P., & Woodward, R. (2013). Introduction to Agricultural Economics. 5th Edition. New Jersey: Prentice Hall.
2. Samuelson, P. A., & Nordhaus, W. D. (2009). Economics. 19th Edition. New York: McGraw Hills.
3. McConnel, C.R; Brue, S.L and Flynn, S.M. (2011). Economics: Principles, Problems and Policies 19th Edition. New York: McGraw-Hills.

Suggested readings

1. Mankiw, N. Gregory. (2011). Principles of Economics. 5th Edition. Mason: South-Western Cengage learning Publisher.
2. Penson, J. B., Capps, O., Rossen C. P., & Woodward, R. (2013). Introduction to Agricultural Economics. 5th Edition. New Jersey: Prentice Hall.
3. [Cramer](#), G., [Jensen](#) C. W., & [Southgate](#), D. D. (2001). Agricultural Economics and Agribusiness. 8th Edition. Wiley Publisher.
4. Pakistan, Government of. Economic Survey of Pakistan (Various Issues), Economics Advisor Wing, Ministry of Finance, Government of Pakistan.

Stat – 102:

INTRODUCTORY STATISTICS

3 (3-0)

Objectives

To equip the students with basic concepts of bio-statistics and experimental design

Course outlines

Definition and importance of Statistics in Agriculture, Different types of data and variables, Frequency distribution frequency curve.

Definition and calculation of Arithmetic mean, Geometric mean, Harmonic mean, Median quantities and Mode in grouped and ungrouped data.

Mean deviation, Standard deviation and variance, coefficient of variation.

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.

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
3. A. Concise Course in A. Level Statistic with world examples by J. Crawshaw and J. Chambers (1994)
4. Basic Statistics an Inferential Approach 2nd Ed. (1986) Fran II. Dietrich-II and Thomes J. Keans
5. Introduction to Statistical Theory Part-II by Sher Muhammad and Dr. Shahid Kamal (Latest Edition)
6. Principles and Procedures of Statistics A Bio-metrical approach, 2nd Edition, 1980 by R.G.D Steel and James H. Tarric
7. Statistical Procedures for Agricultural Research 2nd Edition (1980) by K.A. Gomez and A.A. Gomez

FRW – 102:	INTRODUCTION TO FOREST AND WATERSHED MANAGEMENT	2(1-1)
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Objective

To acquaint the students with basic knowledge of forestry and forest resources of Pakistan and principles used in watershed management.

Theory

1. Introduction to Forests and watersheds management.
2. Forest resources of Pakistan (description, composition, distribution and status) in different ecological zones.
3. Importance of these natural resources of Pakistan.

4. Constraints and problems in natural resource management.
5. Principles of sustainable forest management.
6. Forestry practices (Agroforestry, social forestry etc.).
7. Principles of Watershed Management.
8. Watersheds of various streams/rivers of Pakistan, their area, distribution, land use patterns, past history, climatic, physiographic, ecological and socio-economic features.
9. Management problems and potentials of various watersheds, afforestation programmes.
10. Watersheds as a sources of power generation and irrigation

Practical

1. Identification of important forest species
2. Visits to various forest types and watershed areas.
3. Watershed measurements (instruments, area, drainage, flow etc.).
4. Study of land use pattern,
5. Visit to watershed projects and river dams.

Recommended Books

1. Franzel, S.; Scherr, S.J. 2001. Trees on the Farm. CAB International.
2. Champion, H.G. et al. 1967. Manual of Silviculture for Pakistan. Pakistan Forest Institute, Peshawar.
3. Quraishi, M. A. A. 1999. Basics of Forestry and Allied Sciences. A-One Publishers, Urdu Bazar, Lahore.
4. Sharpe, G. W., Chare W. Hendee and Wenonah F. Sharpe. 1986. Introduction to Forestry. McGraw Hill Book Co., New York.
5. Sheikh, M.I. 1999. Forests and Forestry in Pakistan. A-One Publishers, Urdu Bazar, Lahore.
6. Quraishi, M.A.A. 2002. Watershed Management in Pakistan. Department of Forestry. UAF.
7. Singh, S.P. and Singh J.S. 1992. Forests of Himalaya. Nainital, Gtanodaya Prakashan.
8. Quraishi, M.A.A. and M.T. Siddiqui. 2002. Practical manual of watershed management. Department of Forestry. UAF.
9. Siddiqui, M.T., R.Sands and A.H. Shah. 2009. Glossary of forestry terms. Pulschay

Theory

Concept, significance of crop physiology, basic terminology used in crop physiology, the cell, physico-chemical properties of solutions, suspensions and colloidal system of plant cells, buffers, absorption and transport of water in crop plants, plant nutrients, photosynthesis and respiration, seed germination and dormancy, growth and development, and growth substances and biotechnology.

Practical

Introduction to equipment used in crop physiology, Preparation of various solutions, Measurement of soil and plant water contents, Seed germination and seedling growth, Demonstration of nutrient deficiency in crop plants

Recommended Books

1. Bajracharya, D. 1999. Experiments in Plant Physiology. A Laboratory Manual. Narosa Publication, New Delhi, India.
2. Hopkins, W. G. 2008. Introduction to Plant Physiology. 4th Ed. John Wiley and Sons. New York, USA.
3. Meidner, H. 1984. Class Experiments in Plant Physiology. Allen and Unwin. London, U. K.
4. Moore, T. C. 1981. Research Experiences in Plant Physiology. A Laboratory Manual. 2nd Ed. Springer-Verlag. Heidelberg, Germany.
5. Sadras, V. and D. Calderini. 2009. Crop Physiology. 1st Ed. Academic Press, UK.
6. Salisbury, F. B. and C. W. Ross. 2010. Plant Physiology. 5th Ed., Wordsworth Publishing Company. Belmont, California, USA.
7. Taiz, L. and E. Zeiger. 2010. Plant physiology. 6th Ed. Sinauer Associates, Inc., Publishers, Sunderland, USA.

Prerequisites

Some basic knowledge of Agriculture and physics, Water Science and Technology

Aims

The aim of this course is to develop understanding and transfer the knowledge about the water saving techniques, flow measurement methods, irrigation methods, irrigation network of Pakistan, irrigation scheduling, drainage problems of Pakistan and how these problems can be overcome.

Objectives

1. To transfer the knowledge of Irrigation agronomy and Canal Irrigation System of Pakistan to the students.
2. To produce skilled persons who can contribute in the development of agriculture sector in terms of beneficially utilizing the scarce and precious water and its losses management through;
 - i. Introducing most practicable irrigation techniques
 - ii. Delivering awareness to the farmers to minimize the water losses and bringing the more area under cultivation.
 - iii. Properly applying the schedule of irrigation.
 - iv. The use of precision land leveling.

Theory

Introduction and scope about the Course, Irrigation & Drainage Practices (ID), Definition and importance of irrigation, purpose & goal of irrigation, Benefits of irrigation, disadvantage & ill-effects of irrigation, source of irrigation water in Pakistan, system of irrigation, Indus Basin Irrigation System of Pakistan, Irrigation System Management, Warabandi, Hill Torrents etc., **Water Measurement:** Need of water flow measurement; Terminology used in water flow measurement; **Irrigation Methods:** Basin Irrigation; Border Irrigation Method; Furrow irrigation method; Sub-Surface irrigation method, High Efficiency Irrigation Methods (Drip/trickle, Sprinkler irrigation system), Consumptive use, its importance, and methods of determination, Definition, importance, components of irrigation scheduling. Well Drilling: methods of well drilling (cable tool method, rotary method), cable tool method; Rotary methods (direct rotary method, reverse rotary method), Well strainers, Development of well and pump characteristics, Pumps and their Use: definition, types of pump (reciprocating pump, jet pump, centrifugal pump, deep well turbine pump, and submersible pump), The Evaporation Pan, Introduction To Drainage, Agricultural drainage, Urban drainage; Objectives of Agricultural Drainage; Surface and Sub-surface Drainage; Occurrence of Drainage Problems; Sources of Drainage Water,

Sprinkler Systems; Adverse Effects of Drainage Problems; Identification of Drainage Problems; Solution of the Drainage Problems; Pipe Drainage for Sub-Surface Drainage; Deep Surface Drains for Watertable Control, Irrigation efficiency, Surface Drains for Storm Water Drainage; Drainage Tubewells; Biological Drainage, Rainwater Harvesting/conservation Technologies/ techniques for Small Scale Rainfed Agriculture in Arid and Semi-arid Areas, Role of Remote sensing and GIS in sustainable irrigation,

Practical

Water Measurement Units; Unit Conversion, Find out the discharge of tap of IAGS by volumetric method, Find out the discharge of water course with the help of velocity area method (Float and current meter method), Flow Measurements of water channel using Rectangular, Triangular and Trapezoidal Weir, Irrigation scheduling, Find out the discharge of tube well through trajectory method (Coordinate Method), Infiltration rate and measurement of infiltration rate using the double ring infiltrometer, Evaporation And Measurement Of Evaporation Rate Using, Evaluation, Management And Water Distribution Uniformity, Irrigation Water Quality; Standards and Salinity Management Strategies, Soil and water quality parameters tests in laboratory, Participatory approaches in water management, Laser land leveling, Demonstration of Laser land leveling in Field

Reference Material

1. Irrigation and Drainage Practices for Agriculture 2008 by Dr M. Rafique Choudhry .
2. Irrigation and Water Management by Mukund Joshi, T.M. Prabhakar Setty
3. Irrigation and Water Management Engineering by V.V.N Murtee

PS – 102:	PAKISTAN STUDIES	2 (2-0)
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Objectives

Develop vision of historical perspective, government, politics, contemporary Pakistan, ideological background of Pakistan.

Course Outline

1. *Historical Perspective*

- a. Ideological rationale with special reference to Sir Syed Ahmed Khan, Allama Muhammad Iqbal and Quaid-i-Azam Muhammad Ali Jinnah.

- b. Factors leading to Muslim separatism
- c. People and Land
 - i. Indus Civilization
 - ii. Muslim advent
 - iii. Location and geo-physical features.

2. Government and Politics in Pakistan

Political and constitutional phases:

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

3. Contemporary Pakistan

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

Recommended books

1. Burki, Shahid Javed. *State & Society in Pakistan*, The MacMillan Press Ltd 1980.
2. Akbar, S. Zaidi. *Issue in Pakistan's Economy*. Karachi: Oxford University Press, 2000.
3. S.M. Burke and Lawrence Ziring. *Pakistan's Foreign policy: An Historical analysis*. Karachi: Oxford University Press, 1993.
4. Mehmood, Safdar. *Pakistan Political Roots & Development*. Lahore, 1994.
5. Wilcox, Wayne. *The Emergence of Bangladesh*, Washington: American Enterprise, Institute of Public Policy Research, 1972.
6. Mehmood, Safdar. *Pakistan Kayyun Toota*, Lahore: Idara-e-Saqafat-e-Islamia, Club Road, nd.
7. Amin, Tahir. *Ethno - National Movement in Pakistan*, Islamabad: Institute of Policy Studies, Islamabad.

8. Ziring, Lawrence. *Enigma of Political Development*. Kent England: WmDawson & sons Ltd, 1980.
9. Zahid, Ansar. *History & Culture of Sindh*. Karachi: Royal Book Company, 1980.
10. Afzal, M. Rafique. *Political Parties in Pakistan*, Vol. I, II & III. Islamabad: National Institute of Historical and cultural Research, 1998.
11. Sayeed, Khalid Bin. *The Political System of Pakistan*. Boston: Houghton Mifflin, 1967.
12. Aziz, K.K. *Party, Politics in Pakistan*, Islamabad: National Commission on Historical and Cultural Research, 1976.
13. Muhammad Waseem, *Pakistan Under Martial Law*, Lahore: Vanguard, 1987.
14. Haq, Noor ul. *Making of Pakistan: The Military Perspective*. Islamabad: National Commission on Historical and Cultural Research, 1993.

PBG – 201:

ELEMENTARY GENETICS & PLANT BREEDING

3 (2-1)

Objectives

To enable students to understand the basic concepts of genetics, mechanism of heredity, basis of plant breeding, Reproductive mechanisms in major crops and application of genetic principles in crop improvement.

Theory

Definition of genetics, concepts of heredity and variation. Cell and cell, divisions. Mendelian genetics: chromosome theory of heredity, various, genotypic and phenotypic ratios and their modifications. Differences between allelic and non-allelic interactions (epistasis), illustration of epistasis with suitable examples. Pleiotropy and multiple allelism. Multiple factor hypothesis. Linkage and crossing over. Sex determination: sex linked and sex influenced traits. Chromosomal aberrations. Nucleic acids: nature, structure and function. Classical vs modern concepts of gene. Introduction to plant breeding and its role in crop improvement. Reproductive systems in major crop plants. Genetic variation and its exploitation, creation of variation through genetic recombination, mutation and heteroploidy. Breeding self-pollinated crops: introduction, mass selection, pure line selection; hybridization, pedigree method, bulk method and backcross techniques. Breeding cross-pollinated crops:

introduction, mass selection, recurrent selection, development and evaluation of inbred lines, development of hybrids, synthetic and composite populations. New trends in plant breeding.

Practical

Study of cell divisions and gametogenesis. Calculation of monohybrid and dihybrid ratios. Numerical examples relating to gene interaction, multiple alleles and multiple factor inheritance. Calculation of linkage from test cross and F₂ data. Descriptive study of floral biology, scientific names, chromosome number and ploidy level of important field crops. Selfing and crossing techniques in major crops. List of approved varieties in major field crops.

Recommended Books

1. Singh, B.D. 2004. Genetics. Kalyani Publishers, New Delhi, India.
2. Klug, W.S. and M. R. Cummings. 2003. Concepts of Genetics. (7th ed.), Pearson Education, Singapore.
3. Singh, P. 2003. Elements of Genetics. (2nd ed.) Kalyani Publishers, Delhi, India.
4. Stansfield, W.D. 1988 Theory and Problems of Genetics. 4th ed. McGraw-Hill Book Co, NY.
5. Khan I.A. F.M. Azhar, Z. Ali and A.A. Khan. 2008. Solving Numerical Genetic Problems. Dept. Plant Breed. Genet. Uni. Agri. Faisalabad.
6. Sleper, D. A. and J.M. Poehlman. 2006. Breeding Field Crops. (5th ed.) Iowa State University Press, Ames, USA.
7. Chahal, G.S. and S.S. Gosal. 2003. Principles and Procedures of Plant Breeding. Narosa Publishing House, New Delhi, India.
8. Singh, B. D. 2003. Plant Breeding: Principles and Methods. Kalyani Publishers, New Delhi, India.
9. Singh, P. 2003. Essentials of Plant Breeding. Kalyani Publishers, New Delhi, India.
10. Khan, M.A (Editor). 1994. Plant Breeding. National Book Foundation, Islamabad.
11. Acquaah, G. 2009. Principles of Plant Genetics and Breeding. John Wiley & Sons, UK.

FST- 201:

**INTRODUCTION TO FOOD SCIENCE AND
TECHNOLOGY**

3 (2-1)

Objective

To familiarize the students with basics of food science and technology.

Theory

Introduction: food science, food technology, relationship with other disciplines, career opportunities. Significance of food science and technology. Global & national food and nutrition situation. Food industry: history, developments. Important food industries in Pakistan. Food sources: plants, animals, marine. Food constituents and their functions: water, carbohydrates, lipids, proteins, vitamins, minerals. Classification of foods: perishability, pH. Food spoilage agents: enzymes, microorganisms, insects, rodents, birds, physical factors. Principles of food preservation: prevention or delay of autolysis, microorganisms, pests, physical defects. Food poisoning: causes and remedies. Quality factors in foods: appearance, texture, flavor etc. Food risks and hazards: Hunger, technology and world food needs

Practical

Use of laboratory equipments. Estimation of moisture, fat, protein, carbohydrates, fiber and ash in food samples. Determination of specific gravity, soluble solids, pH, acidity, total solids, refractive index and peroxide value.

Recommended Books

1. Awan, J.A. 2011. Food science and technology. Unitech Communications, Faisalabad-Pakistan.
2. Awan, J.A. and Rehman, S.U. 2014. Food analysis manual. Unitech Communications, Faisalabad-Pakistan.
3. Campbell-Platt, G. 2009. Food science and technology. Wiley-Blackwell, USA.
4. Penfield, M.P. and Campbell, A.M. 2014. Experimental food science (Food Science and Technology). Academic Press, USA.
5. Potter, N.N. and Hotchkiss, J.H. 2007. Food science. The AVI Pub. Co. Inc., USA.

Ento-201:	INTRODUCTORY ENTOMOLOGY	3 (2-1)
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Learning outcomes

The students would be able to;

1. Know about arthropods and especially insects with their morphological features

2. Identify insects of economic importance and acquire working skills for collecting, mounting, and preserving insects

Theory

Introduction; phylum Arthropoda and its classification; morphology, anatomy and physiology of a typical insect, metamorphosis and its types; insect classification, salient characters of insect orders; examples from major families of economic importance.

Practical

Characters of classes of Arthropoda; collection and preservation of insects; morphology and dissection of a typical insect (digestive, reproductive, excretory, nervous, circulatory and tracheal systems); temporary mounts of different types of appendages of insects; Observations for types of metamorphosis.

Recommended books

1. Ahmad, I. 2010. Hashriat "Insects". National Book Foundation, Lahore
2. Awastheir, V.B. 2009. Introduction to General and Applied Entomology. Scientific Publisher, Jodhpur, India.
3. Dhaliwal, G.S. 2007. An Outline of Entomology. Kalyani Publishers, Ludhiana.
4. Elzinga, R.J. 2003. Fundamentals of Entomology. Prentice Hall.
5. Gullan, P. J. and P. S. Cranston. 2010. The Insects: An Outline of Entomology. 4th edition. Wiley-Blackwell. A John Wiley & Sons, Ltd., Publication, UK.
6. Lohar, M.K. 2001. Introductory Entomology. Department of Entomology, Sindh Agriculture University Tandojam Sindh, Pakistan.
7. Richards, O.W. and Davies, R. G. 2004. Imm's General Text-book of Entomology, Vol. I. and II, 10th Ed. Chapman & Hall, London, N.Y.
8. Romoser, W. S. and Stoffolano, J. G. 1998, The Science of Entomology, WCB McGraw-Hill.
9. Triplehorn, C.A. and Jhonson, N.F. 2005. Borror and DeLong's Introduction to the study of Insects. Brooks Cole. 7th Ed.
10. Trigunayat, M.M. 2009. A Manual of Practical Entomology. 2nd Edition Scientific Publisher (India) Judhupur.
11. Yousuf, M. Tayyab, M. and Shazia, Y. 2007. Manual of Introductory Entomology, University of Agriculture, Faisalabad.

12. Pedigo, L.P. and Marlin, E. R. 2009. Entomology and Pest Management, 6th Edition, Person Education Inc., Upper Saddle River, New Jersey 07458, U.S.A

MAB – 201:

AGRIBUSINESS MANAGEMENT

3 (3-0)

Objective and learning outcome

After completing the course, students will have developed some understanding of concepts, principles and issues in business management.

Course outlines

Scope and objectives of Agribusiness Management; Functions of management; Forms of business organizations; Principles and Techniques of farm planning, operation and management. Enterprise budgeting, Resource constraints, optimum combinations and alternate business plans. Balance Sheet, income statement and their analysis; Benefit Cost Analysis, Uncertainty and Risk in Farm Business; Risk Management Strategies; Supply chain management and Relevant Case studies. Role of Government in Agribusiness management.

Text Books

1. Downey, W.D. & Erickson, S. P. (2002). Agribusiness Management. Singapore: McGraw Hill Education.
2. Castle, E. N., Becker, M. H. & Nelson, A. G. (2002). Farm Business Management. New York: Macmillan.

Books Recommended

1. Kinsey, B. H. (2000). Agri. Business and Rural Enterprise. London: Croom Helm Ltd.
2. Goldberg, R. A., Wilson, L. M., & Austin, J. E. (1974) Agribusiness Management for Developing Countries. Cambridge, MA: Ballinger Publishing Company.
3. Buckett, M. (1981). An Introduction to Farm Organization and Management. Elsevier Science & Technology Books.
4. Kay, R., Edwards, W., & Duffy, P. (2007). Farm Management. 7th Edition. McGraw Hill Education, EU.

FRW – 201:

**INTRODUCTION TO RANGELANDS AND WILDLIFE
MANAGEMENT**

2 (1-1)

Objectives

To give basic knowledge of Rangelands and grasses grown in them and how they are becoming habitat of different wildlife.

Theory:

1. Introduction to Rangelands, scope and importance.
2. Basic terminology,
3. Components of Rangelands
4. Constraints and problems of rangelands.
5. Rangeland Resources of Pakistan; ecological zones and vegetation types.
6. Range ecosystem,
7. Principles of Rangeland Management.
8. Grazing system of the world,
9. Grazing system and grazing pattern in Pakistan.
10. Range improvement techniques.
11. Wildlife: Definition and values,
12. Ecosystem concept, characteristics and management requirements for regional eco-systems in Pakistan including arid, wetland, forest, mountain and coastal ecosystems.
13. Introduction to protected areas (National Park, Game Reserve and Wildlife Sanctuary.
14. Introduction to National Parks of Pakistan.

Practicals

1. Identification and preservations of important
2. Grasses and Plant species of Pothowar [or other nearest regional areas].
3. Visits to various Rangeland types and Plantations.
4. Quantitative analysis of range vegetation, Range frequency, relative frequency, density, relative density, cover and relative cover.
5. Measurements and analysis of wildlife population.

Recommended Books:

1. Vallentine, John, F. 2000. Grazing Management. Academic Press (Elsevier Science & Technology Books).
2. Holechek, J. et al., 1989. Range Management, Principles and Practices. Prentice Hall, Inc. Newberry. USA.
1. Quraishi, M. A. A., G.S. Khan and M. S. Yaqoob. 1993. Range Management in Pakistan, University of Agriculture, Faisalabad.
2. Mohammad, N. 1989. Rangeland Management in Pakistan. NARC Published by ICIMOD.
3. Stoddard, L.A., A.D. Smith and T.W. Box. 1975. Range Management. McGraw Hill Book Co., New York.
6. Quraishi, M.A.A., M. Ishaque, 1995. Practical Manual of Range Management, University of Agriculture, Faisalabad.

VMD - 201:	INTRODUCTION TO VETERINARY PREVENTIVE MEDICINE	2 (1-1)
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Pre Requisites

Students should know the concept of health, disease and treatment

Aims

To give students basic knowledge animal health and preventive measures to protect animal from different diseases.

Objectives

- Students can differentiate between healthy and ill animals
- Students should understand public health importance of veterinary diseases and zoonotic diseases.
- Students can guide farmers to response in case of animal disease

Students can handle animals and know the measures to help medical agencies in case of disease outbreak.

Theory

Concept of disease and health, Signs of health and disease, Importance of animal diseases in national economy, Types of animal diseases on the basis of etiology, Principles of treatment of diseases, Prevention, Levels of prevention, control and eradication, Introduction to Zoonosis, A very brief account of the following important conditions/diseases/issues:

Fever, Hyperthermia, Hypothermia, Diarrhea, Tympani, Pneumonia, Hemorrhagic septicemia, Mastitis, Anthrax, Tetanus, Black quarter, Enterotoxaemia, Foot & Mouth disease, Rabies, Milk fever, WTO, Drug residues.

Practical

Behavior of different animal species as it relates to the practice of veterinary medicine, Demonstration of methods of restraining of animals, Recording the cardinal parameters of health (Body temperature, pulse & respiration), Demonstration of disease diagnostic methods (Palpation, auscultation, microscopic examination of faeces, skin scrapings & blood), Methods of drug administration in animals (oral and parental), Demonstration of disinfection and other biosecurity measures, Demonstration of veterinary first aid procedures (controlling hemorrhages, dressing wounds, first aid in snake bite, burns, choke etc)

Books Recommended

1. Chakrabarti, A., 2000. A Textbook of Preventive Veterinary Medicine. CBS & IBH Publications, New Delhi, India.
2. Radostits, O.M., C.C. Gay, D.C. Blood and K.W. Hinchcliff 2000. Veterinary Medicine. 9th Ed. W.B. Saunders Co. Philadelphia, USA.
3. McCurnin, D. M., 1998. Clinical Textbook for Veterinary Technicians. 4th Ed. W.B. Saunders Co. Philadelphia, USA.
4. Blowey, R.W., 1999. A Veterinary Book for Dairy Farmers. 3rd Ed. Farming Press Miller Freeman, UK Ltd.
5. Hungerford, T.G., 1991. Hungerford's Diseases of Livestock. 9th Ed. McGraw-Hill Book Co Sydney, Australia.
6. Khan, M.A., Text Book of Clinical Veterinary Medicine 1st edition 1998. Designed and published by author
7. Chakrabarti, A., 2006. A Textbook of Clinical Veterinary Medicine. 3rd ED. Kulyani Publishers , New Delhi, India.
8. Aiello, S.E., and Mays, A.,1997 The Merck Veterinary Manual 8th ED. Published by Merck and Co., INC White house station , NJ., USA.

FMP – 201:	FARM MECHANIZATION AND PRACTICES	2 (1-1)
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Pre Requisites

Some basic knowledge of Agriculture and physics.

Aims

To familiarize the students with farm implements, machinery and technology to enhance the crop productivity.

Objectives

- To know the comparative facts of mechanized and non-mechanized farming to the students.
- To teach the students about the use and importance of different farm implements.
- To expertise the students so that they can motivate the farmers about the use on farm machines.
- To qualify the students about the engine working principle, tractor's system and its maintenance programme.
- Students will be able to select, recommend and manage equipment based on different needs.

The students after completing the education may serve the nation by mean of lead to farmers in describing the advantages of advance farm machinery than traditional ones.

Theory

1. Definition, Objectives of Farm Mechanization, Scope of Farm Mechanization in Pakistan, Constraints in FM, Organizations Working on Farm Machinery
2. Farm power - sources of different farm power, advantages and disadvantages.
3. Tractor development , Tractors classification, types, points to be considered in selection of tractors,
4. Estimating Farm Power & Machinery Costs.
5. Tillage, Tillage implements, Objectives of Tillage, Types of tillage implements, Primary and Secondary tillage Implements.
6. Sowing and Planting Equipment (Broadcaster, Seed Drill, Planters, Zero Tillage etc.)
7. Inter-culturing and Plant Protection Equipment, types of sprayers
8. Harvesting & Threshing equipment
9. Combine Harvester, Function, Working principle
10. Estimating the operational cost of Combine Harvester
11. Tractor mounted Equipments for land development and soil conservation
12. laser land leveling, objectives, benefits, components, functions, limitations
13. Enhancement of different crops productivity through the use of mechanization technologies (a-case study of rice crop)
14. Agricultural machinery and Equipments for different crops

Practical

1. Internal combustion engine - different components and their functions, working principle of four stroke and two stroke cycle engine, comparison between diesel and petrol engine, difference between four and two stroke engine.

2. Terminology related to engine power: IHP, BHP, FHP, DBHP, compression ratio, stroke bore ratio, piston displacement, and mechanical efficiency. Numerical problems on calculation of IHP, BHP, C.R., stroke bore ratio, piston displacement volume.
3. Tractor Trouble Shooting (Maintenance Routine & its importance)
4. Calibration of Seed Drill
5. Mechanical Transplanting of Rice
6. Calibrating boom sprayers
7. Operation of Combine Harvester
8. Operation of LASER Land Leveling, Earthwork, time and cost analysis of LASER land leveling

Recommended Books / Lab Manual

1. Fundamentals of Tractor & Agricultural Machinery, Dr. A.R Tahir and Dr. M.S.Sabir 2003, University of Agriculture, Faisalabad.
2. Introduction to Agricultural Mechanization, R.N Kaul and C.O Egbo 1985, Published by Mac Millan Publishers Ltd Landon
3. Farm Tractor Maintenance and Repair By S.C Jain , C.R Rai
4. Class lectures and internet material

Agr-201:

FIELD CROP PRODUCTION-I

2 (1-1)

Objective

To understand the production technology of cereals, fibre, sugar and green manure crops.

Theory

Concept and classification of field crops; Cropping intensity, cropping schemes and cropping patterns; Cropping patterns in different ecological zones, factors affecting cropping patterns. Mono versus multiple cropping; Production technology of cereals (wheat, barley, oats, triticales, rice, maize, sorghum and millets), Fibre crops (cotton, jute, sun hemp, deccan-hemp), Sugar crops (sugarcane and sugar beet), Green manure crops (guara, dhancha. pigeon pea, senji, etc.).

Practical

Identification and plant characteristic of crops, cultivars, and seeds; Demonstration of improved sowing methods; Raising of crop nurseries and their transplanting; Intercultural practices;

Delinting of cotton seed; Burying of green manure crops; Visits to University/College research area.

Recommended Books

1. Bhatti, I.M. and A.H. Soomro. 1996. Agricultural inputs and Field Crop Production in Sindh, Directorate General, Agri., Res. Institute, Sindh, Hyderabad.
2. Byerlee, D. and T. Hussain, 1992. Farming Systems of Pakistan. Vanguard Books, Lahore.
3. Martin, J.H., R.P.Waldren and D.L. Stamp. 2006. Principles of Field Crop Production 4th Ed. The McMillan Co., New York.
4. Nazir, M.S., E. Bashir and R. Bantel. (Eds.) 1994. Crop Production. National Book Foundation, Islamabad.
5. Reddy, SR. 2004 Principles of Crop Production. 2nd Ed. Kalyani publishers New Delhi.
6. Shrestha, A. 2003 Cropping System. Food Products Press. Haworth Press, Inc. Binghamton, New York NY.
7. Wolfe, T.K. and M.S. Kipps. 2004. Production of Field Crops: A Textbook of Agronomy. McGraw-Hill Book Co. New York.

PP 202:

INTRODUCTORY PLANT PATHOLOGY

3 (2-1)

Prerequisites

Biology (Higher Secondary level)

Learning Objectives

To acquaint students with basic concepts of Plant Pathology

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:

1. Agrios, G.N. 2005. Plant Pathology, 5th edition, Academic Press, New York, USA.
2. Ahmad, I. and A.R. Bhutta. 2005. A Text Book of Introductory Plant Pathology. Published by National Book Foundation, Islamabad, Pakistan.
3. Chaube, H.S. and R. Singh. 2002. Introductory Plant Pathology. International Book Distributing Co.
4. Hafiz, A. 1986. Plant Diseases. Pakistan Agricultural Research Council, Islamabad, Pakistan.
5. Mathew, J.D. 2003. Molecular Plant Pathology. Bios Scientific Publishers Ltd. UK.
6. Mehrotra, R.S. and A. Agarwal. 2003. Plant Pathology, 2nd Edition. TATA McGraw-Hill. Pub. Company Ltd. New Delhi.
7. Sambamurty, A.V.S.S. 2006. A Text Book of Plant Pathology. I.K. International Pvt. Ltd.
8. [Schumann](#), G.L. and [C.J. D'Arcy](#). 2010. Essential Plant Pathology. APS Press. 369.PP.
9. Strange, R.N. 2003. Introduction to Plant Pathology. John Willey & Sons, New York.

FST – 202:

FOOD PROCESSING & PRESERVATION

3 (2-1)

Objective:

To equip the students with basic techniques of food preservation

Theory:

Postharvest handling and preparation of foods for food processing: introduction, properties of raw materials, handling, storage and transportation of raw materials. Preparatory operations: cleaning, sorting, grading, size reduction, sulphiting. Thermal processing: principles & application – blanching, pasteurization, sterilization, HTST, commercial sterilization, UHT, canning. Low temperature preservation: Principles & application - refrigeration, chill injury, controlled atmospheric storage, modified atmosphere packaging. Freezing: methods, changes in foods, freeze burn. Dehydration & drying - significance: concentration and condensation. Drying systems: solar drying, hot air drying, drum drying, spray drying. Chemical preservation: different chemical additives and their mode of action. Fermentation technology: principles, objectives, types - alcoholic, acetic and lactic fermentations. Fermented foods: bread, wine, vinegar, yoghurt, sausages, pickles. Food irradiation: principles, applications, safety aspect, effect on food properties

Practical

Preparatory operation in food processing and preservation. Canning of selected fruits and vegetables. Cold storage, freezing and dehydration of fruits and vegetables. Use of chemicals in preservation of food products. Preparation of fermented food products.

Recommended Books:

1. Awan, J.A. 2011. Food processing and preservation. Unitech Communications, Faisalabad-Pakistan.
2. Awan, J.A. and Rehman, S.U. 2011. Food preservation manual. Unitech Communications, Faisalabad-Pakistan.
3. Bhat, R., Alias A.K. and Paliyat, G. 2012. Progress in food preservation. John Wiley and Sons Ltd., USA.
4. Brennan, J.G. 2006. Food processing handbook. Wiley-VCH Verlag GmbH & Co. KGaA, Weinheim, Germany.
5. Fellow, P.J. 2005. Food processing technology. Woodhead Publishing Ltd. Cambridge, England.
6. Heldman, D. 2011. Food preservation process design. Elsevier Corporation, USA.
7. Rahman, M.S. 2007. Handbook of food preservation. CRC Press, Taylor & Francis Group, Boca Raton, Florida, USA.

Ento-202:**APPLIED ENTOMOLOGY****3 (2-1)****Learning outcomes**

The students would be able to;

1. Acquire knowledge of insect pests of crops, vegetables, fruits, stored grains and household pests.
2. Identification of insect pests, their control methods and pesticide application equipments.
3. Introduction with entomological cottage industries.
4. Enhance the productivity of agricultural crops through insect pest management.

Theory

Introduction; causes of success and economic importance of insects; principles and methods of insect control i.e. cultural, biological, physical, mechanical, reproductive, legislative, chemical and bio-technological control; introduction to IPM; insecticides, their classification, formulations

and application equipments; identification, life histories, mode of damage and control of important insect pests of various crops, fruits, vegetables, stored grains, household, termites and locust; introduction to entomological industries: apiculture, sericulture and lac-culture.

Practical

Collection, identification and mode of damage of insect pests of various crops, fruits, vegetables, stored grains and household; insecticide formulations, their dilutions and safe handling; use of application equipments, instructions for apiculture, sericulture and lac-culture.

Recommended Books

1. Atwal, A.S. 2005. Agricultural Pests of Southeast Asia and their Management. Kalyani Publishers, Ludhiana.
2. Awastheir, V.B. 2009. Introduction to General and Applied Entomology. Scientific Publisher, Jodhpur, India.
3. Duncton, P.A. 2007. The Insect: Beneficial and Harmful Aspects. Kalyani Publishers Ludhiana.
4. Gullan, P. J. and Cranstan, P. S. 2010. The Insects: An Outline of Entomology. 4th edition. Wiley-Blackwell. A John Wiley & Sons, Ltd., Publication, UK.
5. Lohar, M. K. 2001. Applied Entomology, 2nd Ed. Department of Entomology, Sindh Agriculture University Tandojam Sindh, Pakistan.
6. Mathews, G.A. 2004. Pesticide Application Methods, 3rd Ed. John Wiley & Sons, Inc. N.Y.
7. Pedigo, L.P. and Marlin, E. R. 2009. Entomology and Pest Management, 6th Edition, Person Education Inc., Upper Saddle River, New Jersey 07458, U.S.A.
8. Pfadt, E.R. 1985. Fundamentals of Applied Entomology, 4th Ed. The McMillan Co., N. Y.
9. Robinson, D.H. 2006. Entomology Principles and Practices. Agro-bios.
10. Shah, H.A. and Saleem, M.A. 2002, Applied Entomology, 3rd Ed. Izhar Sons Printers, Lahore.
11. Srivastava, K.P. 2005. Text Book of Applied Entomology. Kalyani Publishers, New Delhi.
12. Romoser, W. S. and Stoffolano, J. G. 1998, The Science of Entomology, WCB McGraw-Hill.

AEE - 202:

INTRODUCTION TO AGRICULTURE EXTENSION

3 (3-0)

Objectives

At the completion of this course, the students will be able to:

1. Define the given concept of Agricultural Extension Education
2. Describe principles of effective extension
3. Identify the organizational set-up of agricultural extension
4. Analyze barriers to communication

Theory

Agricultural Extension; its definition, objectives and importance. Types of education. Brief history/recent trends in Agricultural Extension. Organizational set-up in Pakistan. Role of private sector in agricultural development. Characteristics of Pakistani farmers, farming problems and solutions thereof. Roles and duties of extension workers at various organizational levels. Principles of effective extension work. Communication process and its components. Barriers to effective communication. Adoption and diffusion of agricultural innovations. Motivation techniques. Laws of adult learning. Role of rural youth and women in agricultural development. Extension, research and farmers linkages. Basic concept of planning, monitoring, and evaluation in Agricultural Extension.

Books Recommended

1. Bashir, E. (Ed.). 1997. Extension Methods (2nd Edition). National Book Foundation, Islamabad.
2. Leeuwis, C. and Van den Ban, A. 2004. Communication for Rural Innovation: Rethinking
3. Agricultural Extension (3rd Edition). Wiley-Blackwell.

Eng - 202:	COMMUNICATION SKILLS AND LEADERSHIP DEVELOPMENT	3 (3-0)
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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, Descriptive, narrative, discursive, argumentative

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

a) Grammar

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

b) Writing

1. Writing. Intermediate by Marie-Christine Boutin, Suzanne Brinand and Francoise Grellet. Oxford Supplementary Skills. Fourth Impression 1993. ISBN 019 435405 7 Pages 45-53 (note taking).
2. Writing. Upper-Intermediate by Rob Nolasco. Oxford Supplementary Skills. Fourth Impression 1992. ISBN 0 19 435406 5 (particularly good for writing memos, introduction to presentations, descriptive and argumentative writing).

c) Reading

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

RS - 202:

RURAL SOCIOLOGY AND DEVELOPMENT

2(2-0)

Objectives and Learning outcomes:

To familiarize the students with society its social groups, rural urban communities, institutions and organizations. The students will be able to:

- Get introduced to the discipline of Social science.
- Basic introduction of the field of Sociology, rural sociology and development

- to enable students develop an analytical eye to study the social problems of the society
- To develop presentational skills through class participation and improve learning abilities of students with home assignments.

Course Outlines:

Introduction: Definitions /types of Sociology, Background, Characteristics of Rural life, Similarities and differences of rural and urban, Conceptual definitions, Managerial qualities of the farmer

Social Groups: Definitions, Factors in formation of social groups, Classification of social groups, Differences between primary and secondary groups

Social stratification,: Definitions and examples, Bases for stratification, Types of social stratification, Characteristics, Differences between class and caste system

Culture and its concepts: Definitions, Types and examples

Social Institutions: Definitions, Major social institutions, Functions, Structures

Social Organizations: Definitions, Types

Social Control: Definitions, Need of social control, Forms of social control, Norms, folkways, mores, taboos and rituals

Social Values and Social Change: Definitions, Nature of social change, Dimensions, factors

Leadership: Definitions, elements of leadership, Classification

Recommended Books

1. Rogers, Everett M. 1960. "Social change in rural society".
2. Nelson, Lowry. 1949. "Rural sociology".
3. Hoggart, Keith and Buller, Henry. 1987. "Rural development".
4. Bertrand, Alvin L. 1958. "Rural sociology an analysis of contemporary rural life".
5. Gowda, Govinda. "Fundamentals of rural sociology"

Agr - 202:

FIELD CROP PRODUCTION-II

2(1-1)

Objective

To familiarize the students with production technology of oil seeds, grain legumes, forages and miscellaneous crops.

Theory

Production technology of oilseed crops (toria, raya, sarsoon, canola, taramira, castor bean, sunflower, safflower, sesame, linseed, groundnut, soybean); Grain legumes (chickpea, lentil, mungbean, mashbean, cowpea, pigeon pea), Forage crops (berseem, shaftal, lucerne, oats, maize, sorghum, millets, mottgrass); Miscellaneous crops (potato, sweet potato, tobacco, tea, medicinal crops); Techniques and practices for enhancing crop productivity.

Practical

Identification and plant characteristic of crops, cultivars, and seeds of the crops; Demonstration of improved sowing methods; Inoculation of legume seeds; Interculture practices; Weed control practices; Demonstration of harvesting and threshing operations; Visits to University/College research areas.

Recommended Books

1. Baldev, B., S. Ramamjan and H.K. Jain. 1988. Pulse Crops. Oxford and IBH Pub. Co., New Delhi.
2. Martin, J.H. R.P. Waldren and D.L. Stamp. 2006. Principles of Field Crop Production 4th Ed. The McMillan Co., New York.
3. Nazir, M.S., E. Bashir and R. Bantel. (Eds.) 1994. Crop Production. National Book Foundation, Islamabad.
4. Rahman, A. and M. Munir. 1984. Rapeseed, Mustard Production in Pakistan, PARC, Islamabad.
5. Reddy, S.R. 2004 Principles of Crop Production. 2nd Ed. Kalyani Publishers New Delhi.
6. Wolfe, T.K. and M.S. Kipps. 2004. Production of Field Crop: A Textbook of Agronomy. McGraw-Hill Book Co. New York.

MB - 102:	BASICS OF MOLECULAR BIOLOGY	2 (2-0)
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Objectives

The students will learn about:

- The genes and genome of living organisms
- The biochemistry of DNA and RNA.
- Regulation of gene expression in living organisms

Course Outline

Introduction: History, contribution and scope. Cell: Structure, chromosomes, genes and genome, mitosis, meiosis; DNA: Structure, replication, mutability, repair and recombination. RNA: Structure, synthesis and splicing. Proteins: Structures, synthesis, proteomics, targeting and turnover. Genes regulation: Genes expression in prokaryotes and eukaryotes, post transcriptional modification in eukaryotes.

Books Recommended

- a. Albert, B., D. Bary, J. Lewis, M. Raff, K. Roberts and J. D. Watson, 1994. Molecular Biology of Cell. 3rd Ed. Garlands Publishing Inc., NY, USA.
- b. Lodish, H., D. Baltimore, A. Erk, S. L. Zipursky, P. Matsudaira, and J. Danell, 1995. Molecular Cell Biology. 3rd Ed. Scientific American Books, N.Y. USA.
- c. Warner, R., 1992. Essential Biochemistry and Molecular Biology. 2nd Ed. Elsevier N. Y.
- d. Weaver, R.F. 2007. Molecular Biology. 4th Ed. McGraw Hill, USA.
- e. Alberts, B. 2007, Molecular Biology 5th Ed. Taylor and Francis, Uk.
- f. Tropp, B.E. 2007. Molecular Biology, Genes and Proteins 3rd Ed. Jones and Bartlett, USA

FRW - 202:	INTRODUCTION TO GIS AND RS	3 (2-1)
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Objective:

To acquaint students with the modern tools of GIS and RS for forest management.

Theory

1. Aerial Photos. Sensors, Cameras, films and filters.
2. Types of photos scale of photos. Season of photography.
3. Aerial photo interpretation techniques
4. Photo-grammetry, measurement of scale, distance, heights and slope.
5. Satellite based Remote Sensing. Sensors platforms.
6. Introduction to energy sources and radiation principles.

7. Thermal Infrared and microwave Remote Sensing.
8. Introduction to GIS
9. Spatial data
10. Georeferencing and digitizing
11. Global Positioning System (GPS)

Practical

1. Introduction to RS and GIS software
2. Georeferencing, digitizing and map making.

Recommended Books

1. Paul Bolstad. 2008. GIS Fundamentals, a First Text on GIS. 3rd Edition. Eider Press.
2. Lillesand, T.M., R.W. Kiefer and J. Chipman. 2007. Remote sensing and Image Interpretation. 6th edition. Wiley and Sons.
3. P.A. Longley, M.F. Goodchild, D.G. Maguire and D.W. Rhind. 2005. GIS and Science. 2nd edition. Wiley and Sons.
4. G.N. Peterson. 2009. GIS Cartography: A guide to effective map design, CRC Press.

FRW - 204:

BIODIVERSITY AND CLIMATE CHANGE

2 (2-0)

Objective

To equip the students with knowledge and importance of biodiversity and climate change and learn skills and techniques to conserve biodiversity and mitigate global warming and climate change.

Course Outline

1. Definition of biodiversity and its scope.
2. Factors affecting biodiversity of flora and fauna (human population, industrialization and unsustainable land uses).
3. Biodiversity status of flora and fauna in various zones/regions. Threatened and endangered mammals, birds, and plant species in Pakistan.
4. Biodiversity rich areas and hotspots.
5. Conservation and management strategy for biodiversity in Pakistan.
6. Ecosystem based adaptation
7. The concept of climate change and its harmful effects. Causes of climate change.

8. Climate change assessment and predictions.
9. Recommended actions to reduce global warming and climate change.

Recommended Books

1. IUCN (1996): Sarhad Provincial Conservation Strategy, Government of NWFP.
2. Khattak, A.K. (2006): Resource Management Plan for Palas Forests, Lower Kohistan Forest Division, NWFP Forest Department.

AE - 201:

ECONOMICS OF CLIMATE CHANGE

3 (3-0)

Objective

After qualifying the course, students will be aware of impacts of climate change on the agricultural sector and overall economic performance.

Course Outlines

Climate Change—Concept, nature and indicators; Weather and Climate; Climate change and variability; Climate change—importance, global warming, some observed trends of human vulnerability to climate; Forms of Climate changes: global warming, precipitation and evaporation, sea level rise, surface warming, extreme events (also shall be covered impacts thereof). Mitigation: limiting the climate change, the need of mitigation, mitigation options and obstacles, mitigation strategies in developing world; Adaptation to climate: adaptation concept and strategies, adaptation costs and benefits; Climate and developing world: adaptation capacity and increasing the adaptation capacity; Climate change and Development; Climate Change and agriculture; Climate change and food security; Climate change and climate policy; Impact assessment of climate change; political economy of climate change; future perspective (way forward).

Suggested Readings

1. Andrew Dessler, (2012). Introduction to Modern Climate Change (2nd edition New York, USA, Cambridge, University Press.
2. Andrew Dessler, Edward A. Parson, (2010)The Science and Politics of Global Climate Change: A Guide to the Debate (2nd edition), UK Cambridge University Press,.
3. Erial Dinar and Robert Mendelsohn, Handbook on Climate Change and Agriculture Edward Elgar publishing Limited, (2011), Messachusetts, USA.

4. KashavLaalMaharajan and NirajParkash Joshi, Climate Change, agriculture and Rural Livelihood in Developing Countries, Springer, 2013.
5. K. Raja Reddy, H. F. Hodges, Climate Change and Global Crop Productivity New York, USA: CABI publishing,.
6. PradeepKurukulasuriya, Shane Rosenthal, Climate Change and Agriculture: A Review of Impacts and Adaptations World Bank 2003.

RS - 204:

AGRICULTURE AND RURAL DEVELOPMENT

3 (3-0)

Course Contents

Development, Rural development, Study and analysis of rural development models, Strategies and Policies for rural development in Pakistan, Delivery and receiving systems for Agriculture and Rural development, Rural infrastructure, Rural industrialization and development, Role of land tenure and land reform in rural development, Technology, output and employment Potential in Farm and non-farm sectors, Role of women in rural development, Planning and participation at grass root, Local government and rural development.

Text Books

1. Singh, K. (2009). Rural Development: Principles, Policies and Management, 3rd Edition, SAGE Publication (Pvt) Ltd.
2. Khan, M. H. (2009). Participatory Rural Development in Pakistan: USA: Oxford University Press.

Suggested Readings

1. Mosley, M. (2003). Rural Development, Principles and Practice. SAGE Publication (Pvt) Ltd.
2. Tripathy, S.N. (2000). Rural Development. India: Discovery Publishing House.
3. Ali, K. (1988). The Political Economy of Rural Development. Lahore: Vanguard Publications Limited.
4. Khan, S. S. (1980). Rural Development in Pakistan. Pakistan: Waqas Publishing House.

Biotech - 201:

RECOMBINANT DNA TECHNIQUES

2 (2-0)

Objectives

To acquaint the students with Basic techniques and tools used in gene manipulation and its practical uses.

Course Outlines

Introduction and History of Recombinant DNA technology, Structure of DNA, Basic techniques, gel electrophoresis, Blotting techniques, restriction endonucleases, restriction mapping, vectors and their types, cloning vectors, transformations, Polymerase Chain reaction, Cloning strategies, Site-directed mutagenesis. Sequencing strategies, Application of recombinant DNA Technology (agriculture, health, industry, environment and basic research).

Recommended Books

1. [Robert F.W., 2005. Molecular Biology.](#) McGraw-Hill.
2. Dale, J.W. and von Schantz, M. 2002. [From Genes to Genomes: Concepts and Applications of DNA Technology.](#) John-Wiley and Son Limited.
3. Meyers, R.A., 2006. [Genomics and Genetics.](#) John-Wiley and Son Limited.
4. Primrose, S.B., and Twyman, R.M. 2006. Gene Manipulation and Genomics 6th edition. Blackwell Publishing.
5. Watson, J.M., Caudy, A.A., Meyers, R.A., and Witkowski, J.A., 2007. Recombinant DNA. Gene and genomes. 3rd Edition. W.h. Freeman and Company, New York.

Biotech - 202:

BIOSAFETY AND BIOETHICS

1 (1-0)

Objectives

To acquaint students with principles of biosafety and ethical perspectives of Biotechnological systems.

Course Contents

Introduction to Biosafety (Definition, Concept, Uses and abuses of genetic information, Biohazards), Good Laboratory Practices, Risks Related to GMOs, International Rules & regulations for Biosafety & GMOs. Introduction to Bioethics, Ethical issues regarding GMOs, Euthanasia, Issues related to Reproductive & Cloning technologies, Issues to transplants and Eugenics, Patenting, Commercialization and Benefits Sharing, role of National Bioethic committees. Biosafety levels.

Recommended Books

1. WHO. 2006. Laboratory Biosafety manual third edition. AITBS publishers and distributors, India. (Available online free of cost).

2. Lewis RJ. Sax dangerous properties of Industrial materials, 10th edition. Toronto, John Wiley and sons, 1999.
3. Lenga RE. 1988. The Sigma-Aldrich Library of chemical safety data, 2nd ed. Milwaukee, WI, Aldrich chemical company.
4. Furr AK. 2000. CRC handbook of laboratory safety 5th edition. Boca Raton, FL, CRC press.
5. United states Department Health and Human services. 1999. Biosafety in Microbiological and biomedical laboratories. 4th edition. Centers for disease control and prevention/National institutes of Health, Washington DC.
6. Biosafety in the Laboratory: Prudent Practices for Handling and Disposal of Infectious Materials Committee on Hazardous Biological Substances in the Laboratory, National Research Council ISBN: 0-309-55920-0, (1989) available from the National Academies Press at: <http://www.nap.edu/catalog/1197.html>
7. Genes Technology and Policy. Jose Maria A. Ochave 2003 <http://www.apdip.net/publications/iespprimers/eprimer-genes.pdf>
8. Bioethics & Biosafety in Biotechnology by V Sree Krishna.

Biotech - 204:

INTRODUCTORY BIOINFORMATICS

2 (0-2)

Objectives

To acquaint the students with bioinformatics tools, databases, algorithms and applications.

Course Contents

Introduction to computer hardware and software, computer applications for biotechnologists, Spreadsheet work, Word processing; Graphical and Statistical analysis packages.

Biocomputing (Introduction to String Matching Algorithms, Database Search Techniques, Sequence Comparison and Alignment Techniques, Use of Biochemical Scoring Matrices, Introduction to Graph Matching Algorithms, Genome Comparison, Prediction and its Implication).

Introduction to Bioinformatics, its Definition and History, Introduction to Data Mining and its Application, Database Hierarchies, Genomic and Proteomic Sequence Database and their Interpretation (UCSC Genome Database, NCBI, PDB, EcoCyc, DDBJ, SWISS-PROT, TIGR, KEGG etc)

Bioinformatics Tools: Repeatmasker, PHRED, PHRAP, BLAST, Prosite/BLOCKS/PFAM, CLUSTALW, Emotif, RasMol, Oligo, Primer3, Molscrip, Treeview, Alscript, Genetic Analysis Software, Phylip

Recommended Books

1. Claverie, J.M. and Notredame C. 2003 Bioinformatics for Dummies. Wiley Editor.
2. Letovsky, S.I. 1999 Bioinformatics. Kluwer Academic Publishers.
3. Baldi, P. and Brunak, S. 1998 Bioinformatics. The MIT Press.
4. Setubal, J. and Meidanis, J. 1996 Introduction to Computational Molecular Biology. PWS Publishing Co., Boston.
5. Lesk, A.M. 2002 Introduction to Bioinformatics. Oxford University Press.
6. Rastogi, S.C., Mendiratta, N. and Rastogi, P. 2004 Bioinformatics: Concepts, Skills & Applications. CBS Publishers & Distributors, New Delhi.
7. Fogel, G.B. and Corne, D.W., Evolutionary Computation in Bioinformatics.
8. Mont, D.W., Bioinformatics: Sequence and Genome Analysis.
9. Evens, W.J. and Grant, G.R., Statistical Methods in Bioinformatics: An Introduction.
10. Pierre Baldi and Soren Brunak, Bioinformatics: The Machine Learning Approach.
11. Jae K. Lee, Statistical Bioinformatics, John Wiley & Sons Inc.
12. Introduction to Bioinformatics. (A Theoretical and Practical Approach). A. Krawetz and D. Womble. 2002. Humana Press.

Biotech - 206:

AGRICULTURAL BIOTECHNOLOGY

3 (2-1)

Objectives

To acquaint the students with the techniques to develop skills to produce Transgenic Crops.

Theory

The concepts of Plant Molecular Markers, Historical Back ground of Tissue Culture, Requirements for in-vitro cultures, Role of Phyto-hormones in somatic embryogenesis, Types of Cultures: Tissue culture and regeneration, Cell culture, Haploid Culture, Protoplast culture. Somaclonal variations as breeding tool, Somatic Hybridization, Commercial application and Issues related to tissue culture, Plant Transformation; Gene Gun Method of Transformation, *Agrobacterium*-Mediated transformation, Chloroplast Transformation, PEG mediated

transformation etc, Field Evaluation and Commercialization, Transgenic crops for Herbicide, Biotic and Abiotic stress resistance, Introduction to Biofertilizers. Biosafety Concerns and Bioethics on GM crops.

Practical:

Selection of ex-plant, Medium Preparation and Callus Induction, Culturing Agrobacterium and Infection to plant callus, Selection of Transformants, Regeneration of Plantlets and acclimatization, Plant DNA extraction and PCR for Trans gene.

Recommended Books

1. Jitendra Prakash, R.L.M. Pierik, 1993. Plant Biotechnology: Commercial Prospects and Problems, Intercept
2. Peter M. Gresshoff, 1992. Plant Biotechnology and Development, CRC Press
3. Adrian Slater, Nigel W. Scott, Mark R. Fowler, 2008. Plant Biotechnology: The Genetic Manipulation of Plants, Oxford University Press.
4. Sheela Srivastava, Alka Narula, S. S. Bhojwani, Inc NetLibrary, 2004 “Plant
5. Biotechnology and Molecular Markers” publishers Springer link
6. H.S. Chawla, 2002 “Introduction to Plant Biotechnology” Second Edition, ISBN 978-1-57808-228-5; 562 Pages, Science publishers, USA
7. S Harding, 2007. Biotechnology and Genetic Engineering Reviews: V. 24, Nottingham University Press
8. Jane K Setlow, 2003. Genetic Engineering: Principles and Methods, Springer
9. National Biosafety Guidelines Biosafety rules 2005
10. Clarice Swisher, Carol Wekesser, 1996. Genetic Engineering, Lucent Books

SS - 202:

AGRICULTURAL CHEMISTRY

3 (2-1)

Objectives

The students will learn about:

- Discipline of Agricultural Chemistry and its applications
- Concepts of acids and bases
- Importance of carbohydrates, proteins, lipids and enzymes

Theory

Agricultural chemistry: Introduction, history, contribution and scope. Acids and bases: General concepts, relative strength of acids and bases, significance of pH, buffer solution and standard solutions. Water: Importance, sources, quality concern and management. Importance of carbohydrates, proteins and lipids: Classifications, reactions and qualitative analysis. Enzymes: Terminology, nature, classification, specificity and factors affecting enzyme activity.

Practical

Laboratory equipment and apparatus, name and use, general lab instructions Preparation and standardization of solutions Determination of moisture and ash contents Qualitative tests of carbohydrates and protein Determination of reducing and non-reducing sugars Determination of protein by Kjeldahl method

Books Recommended

- a. David, H. 2000. Modern Analytical Chemistry. International ed. McGraw Hill Co. Inc. New York.
- b. Jain, J.L., S. Jain and N. Jain. 2006. Fundamentals of Biochemistry. S.Chand company Ltd. Ram Nagar, New Delhi.
- c. Khalil, I. A. and H. Shah. 2003. Basic Biochemistry. National Book Foundation Islamabad, Pakistan.
- d. Lehninger, A.L. 2000. Principles of Biochemistry. 3 rd ed. Worth Publisher, New York. USA.
- e. Rupm, H. and H. Krist, 1992. Laboratory Manual for the Examination of Water, Wastewater and Soil. 2nd ed. Weinheim, Fed. Rep. Germany.
- f. Stryer, L. 1994. Biochemistry. 5 th ed. W. H. Freeman and Co. London UK.
- g. Vogel, A. I. 1995. A Text Book of Macro and Micro Quantitative Inorganic Analysis. 1st ed. Longman Green and Co. Inc, New York.
- h. Zubay, G. 1999. Biochemistry. 4 th ed. MacMillan Publishing Co. London UK.
- i. Shah Hamid Ullah, 2010. Laboratory Safety Manual. HEC-BC JHELPII, NWFP Agriculture University Peshawar.
- j. James, Finlay, Weir and Johnston., 2008, Elements of Agricultural Chemistry and Geology. Biblio Bazaar, USA.
- k. Fraps. G.S. 2009, Principles of Agricultural Chemistry. Cornell University, USA.

Objectives

The students will learn about:

- Food security in relation to food production in Pakistan
- Policies and plans to ensure food security
- Post harvest management

Course Outlines

Introduction: Food security, international commitment to end hunger and malnutrition. Food security and human rights: Conceptual understanding of food security, nutrition security, household food security. Factors affecting food security: Determinants/dimensions, nutrition linkages and millennium development goals, postharvest technology and food security. Food safety and food quality. Food laws in Pakistan, quality control and quality assurance system in Pakistan. food trade, WTO and Codex Alimentarius. Food insecurity and its measurement: Chronic, transitory and seasonal food insecurity, FIVIMS, meeting the challenges of food security in Pakistan, the role of agriculture.

Books Recommended

1. FAO (2003) Focus on food insecurity and vulnerability-A review of the UN system common country assessment and World Bank poverty reduction strategy papers. FIVIMS secretariat and Wageningen University and research centre. www.fao.org/DOCREP/006/Y5095EOO.htm.
2. FAO 1997, Food, Agriculture and Nutrition, Food and Nutrition FAO, Rome, Italy.
3. FAO website: <http://www.foodsec.org/pubs.htm> and other literature.
4. FAO/WHO, 1992. International Conference on Nutrition (ICN). Final report of the conference, Rome, Italy.
5. Jones, J.M. 1992. Food Safety. AAacc. Paul, Minn, USA.
6. Khalil, J.K. 2007. Food security with special reference to Pakistan. Higher Education Commission, Pakistan, Islamabad. (Text book).
7. Schmidt, R.H. and G.E. Rodrick. 2003. Food Safety Hand Book. John Wiley, USA .
8. Ryan, J., J. Glarum, 2008. Biosecurity and Bioterrorism containing and Preventing Biological Threats. Elsevier, The Netherlands

Objective

To equip the students with fundamental of GIS and its application in agriculture

Theory

Introduction: what is GIS, why GIS, history of GIS, functional components of GIS, questions GIS can answer, GIS data models: vector data model, raster data model. *Spatial Data Acquisition and Management:* data acquisition techniques, data quality and assessment, accuracy, precision; map reference system, map projections, coordinate systems, properties of map projection, types of map projection, map datum. *GIS Database Management Systems:* what is database, advantages of database, components of DBMS. *Global Positioning System (GPS):* brief history, components of GPS, how GPS work, GPS errors, absolute positioning, differential positioning, GPS applications. *Spatial Analysis:* what is spatial analysis, application areas, vector overlay analysis; buffering, map overlay, dissolve, clip, merge, select, eliminate, update, erase, and split tools; raster overlay analysis; high value vs low value, top map vs bottom map, factor combination model in raster GIS. *Remote Sensing:* why remote sensing, how remote sensing works, major component of remote sensing, remote sensing platforms and sensors, characteristics of optical sensors, earth resource remote sensing satellite, remotely sensed data characteristics: spectral, radiometric, spatial and temporal resolution, spectral signatures

Practical

Hands on practices on ArcGIS software; displaying spatial data; classifying features and rasters; labeling features; georeferencing, use of GPS for acquiring data, extraction of catchment area, hillshad etc from digital elevation model (DEM)

Books Recommended

1. Chang, Kang-Tsung. 2006. Introduction to Geographic Information Systems. McGraw-Hill Higher Education, Columbus, Ohio, USA
2. Shamsi, U.M.. 2005. GIS Applications for Water, Wastewater, and Stormwater Systems CRC, Boca Raton, FL, USA
3. Bernhardsen, T., A. Viak and A. Norway. 2002. Geographic Information System: An Introduction. John Wiley & Sons Inc., New York, USA
4. Maidment, D. R. 2002. Arc Hydro: GIS for Water Resources. ESRI, Inc., USA.

5. ICIMOD. 2001. Application of GIS and RS in Planning for Mountain Agriculture and Land Use Management. International Centre for Integrated Mountain Development (ICIMOD), Nepa

ES - 204:

ECOSYSTEM AND ENVIRONMENT

3 (2-1)

Objectives

To acquaint the students with the knowledge of ecosystems and the environment.

Theory

Concept, overall structure and components of Ecosystem, Energy flow and Biogeochemical cycling, Energy transfer (Food chain, Food webs, Food cycle, Trophic levels), Ecological pyramids, Productivity of ecosystems, Factors influencing environments and habitats, Impact of man on ecosystem, Fundamental of population ecology and community ecology, Human impacts on ecosystems, The Atmosphere (Composition, Minor and major gases, Water in atmosphere, Aerosols, Global circulation pattern), Pollution (Air, Water, Land, Thermal, Radiation and Noise), Climate Change (Green House Effect and Global Warming), Ozone Depletion (Ozone-structure, Properties/Significances, Ozone destroying catalysts, Natural, Anthropogenic, Antarctic zone hole, Changing ozone Level, Impact on biosphere), Waste Type, Disposal and Management, Environmental Ethics.

Practicals:

Study of pond freshwater ecosystem, Study of vegetation profile, Study of grassland, rangeland and forest, Study of some biotic and abiotic factors of grassland, rangeland and aquatic ecosystem, methods of sampling. Measurements and description of plant communities by different methods. Study of decomposition of leaf litter by organisms.

Recommended Books

1. Davet, P. 2004. Microbial ecology of soil and plant growth. Science Publishers.
2. Nico, M., Straalen, V., and Roelofs, D., 2006. An Introduction to Ecological Genomics. Oxford University Press.
3. Aston, A., Harris, S., Lowe, A., 2004. Ecological Genetics: Planning and Application. Blackwell Science (UK).
4. Costa, L. G., and Eaton, D. L., 2006. [Gene-Environment Interactions: Fundamentals of Ecogenetics](#). John-Wiley and Son Limited.

5. Freeland, J. R., 2005. [Molecular Ecology](#). John-Wiley and Son Limited.
6. Light, A and Rolston III.H. 2003. Environmental Ethics. Blackwell Publishers Ltd. U.S.A.
7. [Wenz](#), P. S., 2001. Environmental Ethics Today, Oxford University Press.
8. [Louis P. and Pojman](#), L. P., 2004. Environmental Ethics: Readings in Theory and Application, 4th edition. Wadsworth Publishing.
9. Light, A., and Rolston, III. H., 2005. Environmental Ethics. Blackwell Publishing Incorporated.
10. Raven, P. H., and Berg, L. R., 2005. [Environment, 5 Edition](#)th. John-Wiley and Son Limited

PP – 309/201:

INTRODUCTION TO PLANT PATHOGENS

3 (2-1)

Prerequisites: Biology (Higher Secondary level)

Learning Objectives: To acquaint students with basic concepts and identification of plant pathogens

Course Contents:

Theory:

Introduction; economic importance; general characteristics (morphology, reproduction and ecology); Identification of plant pathogens including fungi, prokaryotes, viruses, viroids, nematodes, fungus like organisms and phagocytic 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:

1. Agrios, G.N. 2005. Plant Pathology, 5th edition. Academic Press, New York, USA.
2. Ahmad, I., and A.R .Bhutta. 2005. Textbook of introductory Plant Pathology. Publisher NBF, 397 pp.
3. Alexopoulos, C.J., C.W. Mims and M. Blackwell. 1996. Introductory Mycology. 4th edition, John Wiley and Sons, Inc., New York, USA
4. Bos, L. 1999. Plant Viruses: Unique and Intriguing Pathogens: A textbook of Plant Virology. Backhuys Publishers.
5. Mehrotra, R.S. and A. Agarwal. 2003. Plant Pathology. 2nd Edition. TATA McGraw-Hill. Pub. Company Ltd. New Delhi.
6. Ravichandra, N.G. 2013. Fundamentals of Plant Pathology. Prentice Hall of India Pvt.,Ltd.
7. Trigiano, R.N., M.T. Windham and A.S. Windham. 2008. Plant Pathology: Concepts and Laboratory Exercises. 2nd edition. CRC Press.
8. Vidhyasekram, P. 2004. Concise Encyclopedia of Plant Pathology. Food product Press and Haworth Press Inc. Binghamton, New York, USA.

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:

10. Agrios, G.N. 2005. Plant Pathology, 5th edition, Academic Press, New York, USA.
11. Ahmad, I. and A.R. Bhutta. 2005. A Text Book of Introductory Plant Pathology. Published by National Book Foundation, Islamabad, Pakistan.
12. Chaube, H.S. and R. Singh. 2002. Introductory Plant Pathology. International Book Distributing Co.
13. Hafiz, A. 1986. Plant Diseases. Pakistan Agricultural Research Council, Islamabad, Pakistan.
14. Mathew, J.D. 2003. Molecular Plant Pathology. Bios Scientific Publishers Ltd. UK.
15. Mehrotra, R.S. and A. Agarwal. 2003. Plant Pathology, 2nd Edition. TATA McGraw-Hill. Pub. Company Ltd. New Delhi.
16. Sambamurty, A.V.S.S. 2006. A Text Book of Plant Pathology. I.K. International Pvt. Ltd.
17. Schumann, G.L. and C.J. D'Arcy. 2010. Essential Plant Pathology. APS Press. 369.PP.
18. Strange, R.N. 2003. Introduction to Plant Pathology. John Wiley & Sons, New York.

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:

1. Ahlawat, Y.S. 2010. Diagnosis of Plant Viruses and Allied Pathogens. Stadium Press (India) Pvt. Ltd.
2. Bashir, M. and S. Hassan. 1998. Diagnostic Methods for Plant Viruses. Pakistan Agricultural Research Council, Islamabad, Pakistan.
3. Bos, L. 1999. Plant Viruses: Unique and Intriguing Pathogens: A text book of Plant Virology. Backhuys Publishers.
4. Compendia of different crops. American Phytopathological Society, St. Paul, Minnesota, USA.
5. Foster, G.D. and S.C. Taylor. 1998. Plant Virology Protocols-From Virus Isolation to Transgenic Resistance. Humana Press, New Jersey.
6. Hadidi, A., R. K. Khetarpal and H. Koganezawa (Eds.). 1998. Plant Virus Disease Control. APS, USA.
7. Hull, R. 2009. Comparative Plant Virology. 2nd edition. Academic Press.
8. Loebenstein, G. and G. Thottappilly (Eds.). 2004. Virus and Virus-like Diseases of Major Crops in Developing Countries. Springer Press.
9. Matthews. R.E.F. 1991. Plant Virology. 3rd revised edition. Academic Press.
10. Thresh, M. (Ed.). 2006. Plant Virus Epidemiology. Academic press.
11. Walkey, D.G.A. 1985. Applied Plant Virology. John Wiley & Sons.
- 12.

PP – 305:**INTRODUCTION TO PLANT PROKARYOTES****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:

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

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:

1. Alexopoulos, C.J., C.W. Mims and M. Blackwell. 1996. Introductory Mycology. 4th edition, John Wiley & Sons, Inc. New York, USA.
2. Barnett, H.L. 1998. Illustrated Genera of Imperfect Fungi. 4th ed. ACS, Washington, DC, USA.
3. Carlile, M.J., S.C. Watkinson and G.W. Gooday. 2001. The Fungi. Academic Press.
4. Deacon, J. 2006. Fungal Biology, 4th edition. Blackwell.
5. Johri, R.M. 2005. A Textbook of Fungi. Dominant Publishers and Distributors, India.
6. Kendrick, B. 2000. The Fifth Kingdom. (3rd ed.). Focus Publishing/R. Pullins Company, Incorporated. 373 pp.
7. Liliane Elisabeth Petrini-Klieber, L.E. and O. Petrini. 2013. *Identifying Moulds: A Practical Guide*. Gebruder Borntraeger Verlagsbuchhandlung, Science Publishers.
8. Rai, M. 2010. Progress in Mycology. Springer.
9. Swanton, E.W. 2004. Hand Book of Fungi. Reprint Publication, India.
10. Ulloa, M. and R.T. Hanlin. 2000. Illustrated Dictionary of Mycology, American Phytopathological Society, St. Paul, Minnesota, USA.
11. Webster, J. and R. Weber. 2007. Introduction to Fungi. Cambridge University Press.

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:

1. Agrios, G.N. 2005. Plant Pathology. 5th edition. Academic Press. 952 pp.
2. Bridge, J. and J.L. Starr. 2007. Plant Nematodes of Agriculture Importance: A color hand book. Manson Publishing.
3. Dropkin, H.V. 1980. Introduction to Plant Nematology. A Wiley-Interscience Publication, New York.
4. Hunt, D.J. 1993. Aphelenchida, Longidoridae and Trichodoridae: Their Systematics and Bionomics. CABI Publishing.
5. Luc, M., R. Sikora and J. Bridge. 2005. Plant Parasitic Nematodes in Tropical and Subtropical Agriculture. CABI Publishing.
6. Noe, P.J. 2003. Plant-Parasitic Nematodes. pp 61-67. In: Plant Pathology: Concepts and Laboratory Exercises. R. N. Trigiano, M. T. Windham, and A. S. Windham. (Eds.). CRC Laboratory Press, USA.
7. Noe, P.J. 2003. Pathogenicity and Isolation of Plant-parasitic Nematodes. pp 69-73. In: Plant Pathology: Concepts and Laboratory Exercises. R. N. Trigiano, M. T. Windham, and A. S. Windham. (Eds.). CRC Press, USA.
8. Perry, R.N. and M. Moens. 2006. Plant Nematology. CABI Publishing.
9. Saeed, M. 1990. Development of Phytoneematology in Pakistan. pp 515-525. In: Progress in Plant Nematology. S. K. Saxena, A. Rashid, and R. M. Khan. (Eds.). CBS Publications Pvt. Ltd. Delhi.
10. Siddiqui, M.R. 2000. Tylenchida: Parasites of Plants and Insects. 2nd ed. Wallingford, CABI Publishing.

PP – 302:	BENEFICIAL MICROORGANISMS FOR SUSTAINABLE AGRICULTURE	3 (2-1)
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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 biocontrol 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:

1. Bahl, N. 1988. Handbook on Mushroom. 2nd edition. Oxford and IBH Publishing Company New Delhi, India.
2. Burges, H.D. 1998. Formulation of Microbial Biopesticides: Beneficial Microorganisms, Nematodes and Seed Treatments. Kluwer Academic Press.
3. Carandang, G.A. 2011. Grow Your Own Beneficial Indigenous Microorganisms and Bionutrients in Natural Farming [Kindle Edition]. Bronze Age Media. pp. 30.
4. Chang, S.T. and P.G. Miles. 2004. Mushroom Cultivation, Nutritional Value, Medicinal Effect and Environmental Impact. CRC Press, NYC, USA.
5. Dinesh K. and D.K. Maheshwari. 2012. Bacteria in Agrobiolgy: Plant Probiotics. Springer. 371 pp.
6. Elmerich, C. and W. Edward Newton. 2007. Associative and Endophytic Nitrogen-fixing Bacteria and Cyanobacterial. Springer. 322 pp.
7. Eugene, R. and G. Uri. 2011. Beneficial Microorganisms in Multicellular Life Forms. Springer. 348 pp.
8. Javaid, A. 2010. Beneficial Microorganisms for Mungbean Production. VDM Publishing Company. 212 pp.
9. Maheshwari, D.K. 2010. Plant Growth and Health Promoting Bacteria. Springer. pp. 445
10. Nasim, G. and R. Bajwa. 2010. Glomalean Spore Flora of Pakistan. HEC, Islamabad, Pakistan.
11. Podila, K. and D.D. Douds. 2000. Current Advances in Mycorrhizae Research. APS Press, USA.
12. Samuel, S. and S.S. Gnanamanickam. 2007. Plant-Associated Bacteria. Springer. 712 pp.
13. Sundh, I., A. Wilcks and M.S. Goettel. 2013. Beneficial Microorganisms in Agriculture, Food and the Environment: Safety Assessment and Regulation. CABI. 360 pp.

PP – 304:

DISEASES OF FIELD CROPS

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:

1. Bhutta. A.R. 2010. Text book of Introductory Seed Pathology. HEC Pakistan.
2. Compendia of wheat, barley, rice, maize, cotton, sorghum, pea, peanut diseases. American Phytopathological Society, St. Paul, Minnesota, USA.
3. Dickson, J.G. 2008. Diseases of Field Crops Biotech Books; Reprint of McGraw-Hill.
4. Gupta, G.P. 2004. Textbook of Plant Diseases. DPH, India.
5. Hafiz, A.1986. Plant Diseases. Pakistan Agricultural Research Council, Islamabad.
6. Mew, T.W. and P. Gonzales. 2002. A Handbook of Rice Seed Borne Diseases. IRRI, Science Publication,

Philippine.

7. Nyal, R.F. 1989. Field Crops Disease Handbook. AVI Publishing Company Inc. Westport, Connecticut, USA.
8. Rangaswami, G. and A. Mahadevan. 2004. Diseases of Crop Plants in India. Prentice Hall, India.
9. Sharma, R.S. 2000. Plant Disease. Campus Book International, Delhi, India.
10. Vidhyasekram, P. 2004. Concise Encyclopedia of Plant Pathology. Kaganviva, India.
11. Zadoks, J.C. 2004. Modern Crop Protection. International Book Distribution Co, India.

PP – 306:

**INTRODUCTORY RANGE AND FOREST
PATHOLOGY**

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:

1. Bhutta, A.R. 2010. Text book of Introductory Seed Pathology. HEC Pakistan.
2. Khan, A.H. 1989. Pathology of Trees, Vol. II, Univ. of Agriculture, Faisalabad.
3. Manion, P.D. 1991. Tree Disease Concepts, 2nd Ed. Prentice Hall.
4. Sharma, R.C. and G.N. Sharma. 2006. Challenging Problems in Horticultural and Forest Pathology. Indus Publishing Company, India.
5. Sharma, V.K. 2004. Trees and Protection of Environment. Deep and Deep Publication (Pvt.) Ltd. India.
6. Strouts, R.G. and T.G. Winter. 1994. Diagnosis of Ill-health in Trees. HMS Office. London.
7. Tainter, F.H. and F.A. Baker. 1996. Principles of Forest Pathology. John Wiley & Sons. USA.
8. Zabel, R. and J.J. Morell, 1992. Wood Microbiology: Decay and its Preservation. Academic Press, San Diego. California, USA.

PP – 409:

DISEASES OF VEGETABLE CROPS

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:

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

PP – 308:**PLANT RESISTANCE TO DISEASES****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:

1. Agrios, G.N. 2005. Plant Pathology, 5th edition, Academic Press, New York, USA.
2. Boland, G.J., L. David and Kuykendall. 1998. Plant Microbe Interactions and Biological Control. Marcel Dekker, Inc, USA.
3. Moore, D. and L.A.N. Frazer. 2002. Essential Fungal Genetics. Springer Verlag, New York, USA.
4. Punja, Z.K. and Z. Punja. 2004. Fungal Disease Resistance in Plants: Biochemistry, Molecular Biology, and Genetic Engineering. CRC Press.
5. Robert S.F. and E.L. Simms. 1992. Plant Resistance to Herbivores and Pathogens: Ecology, Evolution, and Genetics. The University of Chicago Press, Ltd. London.
6. Russel, G.C. 1981. Plant Breeding for Pest and Disease Resistance. Butterworths and Company, Ltd., London, UK.
7. Sadasivan, S. and B. Thayumanavan. 2003. Molecular Host Plant Resistance to Pest. Marcel Dekker, USA.
8. Singh, D.P. 2002. Breeding for Resistance to Biotic Stress, International Books Distribution Co. India.
9. Slusarenko, A.J., R.S.S. Fraser and L.C. Van Loon. 2000. Mechanisms of Resistance to Plant Diseases. Kluwer Academic Publishers.
10. Staples, C.R. and G.H. Toenniessen. 1981. Plant Disease Control Resistance and Susceptibility. John Wiley & Sons, Inc. New York, USA.
11. Stubbs, R.W., J.M. Prescott, E.E. Sarri and H.J. Dubin. 1986. Cereal Disease Methodology Manual. CIMMYT, Mexico.
12. Van der Plank, J.E. 1984. Disease Resistance in Plants 2nd Edition, Academic Press Inc., London 194 PP.
13. Vidhyasekaran, P. 2002. Bacterial Disease Resistance in Plants: Molecular Biology and Biotechnological Applications, Food Products Press, an imprint of the Haworth Press Inc. 455 PP.

PP – 401:

SOIL-BORNE PLANT PATHOGENS

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:

1. Ashok, P. and K.G. Mukerji. 2007. Biological Control of Plant Diseases. CRC Press.
2. Boland, G. and L. Bolis. 1998. Plant-microbe Interactions and Biological Control. CRC Press.
3. Bruehl, G.W. 1987. Soil-borne Plant Pathogens. Free Press.

4. Gnanamanickam, S.S. 2002. Biological Control of Crop Diseases. Marcel Dekker, Inc.
5. Hillocks, R.J. and J.M. Waller. 1997. Soil-borne Diseases of Tropical Crops. CABI, UK.
6. Jenkins, R. and C.K. Jain. 2010. Advances In Soil-borne Plant Diseases. Oxford Book Co., India.
7. Naik, M.K. and G.S. Devikarani. 2008. Advances in Soil-borne Plant Diseases. New India Publishing Agency Delhi, India.

PP – 313:

**METHODS AND TECHNIQUES IN PLANT
PATHOLOGY**

3 (2-1)

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 performas; 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:

1. Ahmad, I., M. Aslam and A. Munir. 1992. Phytopathological Diagnostic Techniques. Pakistan Agricultural Research Council, Islamabad, Pakistan.
2. Aneja, K.R. 2003. Experiments in Microbiology, Plant Pathology and Biotechnology. New Age International (Pvt.) Ltd. New Delhi. India.
3. Bashir, M. and S. Hassan. 1998. Diagnostic Methods for Plant Viruses, PARC, Islamabad.
4. Bhutta, A.R. and I. Ahmad. 2001. Seed Pathological Techniques and their Application. National Book Foundation, Islamabad, Pakistan.
5. Burns, R. 2008. Plant Pathology; Techniques and Protocols (Methods in Molecular Biology). Humana Press
6. Foster, G.D., I.E., Johansen, Y. Hong and P.D. Nagy. (Eds). 2008. Plant Virology Protocols - From Viral Sequence to Protein Function (2nd edition). Humana Press.
7. Fox, R.T.V. 1994. Principles of Diagnostic Techniques in Plant Pathology. CAB International, UK.
8. Hampton, R., E. Ball and S. DeBoer. 1990. Serological Methods for Detection and identification of Viral and Bacterial Plant Pathogens - A Laboratory Manual. American Phytopathological Press, Saint Paul, Minnesota, USA
9. Malcolm C.S. and W.A. Charles. 2000. Diagnosing Plant Diseases Caused by Nematodes. American Phytopathological Society Press, St. Paul, Minnesota, USA.
10. Narayanasamy, P. 2001. Plant Pathogen Detection and Disease Diagnosis (2nd ed.). Marcel Dekker.
11. Schaad, N.W., J.B. Jones and W. Chun. 2001. Laboratory Guide for Identification of Plant Pathogenic

- Bacteria, Third Edition. American Phytopathological Society Press, St. Paul, Minnesota, USA.
12. Sinclair, J.B., and O.D. Dhingra. 1995. Basic Plant Pathology Methods. CRC Press USA.
 13. Trigiano, R.N., M.T. Windham and A.S. Windham. 2007. Plant Pathology Concepts and Laboratory Exercises, Second Edition.

PP – 403:

DISEASES OF FRUITS AND ORNAMENTALS

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:

1. Chase, A.R. 1987. Compendium of foliage ornamental plant diseases. APS USA.
2. Compendia of apple and pear, citrus, grapes, stone fruits and tropical fruits diseases. American Phytopathological Society, St. Paul, Minnesota, USA.
3. Compendium of ornamental plants, Foliage plant diseases, 1988. American Phytopathological Society, St. Paul, Minnesota, USA.
4. Gupta, V.K. and S.K. Sharma. 2000. Diseases of Fruit Crops. Kalyani Publishers New Delhi, India
5. Leslie, A.R. 1994. Handbook of Integrated Pest Management for Fruit and Ornamentals. CRC Press, London.
6. Machardv, W.E. 1996. Apple Scab. Biology, Epidemiology and Management. American Phytopathological Society, St. Paul, Minnesota, USA.
7. Pathak, V.N. 1981. Diseases of Fruit Crops. Oxford and IBH Publishing Company, New Delhi, India.
8. Ploetz, R.C. 2003. Diseases of Tropical Fruit Crops. CABI – UK.
9. Reddy, P.P. 2010. Bacterial and Viral Diseases and their Management in Horticultural Crops. Scientific Pub. 288 p.
10. Singh, R.S. 2001. Diseases of Fruit Crops. Science Publ. Inc.
11. Stefrud, A. 2005. Diseases of Fruits and Nuts. Biotech Book, Delhi.

PP – 310:

SEED AND POST-HARVEST PATHOLOGY

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:

1. Agarwal, V.K. 2006. Seed Health. International Book Distributing Company. 554 pp.
2. Agarwal, V.K. and J.B. Sinclair. 1996. Principles of Seed Pathology, Second Edition. CRC Press. 560 pp.
3. Barkai-Golan, R. 2001. Post-harvest Diseases of Fruits and Vegetables: Development and Control. Elsevier. 418 pp.
4. Bartz, J.A. and J.K. Brecht. 2002. Post-harvest Physiology and Pathology of Vegetables. Marcel Dekker. India
5. Bhutta, A.R. and I. Ahmad. 2001. Seed Pathological Techniques and their Application. National Book Foundation, Islamabad, Pakistan
6. Bhutta, A.R., A. Hussain and M.R. Rahman. 2004. Hand book on Seed Processing and Storage. Federal Seed Certification and Registration Department, Islamabad, Pakistan.
7. Bhutta, A.R. 2010. Text Book of Introductory Seed Pathology. HEC, Pakistan.
8. Dasgupta, M.K. and N.C. Mandal. 1989. Postharvest Pathology of Perishables. Oxford & IBH Publishing Company Private, Limited. 638 pp.
9. Dennis, S.H. 2002. Pests of stored Foodstuffs and their Control. Kluwer Academic publishers. India
10. Gullino, M.L. and D. Prusky. 2009. Post-Harvest Pathology (Plant Pathology in the 21st Century). Springer.
11. Narayanasamy, P. 2006. Post-harvest Pathogens and Disease Management. John Wiley & Sons, Inc., Hoboken, New Jersey. 578 pp.
12. Neergaard, P. 1977 & 1988. Seed Pathology: Volume 1&2. John Wiley & Sons, Incorporated. pp.1187.
13. Prusky, D. and M. Lodovica Gullino. 2010. Post-harvest Pathology Springer. pp.211.
14. Schumann, G.L. and C.J. D'Arcy. 2010. Essential Plant Pathology. APS Press. 369 pp.
15. Snowdon, A.L. 2010. A color Atlas of Post-Harvest Diseases and Disorders of Fruits and Vegetables: Volume 1: General Introduction & Fruits. Wolfe Scientific Ltd. 302 pp.

PP – 407:

PLANT DISEASE MANAGEMENT

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:

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

PP – 407:

INTRODUCTORY MOLECULAR PLANT PATHOLOGY

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:

1. Ansari, T.M. 2008. Molecular Plant Pathology. Pearl Books, India.
2. De Roberties, E.D.P. and E.M.T. DeRoberties, Jr. 1992. Cell and Molecular Biology. 8th ed. John Wiley & Sons, USA.
3. Desi, L. 2007. Molecular Plant Pathology. Paragon International.
4. Devi, P. 2005. Principles and Methods of Plant Molecular Biology, Biochemistry, Biotechnology and Genetics. Student Edition, India.
5. Dickinson, M. 2003. Molecular Plant Pathology. NIOS Scientific Publishers. 273 pp.
6. Gurr, S.J., M.J. Pherson and D.J. Bowles. 1991. Molecular Plant Pathology: A Practical Approach. Oxford University Press.
7. Gurr, S.J., M.J. McPherson and D.J. Bowles. 1992. Molecular plant Pathology: A Practical Approach. IRC Press at Oxford University Press. 328 pp..
8. Hafeez, F., Y. Zafar and A. M. Khalid. 2005. Modern Techniques in Biotechnology. A Theoretical Manual. NIBGE, Faisalabad.
9. Lakshman, D. 2007. Molecular Plant Pathology. Paragon, International Publishers.
10. Mathew, J.D. 2003. Molecular Plant Pathology. Bios Scientific Publishers, Ltd., UK.
11. Pena, L. 2005. Transgenic Plants. Methods and Protocol. Humana, USA.
12. Rastogi, S.C. 2006. Cell and Molecular Biology. New Age Publications (Academic).
13. Sigee, D.C. 1993, 2005. Bacterial Plant Pathology: Cell and Molecular Aspects. Cambridge University Press. 329 pp.
14. Singh, U.S. and R.P. Singh. 1995. Molecular Methods in Plant Pathology. CRA Press Inc., pp. 527.
15. Vidhyasekaran, P. 2002. Bacterial Disease Resistance in Plants: Molecular Biology and Biotechnological Applications. Food Products Press, an imprint of the Haworth Press Inc., NY. 455 pp.

PP – 312:**PLANT DISEASE EPIDEMIOLOGY****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:

1. Agrios, G.N. 2005. Plant Pathology. 5th Ed. Academic Press N.Y. USA.
2. Campbell, C.L. and L.V. Madden. 1990. Introduction to Plant Disease Epidemiology. John Wiley & Sons, Inc. New York, USA.
3. Kranz, J. 2002. Comparative Epidemiology of Plant Diseases. Springer;
4. Kranz, J. 1990. Epidemics of Plant Diseases: Mathematical Analysis and Modeling. Springe Publ. London,

UK.

5. Leonard, J.F. and D.A. Neher. 1997. Exercises in Plant Disease Epidemiology. American Phytopathological Society Press, St. Paul, Minnesota, USA.
6. Savary, S. and B.M. Cooke. 2006. Plant Disease Epidemiology: Facing Challenges of the 21st Century: Under the aegis of an International Plant Disease Epidemiology Workshop held at Landernau, France, 10-15th April, 2005. Springer.

PP – 413:

HISTOPATHOLOGY OF DISEASED PLANTS

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 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:

1. Ayres, P.G. 1981. Effects of Disease on the Physiology of the Growing Plants. Cambridge University Press.
2. Baily, J.A. and B.J. Deverall. 1983. The Dynamics of Host Defense. Academic Press, New York, USA.
3. Fritig, B. and M. LeGrand. 1993. Mechanisms of Plant Defense Responses. Kluwer, Dordrecht, The Netherlands.
4. Goodman, R.N., Z. Kiraly, and K.R. Wood. 1986. The Biochemistry and Physiology of Plant Disease. Univ. of Missouri Press, Columbia, USA.
5. Kaul, T. and B.L. Dhar. 1986. The Biochemistry and Physiology of Plant Disease. Robert N. Goodman, Zoltán Király and K. R. Wood, 433 PP.
6. Lawlor, W.D. 2001. Photosynthesis. 3rd Ed. Viva Books (Pvt.) Ltd. India.
7. Misra, J.R. 2004. Photosynthesis in Plants. DPH, India.
8. Petrini, O. and G.B. Ouellette. 1994. Host Wall Alterations by Parasitic Fungi. American Phytopathology Society Press, St., Paul. Minnesota, USA.
9. Schumann, G. L. and C. J D'Arcy. 2010. Essential Plant Pathology. APS Press, 369 pp.
10. Strange, R.N. 2003. Introduction to Plant Pathology. John Wiley and Sons Ltd.
11. Dragoljub D. Šutić and J.B. Sinclair. 1991. Anatomy and Physiology of Diseased Plants. CRC Press, 232 pp.

PP – 405: PESTICIDES, THEIR ACTION AND APPLICATION**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 nematocides etc.); equipments and different methods of application; FAO code of conduct for pesticide use and handling (codex alimentarius); 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:

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

PP – 311: ABIOTIC DISEASES OF PLANTS**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:

1. Bergstrom, L. and H. Kirchmann. 1998. Carbon and Nutrient Dynamics in Natural and Agricultural Tropical Ecosystem. CAB Inc. UK.
2. Haard, N.F. and D.K. Salunkle. 1980. Symptoms on Post Harvest Biology and Handling of Fruits and Vegetables. The AUI Publishing Co. Inc. West Post Connecticut, USA.
3. Hill, M.K. 2004. Understanding Environmental Pollution, 2nd Ed., Cambridge Press, UK.
4. Shurtleff, M.C. and C.W. Averre. 1997. The Plant Disease Clinic and Field Diagnosis of Abiotic Diseases. American Phytopathological Society Press, St. Paul, Minnesota, USA.
5. Tandov, H.L.S and R.N. Roy. 2004. Integrated Nutrient Management. A Glossary of Terms. FAO, UN, Rome.

PP – 314:	BIOTECHNOLOGY AND ITS APPLICATION IN PLANT PATHOLOGY	3 (2-1)
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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, screen able 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:

1. Agrios, G.N. 2005. Plant Pathology. Elsevier Academic Press.
2. Aneja, K. R. 2003. Experiments in Microbiology, Plant Pathology and Biotechnology, 4th Ed. New Age International Publishers, 609 pp..
3. Campbell, L.L. 1991. Biotechnology in Plant Pathology: Potential for Change. Physiopathology News, 25-30.
4. Chawla, H.S. 2004. Introduction to Plant Biotechnology, 2nd Edition. Science Publishers, Inc., USA. 541 pp.
5. [Ilan Chet](#), I. 1993. Biotechnology in Plant Disease Control. Wiley-Liss, 373 pp.
6. Kumar, A. and S.K. Sopory. 2008. Recent Advances in Plant Biotechnology and Its Applications. I.K. International Publishing House Pvt. Ltd., India. 694 pp.
7. Primrose, S.R. 2001. Molecular Biotechnology. 2nd edition. Panima Publl. Corp. India.

8. Punja, Z.K., S.H. De Boer and H. Sanfaçon. 2007. Biotechnology and Plant Disease Management. CAB International, North America.
9. Purohit, S.S. 2003. Plant Tissue Culture. (Student Edition), India, Rastogi Publications, India.
10. Rena, L. 2005. Transgenic plants, methods and protocols. Humana N.J. USA.
11. Srivastava, M. and R.R. Shoferma. 2004. Plant Propagation and Nursery Management. Int. Book Distribution, India.

PP – 415:	BIOLOGY AND CULTIVATION OF EDIBLE FUNGI	3 (2-1)
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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:

1. Alexopoulos, C.J., C.W. Mims and M. Blackwell. 1996. Introductory Mycology. 4th ed. John Wiley & Sons, Inc. New York, USA.
2. Bahl, N. 1988. Hand book on Mushrooms. 2nd Ed. Oxford & IBH Publ. Co. New Delhi. India.
3. Chang, S.T. and P.G. Miles. 2004. Mushroom Cultivation, Nutritional Value, Medicinal Effect and Environmental Impact. CRC Press, NYC, USA.
4. Chang, S.T. and T.H. Quimio. 1982. Tropical Mushrooms: Biological Nature and Cultivation Methods. Chinese University Press.
5. Khan, S.M. and S.M. Khan. 2005. Mushroom cultivation. N SRS Publishers, Faisalabad.
6. Miles, P.G. and S.T. Chang. 1997. Mushroom Biology: Concise Basic and Current Developments. World Scientific Publishing Company.
7. Nasim, G. and R. Bajwa. 2010. Glomalean Spore Flora of Pakistan. HEC, Islamabad, Pakistan.

PP – 315/309:	PLANT QUARANTINE AND SPS MEASURES	3 (2-1)
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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:

1. Devorshak, 2012. Plant Pest Risk Analysis, Concepts and Application CABI, International. 296 pp.
2. Bhutta, A.R. 2010. Introductory Seed Pathology, HEC Press Islamabad Pakistan. 557 pp.
3. Bhutta A.R. and I. Ahmed-2001. Seed Pathological Techniques and Their Applications Publ. by NBF, Islamabad
4. Ebbels, D.L, 2003. Principles of Plant Health and Quarantine-CABI, Publication.
5. FAO-2000. Multilateral Trade Negotiation on Agriculture. A Resource Manual-III SPS & TBT Agreement Publ. by FAO-UN, Rome, Italy.
6. Plant Quarantine Act-1976 and Rules 1967. Govt. of Pakistan, Karachi.
7. Ranjan.S, 2007. Sanitary and Phytosanitary Measures – An Introduction, Lefai Uni. Press India.
8. Seed Act, 1976, Seed Amendment Bill-2014 Govt. of Pakistan, Islamabad.

PP – 422:**INTERNSHIP / STUDY PROJECT****5 (0-5)**

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).

PP – 424:**SEMINAR****1 (1-0)**

The seminar/presentation delivered for internship/research will be mandatory.