



DEPARTMENT OF PLANT PATHOLOGY

Faculty of Agriculture

Academic Programs Offered:

1. B.Sc. (Hons.) Agriculture
2. M.Sc. (Hons.) Plant Pathology
3. PhD Plant Pathology

B.Sc. (Hons.) Agriculture

Eligibility: At least 45% marks in intermediate or equivalent.

Duration: 04 Year Program (08 Semesters)

Degree Requirements: 137 Credit Hours

Semester-I

Course Code	Course Title	Credit Hours
SAES-5801	Introduction to Soil Science-I	3(2+1)
AGRO-5901	Basic Agriculture	3(2+1)
ZOOL-6141/ MATH-5128	Introduction to Biology-I (for Pre-Engineering students)/ Mathematics (for Pre-Medical students)	3(3+0)/ 3(3+0)
URCI-5109	Introduction to Information & Communication Technologies	3(2+1)
URCE-5102	English-II (Language Comprehension & Presentation Skills)	3(3+0)
URCI-5105/ ISLS-5108	Islamic Studies/ Ethics (for Foreigner or Non-Muslims)	2(2+0)/ 2(2+0)

Semester-II

AGRO-5902	General Crop Production	3(2+1)
SAES-5802	Introduction to Soil Science-II	3(2+1)
FWRW-5701	Introduction to Forest and Watershed Management	3(2+1)
AEXT-5401	Introduction to Agricultural Extension and Rural Development	3(3+0)
URCE-5103	English-III (Academic Writing)	3(3+0)
URCP-5106	Pakistan Studies	2(2+0)

Semester-III

PLBG-5201	Introductory Genetics	3(2+1)
ENTO-5101	Introductory Entomology	3(2+1)
PLPT-5301	Introduction to Plant Pathogens	3(2+1)
HORT-5601	Introductory Horticulture	3(2+1)
FWRW-5702	Introduction to Rangelands and Wildlife Management	3(2+1)
AGEC-5501	Introduction to Agricultural Economics	3(3+0)
URCC-5110	Citizenship Education and Community Engagement	3(1+2)

Semester-IV

PLBG-5202	Introductory Plant Breeding	3(2+1)
ENTO-5102	Applied Entomology	3(2+1)
PLPT-5302	Introductory Plant Pathology	3(2+1)
HORT-5602	Horticultural Crop Production	3(2+1)
FSAT-5101	Introduction to Food Science and Technology	3(2+1)
STAT-5126	Statistics for Agricultural Sciences	3(3+0)

Semester-V

AEXT-6408	Communication Skills in Agricultural Extension	3(2+1)
PLPT-6303	Introductory Mycology	3(2+1)
PLPT-6304	Introduction to Plant Parasitic Nematodes	3(2+1)
PLPT-6305	Introduction to Plant Prokaryotes	3(2+1)
PLPT-6306	Introduction to Plant Viruses	3(2+1)
PLPT-6307	Abiotic Diseases of Plants	2(2+0)

Semester-VI

PLPT-6308	Diseases of Field Crops	3(2+1)
PLPT-6309	Diseases of Fruits and Ornamentals	3(2+1)
PLPT-6310	Introductory Range and Forest Pathology	2(1+1)
PLPT-6311	Plant Disease Epidemiology	3(2+1)
PLPT-6312	Beneficial Microorganisms for Sustainable Agriculture	3(2+1)
PLPT-6313	Plant Biochemistry	3(2+1)

Semester-VII

PLPT-6314	Diseases of Vegetable Crops	3(2+1)
PLPT-6315	Plant Disease Management	3(2+1)
PLPT-6316	Plant Quarantine and SPS measures	3(3+0)
PLPT-6317	Seed and Postharvest Pathology	3(2+1)
PLPT-6318	Methods and Techniques in Plant Pathology	3(1+2)

Semester-VIII

AGEC-6523	Agribusiness, Marketing and Trade	3(3+0)
PLPT-6319	Introductory Molecular Plant Pathology	3(2+1)
PLPT-6320	Soil-borne Plant Pathogens	3(2+1)
PLPT-6321	Pesticides, their Action and Application	3(2+1)
PLPT-6322	Research Project / Internship	4(0+4)

M.Sc. (Hons.) Plant Pathology

Eligibility: BSc. (Hons.)/BSc. 4 Years or equivalent (16 Years of Education) in the relevant field with minimum CGPA 2.50/4.00 + Departmental Test

Duration: 02 Year Program (04 Semesters)

Degree Requirements: Minimum 30 Credit Hours (24 Credit Hours of Course Work+ 06 of Dissertation)

PLPT-7101	Mycology-I	3(2+1)
PLPT-7102	Mycology-II	3(2+1)
PLPT-7103	Fungal systematics	3(2+1)
PLPT-7104	Fungal Plant Pathology	3(2+1)
PLPT-7105	Plant Virology	3(2+1)
PLPT-7106	Plant Bacteriology	3(2+1)
PLPT-7107	Plant Nematology	3(2+1)
PLPT-7108	Seed Pathology	3(2+1)
PLPT-7109	Special Problem	1(1+0)
PLPT-7110	Seminar	1(1+0)
PLPT-7111	Integrated Plant Disease Management	3(2+1)
PLPT-7112	Vector Transmission of Plant Diseases	3(2+1)
PLPT-7113	Forest and Shade Tree Pathology	3(2+1)
PLPT-7114	Biological Control of Plant Pathogens	3(2+1)
STAT-7151	Statistical Methods for Agricultural Research-I	3(3+0)

PhD Plant Pathology

Eligibility: MSc. (Hons.) Plant Pathology or equivalent with minimum CGPA 3.00/4.00 + Departmental Test

Duration: 03-05 Year Program (06-10 Semesters)

Degree Requirements: Minimum 18 Credit Hours Course Work, Comprehensive Exam. + Dissertation

PLPT-8101	Ecology and Epidemiology of Plant Diseases	3(2+1)
PLPT-8102	Biochemistry and Physiology of Diseased Plants	3(2+1)
PLPT-8103	Genetics of Plant Pathogens	3(3+0)
PLPT-8104	Post-harvest Pathology	3(2+1)
PLPT-8105	Advances in Plant Pathology	3(3+0)
PLPT-8106	Molecular Plant Virology	3(2+1)
PLPT-8107	Molecular Plant Microbe Interactions	3(2+1)
PLPT-8108	Bioinformatics in Plant Pathology	3(2+1)
PLPT-8109	Special Problem	1(1+0)
PLPT-8110	Seminar	1(1+0)
PLPT-8111	Plant Pathology and Environmental Concerns	3(3+0)
PLPT-8112	Plant Pathology and International Obligations	3(3+0)
STAT-8131	Statistical Methods for Agricultural Research-II	3(3+0)

B.Sc. (Hons.) Agriculture

COURSE CONTENTS

SEMESTER-I

SAES-5801

Introduction to Soil Science-I

3(2+1)

This is an introductory course designed to introduce the concept and significance of soil science for agriculture students at undergraduate level. It provides information to the students about soil science and its branches as well as their environmental significance. This course also delivers knowledge to the students about weathering of rocks and minerals as well as their classification. This course gives information to the students about physical properties of soil and their significance in agriculture. This subject also improves the awareness of the students about impact of agricultural and industrial wastes on our environment. In addition, this course also improves the skills of the students how to collect soil and water samples for physico-chemical analysis. Laboratory exercise will be designed to develop student competency for analysis of irrigation water and soil samples. Ability to highlight and support the importance of both water and soil quality analysis for judicious-use of resources.

Contents

1. Introduction to Soil and environment: definition of earth, geology and soil science; disciplines of soil science; lithosphere, hydrosphere and biosphere
2. Soil forming rocks and minerals: types and their formation.
3. Weathering of rocks and minerals: definition. Agents and classification
4. Parent materials: definition and types
5. Soil formation: definitions, processes and factors
6. Soil profile: definition and description
7. Physical properties of soil and their significance
8. Introduction to soil classification and land use capability classes
9. Soil, water and air pollution: sources and types

Practical

1. Methods of soil sampling and handling
2. Preparation of saturated soil paste
3. Determination of soil water contents
4. Analysis of irrigation water, report writing and interpretation.
5. Textural analysis of soil

Recommended Texts

1. Bashir, E. & R. Bantel. (2001). *Soil Science*. Islamabad, National Book Foundation.
2. Brady, N.C. & R.R. Weil. (2007). *The Nature and Properties of Soils* (14th ed.). Upper Saddle River, NJ, USA, Pearson Education.

Suggested Readings

1. Brady, N.C. & R.R. Weil. (2009). *Elements of the Nature and Properties of Soils* (3rd Ed.). Upper Saddle River, NJ, USA, Pearson Education.
2. Hillel, D. (2008). *Soil in the Environment: Burlington, MA, USA. Crucible of Terrestrial Life*. Elsevier Inc.
3. Das, D.K. (2011). *Introductory Soil Science* (3rd ed.). New Delhi-110002, India, Kalyani Publ.

The main aim of this course is to provide the basic knowledge and background about Pakistan's Agriculture. Basic Agriculture is a graduate-level course which gives the students a basic knowledge of agriculture/ It will enable the students to understand the basic terminologies of agriculture, its different branches, allied disciplines, salient features of Pakistan's agriculture including climate, land resources etc. as well as the problems of Pakistan agriculture. There will be detailed discussion about the various agro-ecological zones of Pakistan. Basic knowledge about agricultural inputs such as seed, fertilizer, irrigation etc. will be communicated. Crop growth related problems like weeds, insect pests will be elaborated. The students will be able to understand the conventional and international system of land measurement. The knowledge of post-harvest technology is also shared with the students.

Contents

Theory

- 1 Agriculture, history, importance, branches and allied sciences.
- 2 Salient features of Pakistan's agriculture.
- 3 Climate, land and water resources.
- 4 Agro ecological zones of Pakistan. Farming systems.
- 5 Tillage: objectives and types. Seed: types and quality.
- 6 Crop nutrients, manures and fertilizers, sources and methods of application.
- 7 Irrigation: systems, types and management. Crop protection measures.
- 8 Crop rotation. Harvesting, processing, storage and marketing of farm produce.
- 9 Agro-based industries.
- 10 Environmental pollution and health hazards.

Practical

- 1 Land measuring units.
- 2 Demonstration of hand tools and tillage implements.
- 3 Identification of meteorological instruments.
- 4 Identification of crop plants, weeds and seeds.
- 5 Identification of organic and inorganic fertilizers.
- 6 Calculation of nutrient-cum-fertilizer unit value.
- 7 Demonstration of various irrigation methods.
- 8 Field visits.

Recommended Texts

- 1 Bashir, E. and Bantel, R.. (2001), *Soil Science*, Islamabad, National Book Foundation.
- 2 Brady, N.C. and Weil, R.R. (2013). *Elements of the Nature and Properties of Soils*, 3rd Ed. Upper Saddle River, NJ, USA, Pearson Education.

Suggested Readings

- 1 Hillel, D. (2008). *Soil in the Environment: Crucible of Terrestrial Life*. Burlington, MA, USA, Elsevier Inc.
- 2 Singer, M. J. and Munns, D. N. (2002). *Soils- An Introduction*, 5th ed. Upper Saddle River, NJ, USA. Prentice-Hall, Inc.
- 3 Das, D.K. (2011). *Introductory Soil Science* (3rd ed.). New Delhi-110002, India, Kalyani Publ.

This subject aims to yield students with a sense of practical relevance of biology to everyday life. This will make students comprehend life by understanding some of the molecular processes that occur in and around cells, to make students cognizant of biologic phenomenon (nature, body, etc.) on an evolutionary, ecological, behavioral, physiologic, tissue, cellular, and molecular level. In this subject students will examine how life is organized into hierarchical levels; how living organisms use and produce energy; how life grows, develops, and reproduces; how life responds to the environment to maintain internal stability; and how life evolves and adapts to the environment. Moreover, it will also enable them to investigate the biological molecules, homeostasis in vertebrates, and the influence of hormones on coordination and control systems of animal body. Upon completion of this subject students will be having an enhanced knowledge and appreciation of the basics of growth and development plans of animals and can develop cogent and critical arguments based on the course material.

Contents

1. Introduction: Nature and scope of biology, Branches of biology, Relationship between biology and psychology
2. Biological molecules: Carbohydrates, Proteins, Fats, Nucleic acids, Water
3. The cell: Structure and function of cell, Cell organelles, Different types of cells
4. Homeostasis: Osmoregulation, Structure and functions of Nephron, Thermoregulation
5. Coordination and control: Structure and physiology of Neuron, Introduction to central and peripheral nervous system, Hormones
6. Basics of growth and development: Embryonic and post embryonic development

Recommended Texts

1. Michael, J. and Lenardo. (2013). *Immune Homeostasis: Methods and protocol*. Humana press.
2. Campbell, M. and Christopher J. P. (2016). *Organismal homeostasis*. Momentum press.

Suggested Readings

1. Lisa A. U., Michael L. C., Steven A. W., Peter V. M., Jane B. R. and Neil A. C. (2016). *Campbell biology*. 11th Pearson
2. Campbell, N. A. Mitchell, I. G. and Reece, J. B. (2009). *Biology: Concepts and connections*. 6th edition San Francisco: Addison Wesley, Longman
3. Anna A. S., Richard B. P. (2019). *An Introduction to Conservation Biology* 2nd Edition. Sinauer Associates is an imprint of Oxford University Press

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. Mathematics, as a study of patterns, both practical and abstract, involves analytical thought, logical reasoning, problem solving skills, and precise communication. Because of its power and versatility, mathematics has often been called the "Queen of the Sciences." There is no field of scientific inquiry that does not express itself through the language of mathematics. An undergraduate degree in mathematics provides an excellent foundation for students who are interested in pursuing an advanced degree in mathematics or in a related specialized profession. Mathematics can also provide an excellent foundation for students considering professional degrees in such allied fields such as Law, Business Administration, or Medicine. The kinds of analytical and logical thinking skills that one develops while studying mathematics are precisely the skills that recruiters look for in potential employees. Jobs involving significant mathematical background also consistently rank near the top of the list in annual career surveys.

Contents

1. Real Numbers
2. Relations and Functions
3. Inequalities
4. Quadratic Functions and Complex Numbers
 - 1 Linear Equations and Quadratic Equations: Formation of Linear equation
 - 2 Solving Linear equation involving one variable
 - 3 Solution of Quadratic equation by factorization method
 - 4 Solution of quadratic equation by square completion methods
 - 5 Solution of quadratic equation by quadratic formula
5. Application of quadratic equation
6. Sequence and Series
7. Types of Sequences; A. P, A. M., G. P., H. P
8. Trigonometric Functions, Trigonometric Applications
9. Graph of Functions and Modelling
10. Limits and Continuity
11. Derivatives, Integration
12. Probability and Binomial Theorem.

Recommended Texts

- 1 Gantert, A. X. (2009). *Algebra 2 and trigonometry*. New York: AMCOS School Publication INC.
- 2 Kaufmann, J. E. (1994). *College algebra and trigonometry* (3th ed.). Boston: PWS-Kent Pub. Co.

Suggested Readings

- 1 Swokowski, E. W. (1993). *Fundamentals of algebra and trigonometry* (8th ed.). Boston: PWS-Kent Pub. Co.
- 2 Nauman, K. (2019). *Basic mathematics-I: algebra and trigonometry* (2nd ed.). Lahore: Al-Hassan Pub.
- 3 Anton, H. (1999). *Calculus: A new horizon* (6th ed.). New York: John Wiley.
- 4 Stewart, J. (2012). *Calculus* (7th ed.). Belmont: Brooks/Cole

The course introduces students to information and communication technologies and their current applications in their respective areas. Objectives include basic understanding of computer software, hardware, and associated technologies. They can make use of technology to get maximum benefit related to their study domain. Students can learn how the Information and Communications systems can improve their work ability and productivity. How Internet technologies, E-Commerce applications and Mobile Computing can influence the businesses and workplace. At the end of semester students will get basic understanding of Computer Systems, Storage Devices, Operating systems, E-commerce, Data Networks, Databases, and associated technologies. They will also learn Microsoft Office tools that includes Word, Power Point, Excel. They will also learn Open office being used on other operating systems and platforms. Specific software's related to specialization areas are also part of course. Course will also cover Computer Ethics and related Social media norms and cyber laws.

Contents

1. Introduction, Overview and its types.
2. Hardware: Computer Systems & Components, Storage Devices and Cloud Computing.
3. Software: Operating Systems, Programming and Application Software,
4. Introduction to Programming Language
5. Databases and Information Systems Networks
6. The Hierarchy of Data and Maintaining Data,
7. File Processing Versus Database Management Systems
8. Data Communication and Networks.
9. Physical Transmission Media & Wireless Transmission Media
10. Applications of smart phone and usage
11. The Internet, Browsers and Search Engines.
12. Websites Concepts, Mobile Computing and their applications.
13. Collaborative Computing and Social Networking
14. E-Commerce & Applications.
15. IT Security and other issues
16. Cyber Laws and Ethics of using Social media
17. Use of Microsoft Office tools (Word, Power Point, Excel), mobile apps or other similar tools depending on the operating system.
18. Other IT tools/software specific to field of study of the students if any

Recommended Texts

1. Vermaat, M. E. (2018). *Discovering computers: digital technology, data and devices*. Boston: Course Technology Press.

Suggested Readings

1. Timothy J. O'Leary & Linda I. (2017). *Computing essentials*, (26th ed.). San Francisco: McGraw Hill Higher Education.
2. Schneider, G. M., & Gersting, J. (2018). *Invitation to computer science*. Boston: Cengage Learning.

The course aims at developing linguistic competence by focusing on basic language skills in integration to make the use of language in context. It also aims at developing students' skills in reading and reading comprehension of written texts in various contexts. The course also provides assistance in developing students' vocabulary building skills as well as their critical thinking skills. The contents of the course are designed on the basis of these language skills: listening skills, pronunciation skills, comprehension skills and presentation skills. The course provides practice in accurate pronunciation, stress and intonation patterns and critical listening skills for different contexts. The students require a grasp of English language to comprehend texts as organic whole, to interact with reasonable ease in structured situations, and to comprehend and construct academic discourse. The course objectives are to enhance students' language skill management capacity, to comprehend text(s) in context, to respond to language in context, and to write structured response(s).

Contents

- 1 Listening skills
- 2 Listening to isolated sentences and speech extracts
- 3 Managing listening and overcoming barriers to listening
- 4 Expressing opinions (debating current events) and oral synthesis of thoughts and ideas
- 5 Pronunciation skills
- 6 Recognizing phonemes, phonemic symbols and syllables, pronouncing words correctly
- 7 Understanding and practicing stress patterns and intonation patterns in simple sentences
- 8 Comprehension skills
- 9 Reading strategies, summarizing, sequencing, inferencing, comparing and contrasting
- 10 Drawing conclusions, self-questioning, problem-solving, relating background knowledge
- 11 Distinguishing between fact and opinion, finding the main idea, and supporting details
- 12 Text organizational patterns, investigating implied ideas, purpose and tone of the text
- 13 Critical reading, SQ3R method
- 14 Presentation skills, features of good presentations, different types of presentations
- 15 Different patterns of introducing a presentation, organizing arguments in a presentation
- 16 Tactics of maintaining interest of the audience, dealing with the questions of audience
- 17 Concluding a presentation, giving suggestions and recommendations

Recommended Texts

- 1 Mikulecky, B. S., & Jeffries, L. (2007). *Advanced reading power: Extensive reading, vocabulary building, comprehension skills, reading faster*. New York: Pearson.
- 2 Helgesen, M., & Brown, S. (2004). *Active listening: Building skills for understanding*. Cambridge: Cambridge University Press.

Suggested Readings

- 1 Roach, C. A., & Wyatt, N. (1988). *Successful listening*. New York: Harper & Row.
- 2 Horowitz, R., & Samuels, S. J. (1987). *Comprehending oral and written language*. San Diego: Academic Press.

Islamic Studies engages in the study of Islam as a textual tradition inscribed in the fundamental sources of Islam; Qur'an and Hadith, history and particular cultural contexts. The area seeks to provide an introduction to and a specialization in Islam through a large variety of expressions (literary, poetic, social, and political) and through a variety of methods (literary criticism, hermeneutics, history, sociology, and anthropology). It offers opportunities to get fully introductory foundational bases of Islam in fields that include Qur'anic studies, Hadith and Seerah of Prophet Muhammad (PBUH), Islamic philosophy, and Islamic law, culture and theology through the textual study of Qur'an and Sunnah.

Islamic Studies is the academic study of Islam and Islamic culture. It majorly comprises of the importance of life and that after death. It is one of the best systems of education, which makes an ethical groomed person with the qualities which he/she should have as a human being. The basic sources of the Islamic Studies are the Holy Qur'an and Sunnah or Hadith of the Holy Prophet Muhammadﷺ. The learning of the Qur'an and Sunnah guides the Muslims to live peacefully.

Contents

1. Study of the Qur'an (Introduction to the Qur'an, Selected verses from *Surah Al-Baqarah, Al-Furqan, Al-Ahzab, Al-Mu'minoon, Al-An'am, Al-Hujurat, Al-Saff*)
2. Study of the Hadith (Introduction to Hadith literature, Selected Ahadith (Text and Translation))
3. Introduction to Qur'anic Studies
4. Basic Concepts of Qur'an
5. History of Quran
6. Basic Concepts of Hadith
7. History of Hadith
8. Kinds of Hadith
9. Uloom –ul-Hadith
10. Sunnah & Hadith
11. Seerat ul-Nabi (PBUH), necessity and importance of Seerat, role of Seerah in the development of personality, Pact of Madinah, Khutbah Hajjat al-Wada' and ethical teachings of Prophet (PBUH).
12. Legal Position of Sunnah
13. Islamic Culture & Civilization
14. Characteristics of Islamic Culture & Civilization
15. Historical Development of Islamic Culture & Civilization
16. Comparative Religions and Contemporary Issues
17. Impact of Islamic civilization

Recommended Books

1. Hassan, A. (1990). *Principles of Islamic jurisprudence*. New Dehli: Adam Publishers.
2. Zia-ul-Haq, M. (2001). *Introduction to al-Sharia al-Islamia*. Lahore: Aziz Publication.

Suggested Readings

1. Hameedullah, M. (1957). *Introduction to Islam*. Lahore: Sh M Ashraf Publisher.
2. Hameedullah, M. (1980). *Emergence of Islam*. New Dehli: Adam Publishers.
3. Hameedullah, M. (1942). *Muslim conduct of state*. Lahore: Sh M Ashraf Publisher.

This course is an introduction to the philosophical study of morality, including the theory of right and wrong behavior, the theory of value (goodness and badness), and the theory of virtue and vice. Besides providing familiarity with the primary questions addressed within moral philosophy and the most influential answers given by well-known philosophers, this course is designed to help students develop their abilities to read, explicate, analyze, and evaluate philosophical literature, write and express themselves well about their own ethical positions, and think critically and analytically about ethical issues. This course is intended for the student who has had little or no prior exposure to philosophy. It will provide a broad but reasonably detailed examination of the central issues of moral philosophy and will also consider how these can be applied to several contemporary moral problems. This course has been designed to familiarize students to learn about some of the most important theories and figures of moral philosophy in the hope that you can develop a clear understanding of the questions that recur in ethical debate.

Contents:

1. Overview of Moral Philosophy
2. Theoretical ethics
3. Moral concepts and justify moral principles and theories
4. Applied ethics: an Islamic point of view
5. Metaphysics and Morality
6. Moral Objectivism and Relativism
7. Features of moral objectivism
8. Qur'an and Sunnah on Ethics
9. Individual relativism:
10. God and Morality
11. Criticism and its manners
12. Reason and Emotion
13. Principles of moral reasoning
14. Ethics in *Seerah* and *Taswwuf*
15. Gender and Morality
16. Significant Muslim masters of ethics
17. Rule-utilitarianism, Moral foundations of authorities
18. The social contract, Libertarianism, Welfare liberalism.

Recommended Texts:

1. Mackenzie, John S. LL. D. Glasg. (1983). *A manual of ethics*. London: University Tutorial Press.
2. Syed Sulaiman Nadwi. (1999). *Ethics in Islam*. Karachi: Darul-Ishaat .

Suggested Readings:

1. Williams, B. (1972). *Morality: An Introduction to Ethics*. Cambridge: Cambridge University Press.
2. Steven M. Cahn and Peter Markie. (2019). *History, Theory, and Contemporary Issues*. Oxford: Oxford University Press.

SEMESTER-II

AGRO-5902

General Crop Production

3(2+1)

This course is aimed at acquainting the students with the basic concepts of Agronomy and crop production. It has been designed to develop understanding among students about the production technology of major and minor field crop grown under the agro-ecological conditions of Pakistan. In addition, the commonly followed cropping systems schemes and patterns by the farmers in the country are also discussed in detail indicating the potential opportunities and issues. It also deals with the scientific management of crop environment and pests of field crop cultivated in the country. This course contains the practical aspects of crop production such as demonstration of improved sowing methods, intercultural operations, harvesting and threshing. The student will have a comprehensive knowledge of the production of crop from sowing to the harvesting.

Contents

Theory

- 1 Concept of crop production.
- 2 Classification of field crops.
- 3 Cropping scheme, cropping patterns, cropping systems, cropping intensity.
- 4 Production technology of major field crops: cereals (wheat, rice, maize, barley).
- 5 Sugar crops (sugarcane, sugar beet) and fiber crops (cotton, jute).
- 6 Traditional oil seed crops (rapeseed, mustards, peanut, linseed, sesame etc.).
- 7 Non-traditional oil seed crops (sunflower, soybean, safflower).
- 8 Grain legumes (chickpea, lentil, green gram, black gram).
- 9 Fodders (berseem, lucerne, oats, sorghums, millets, mott grass, cowpea).
- 10 Special crops (tobacco).
- 11 Green manure crops (Guara, Dhancha, Pigeon pea, Senji etc.).

Practical

- 1 Identification of crops and their seeds.
- 2 Demonstration of improved sowing methods of crops.
- 3 Delinting of cotton seed.
- 4 Raising of crop nurseries and transplanting.
- 5 Intercultural practices.
- 6 Seed Inoculation.
- 7 Seed treatment with fungicides.
- 8 Demonstration of harvesting and threshing operations.
- 9 Field visits.

Recommended Texts

- 1 Balasubramanian. (2004). *Principles and Practices of Agronomy*, Jodhpur, India, Agrobios.
- 2 Khalil, I.A. and Jan, A. (2002) *Cropping Technology*. Islamabad, National Book Foundation.

Suggested Readings

- 1 Martin, J.H. Waldren, R.P. and Stamp, D.L. (2006). *Principles of Field Crop Production*, 4th Ed. New York, The McMillan Co.
- 2 Nazir, M.S., Bashir, E. and Bantel, R. (Eds.). (1994). *Crop Production*, Ed. E. Bashir & R. Bantel, Islamabad, National Book Foundation.

This is the continuity of course taught in first semester designed to introduce the concept and importance of soil science for agriculture students at under-graduate level. It provides information to the students about chemistry of soils; especially soil colloids and their environmental significance. How organic matter play a role for enhancing availability of macro and micro nutrients from soil environment. This subject also clears the concept of students about soil pH and its significance regarding nutrients availability from soil to plant. This course also delivers knowledge to the students how to use sagaciously essential elements for better crop growth and production. Acquisition of specific and technical understanding of the students to select best management strategies for soil reclamation and land evaluation. In addition, this introductory course also improves the skills of the students how to calculate percent nutrients in available fertilizer and their chemical analysis about their percent grade.

Contents

1. Soil colloids and clays: description and environmental significance
2. Sources of charges on soil colloids
3. Cation and anion exchange properties of soil and their significance; basic cation saturation percentage
4. Soil pH and its importance
5. Buffering of soil
6. Soil organic matter: sources, composition and significance
7. Elements essential for plant growth: macro and micro nutrients, organic and inorganic fertilizers
8. Salt-affected and waterlogged soils: types, reclamation and management
9. Soil erosion: causes and remedies: soil and water conservation
10. Environmental impact of agricultural and industrial wastes

Practical

1. Fertilizers: Identification, composition and calculation of nutrient percentage
2. Fertilizer analysis for N, P and K
3. Soil analysis for EC and pH
4. Determination of soil organic matter

Recommended Texts

1. Bashir & Bantel. (2001). *Soil Science*. Islamabad, National Book Foundation.
2. Brady, N.C. & R.R. Weil. (2007). *The Nature and Properties of Soils* (14th ed.). Upper Saddle River, NJ, USA, Pearson Education.

Suggested Readings

1. Brady, N.C. & R.R. Weil. (2009). *Elements of the Nature and Properties of Soils* (3rd Ed.). Upper Saddle River, NJ, USA. Pearson Education.
2. Hillel, D. (2008). *Soil in the Environment: Crucible of Terrestrial Life*. Burlington, MA, USA. Elsevier Inc.
3. Singer, M.J., & Munns, D.N. (2002). *Soils - An Introduction*. (5th ed.). Upper Saddle River, NJ, USA. Prentice-Hall, Inc.

Forest and Watershed management must heavily emphasize the understanding of forest resources in relation to watershed with practical knowledge of forest survey and its analysis and interpretation in a valid manner. The objectives of studying this course are to acquaint the students with basic knowledge of Forestry, develop understanding about principles used in Watershed management, to impart knowledge about forest resources in Pakistan, and to teach skills to the students about practical Forest and Watershed management in Pakistan. Watershed management is closely related to forest management as the selection and implementation of different forestry practices play a crucial role in it. Students will learn the different biological and engineering approaches to control and regulate the water flow and to reduce the sedimentation of the streams and lakes fed by this water.

Contents

Theory

1. Introduction to Forest and watershed 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. Hydrological cycle.
10. Management problems and potentials of various watersheds, afforestation programmes.
11. Watershed as a source of power generation and irrigation.
12. Watershed research and education.

Practical

1. Identification of important forest tree species
2. Visits to various forest types and watershed areas.
3. Watershed measurements (instruments, area, drainage, flow etc.).

Recommended Texts

1. Franzel, S. & Scherr, S.J. (2001). *Trees on the Farm*. CAB International.
2. Quraishi, M. A. A. (1999). *Basics of Forestry and Allied Sciences*. Urdu Bazar, Lahore, A-One Publishers.

Suggested Readings

1. Sheikh, M.I. (1999). *Forests and Forestry in Pakistan*. A-One Publishers, Urdu Bazar, Lahore.
2. Quraishi, M.A.A. (2002). *Watershed Management in Pakistan*. Department of Forestry. UAF.
3. Quraishi, M.A.A. and Siddiqui, M.T. (2002). *Practical manual of watershed management*. Department of Forestry. UAF.
4. Siddiqui, M.T., R. Sands and Shah, A.H. (2009). *Glossary of forestry terms*. Faisalabad, Pulschay Publisher.

The main purpose of this course is to give brief introduction of Agricultural Extension education at undergraduate level. The students must know the history and philosophy of agricultural education in the development of present era agricultural system across the world. The following such as concepts of Extension education and rural development, principles of effective extension work, concepts of program planning, research, program evaluation and their importance in agricultural extension and rural development work, Role of communication and ICTs in extension work and development activities in rural areas for the growth of the masses are important to disseminate among undergraduate students so that students will prepare themselves to learn more advance ideas in agricultural education and research. The students will be able to perform better in dissemination of different agricultural technologies.

Contents

1. Agricultural extension; its definition, objectives and importance,
2. Types of education, Brief history/recent trends in agricultural extension,
3. Organizational setup of agricultural extension in Pakistan, Rural development, its definition/concept, objectives, importance and indicators,
4. Elements of rural development process.
5. Rural development through agricultural extension work in Pakistan, Characteristics and problems of Pakistani farmers,
6. Current issues and problems of rural development and extension work in Pakistan. Roles and duties of extension workers at various organizational levels,
7. Extension programs and activities since 1947 to date in Pakistan, role of communication and ICT in Extension and Rural Development work,
8. Principles of effective extension work. Adoption and diffusion of agricultural innovations, Agricultural Technology and its application for Pakistani farmers,
9. Extension, research and farmer's linkages, Basic concept of planning, monitoring and evaluation in Agricultural Extension.

Recommended Texts

1. Ray, G.L. (2006). *Extension Communication and Management*; Kalyani Publishers.
2. Ison, R. & Russell, D. (2004). *Agricultural Extension and Rural Development: Breaking out of Knowledge Transfer Traditions*; Cambridge University Press.

Suggested Readings

1. Bashir, E. (2005). *Extension Methods* (2nd ed.). Islamabad, National Book Foundation.
2. Narasaiah, M.L. (2003). *Approaches to Rural Development*. New Delhi (India), Discovery Publishing House.
3. Leeuwis, C. & Van den Ban, A. (2004). *Communication for rural Innovation: Rethinking Agricultural Extension* (3^r ed.). Wiley-Blackwell.

Academic writing is a formal, structured and sophisticated writing to fulfill the requirements for a particular field of study. The course aims at providing understanding of writer's goal of writing (i.e. clear, organized and effective content) and to use that understanding and awareness for academic reading and writing. The objectives of the course are to make the students acquire and master the academic writing skills. The course would enable the students to develop argumentative writing techniques. The students would be able to the content logically to add specific details on the topics such as facts, examples and statistical or numerical values. The course will also provide insight to convey the knowledge and ideas in objective and persuasive manner. Furthermore, the course will also enhance the students' understanding of ethical considerations in writing academic assignments and topics including citation, plagiarism, formatting and referencing the sources as well as the technical aspects involved in referencing.

Contents

- 1 Academic vocabulary
- 2 Quoting, summarizing and paraphrasing texts
- 3 Process of academic writing
- 4 Developing argument
- 5 Rhetoric: persuasion and identification
- 6 Elements of rhetoric: Text, author, audience, purposes, setting
- 7 Sentence structure: Accuracy, variation, appropriateness, and conciseness
- 8 Appropriate use of active and passive voice
- 9 Paragraph and essay writing
- 10 Organization and structure of paragraph and essay
- 11 Logical reasoning
- 12 Transitional devices (word, phrase and expressions)
- 13 Development of ideas in writing
- 14 Styles of documentation (MLA and APA)
- 15 In-text citations
- 16 Plagiarism and strategies for avoiding it

Recommended Texts

- 1 Swales, J. M., & Feak, C. B. (2012). *Academic writing for graduate students: Essential tasks and skills* (3rd ed.). Ann Arbor: The University of Michigan Press.
- 2 Bailey, S. (2011). *Academic writing: A handbook for international students* (3rd ed.). New York: Routledge.

Suggested Readings

- 1 Craswell, G. (2004). *Writing for academic success*. London: SAGE.
- 2 Johnson-Sheehan, R. (2019). *Writing today*. Don Mills: Pearson.
- 3 Silvia, P. J. (2019). *How to write a lot: A practical guide to productive academic writing*. Washington: American Psychological Association

The course is designed to acquaint the students of BS Programs with the rationale of the creation of Pakistan. The students would be apprised of the emergence, growth and development of Muslim nationalism in South Asia and the struggle for freedom, which eventually led to the establishment of Pakistan. While highlighting the main objectives of national life, the course explains further the socio-economic, political and cultural aspects of Pakistan's endeavors to develop and progress in the contemporary world. For this purpose, the foreign policy objectives and Pakistan's foreign relations with neighboring and other countries are also included. This curriculum has been developed to help students analyze the socio-political problems of Pakistan while highlighting various phases of its history before and after the partition and to develop a vision in them to become knowledgeable citizens of their homeland.

Contents

1. Contextualizing Pakistan Studies
2. Geography of Pakistan: Geo-Strategic Importance of Pakistan
3. Freedom Movement (1857-1947)
4. Pakistan Movement (1940-47)
5. Muslim Nationalism in South Asia
6. Two Nations Theory
7. Ideology of Pakistan
8. Initial Problems of Pakistan
9. Political and Constitutional Developments in Pakistan
10. Economy of Pakistan: Problems and Prospects
11. Society and Culture of Pakistan
12. Foreign Policy Objectives of Pakistan and Diplomatic Relations
13. Current and Contemporary Issues of Pakistan
14. Human Rights: Issues of Human Rights in Pakistan

Recommended Texts

1. Kazimi, M. R. (2007). *Pakistan Studies*. Karachi: Oxford University Press.
2. Sheikh, Javed Ahmad (2004). *Pakistan's Political Economic and Diplomatic Dynamics*. Lahore: Kitabistan Paper Products.

Suggested Readings

1. Hayat, Sikandar (2016). *Aspects of Pakistan Movement*. Islamabad: National Institute of Historical and Cultural Research.
2. Kazimi, M. R (2009). *A Concise History of Pakistan*. Karachi: Oxford University Press.
3. Talbot, Ian (1998). *Pakistan: A Modern History*. London: Hurst and Company.

SEMESTER-III

PLBG-5201

Introductory Genetics

3(2+1)

To enable students to understand: Basic concepts of genetics, understanding, why the characters of off springs are similar to their parents, what can be the possible reason for the variation that the off springs show to their parents. Mechanism of heredity underlying laws of genetics and their practical manifestation in the form of various monohybrid as well as dihybrid crosses. Understanding the linkage and epistasis as potential reasons for deviation from law of independent assortment. Understanding the concepts of allele and gene both at genotypic as well as phenotypic level. Understanding process and purposes of the cell cycle, meiosis, and mitosis, as well as the outcomes of these processes. Enabling the students to solve various genetics problems, making calculated and accurate predictions about inheritance of genetic traits, and map the locations of genes. Chemical and molecular nature of nucleic acids i.e. RNA and DNA. Understanding the concept of gene expression from gene to its product.

Contents

Theory

1. Definition of genetics, concepts of heredity and variation.
2. Cell and cell divisions. Mendelian genetics: chromosome theory of heredity, various genotypic and phenotypic ratios and their modifications.
3. Differences between allelic and non-allelic interactions (epistasis), illustration of epistasis with suitable examples.
4. Pleiotropy and multiple allelism. Multiple factor hypothesis. Linkage and crossing over.
5. Sex determination: sex linked and sex influenced traits.
6. Chromosomal aberrations.
7. Nucleic acids: nature, structure and function.
8. Classical vs modern concepts of gene.

Practical

1. Study of cell divisions and gametogenesis.
2. Calculation of monohybrid and dihybrid ratios.
3. Numerical examples relating to gene interaction, multiple alleles and multiple factor inheritance.
4. Calculation of linkage from test cross and F_2 data.

Recommended Texts

1. Singh, B.D. (2004). *Genetics*. New Delhi, India, Kalyani Publishers.
2. Klug, W.S. & Cummings, M. R. (2003). *Concepts of Genetics*. (7th ed.), Singapore, Pearson Education.

Suggested Readings

1. Singh, P. (2003). *Elements of Genetics*. (2nd ed.) Delhi, India, Kalyani Publishers.
2. Stansfield, W.D. ((1988) *Theory and Problems of Genetics*. 4thed. NY, McGraw-Hill Book Co.
3. Khan I.A. Azhar, F.M. Ali, Z. & Khan, A.A. (2008). *Solving Numerical Genetic Problems*. Dept. Plant Breed. Genetic Faisalabad, Uni. Agri.

This course is aimed to make the students familiar with the basic information about the study of insects. The students would be able to know about arthropods and especially insects with their morphological features, identify insects of economic importance and acquire working skills for collecting, mounting, and preserving insects. Course briefs about the basic external and internal morphological and anatomical features along with their basic functioning principles. Students will learn as well about the insect classification and nomenclature. They can easily identify the insect order, family and type and can properly collect, mount and preserve these invertebrates for further studies. Insect body features and their habits help for their identification. This is the basic course that enables the students to further understand the ways and techniques adopted for the control and management of economically important insect pests.

Contents (Theory)

- 1 Introduction
- 2 Phylum Arthropoda and its classification
- 3 Metamorphosis and its types
- 4 External and internal morphology and physiology with a particular reference to typical insect, 'ak' grasshopper, *Poeciloceris pictus*
- 5 Insect classification and nomenclature
- 6 Salient characters of insect orders with important families and examples of important members

Contents (Practical)

- 1 Characters of classes of Arthropoda
- 2 Collection and preservation of insects
- 3 Morphology and dissection of a typical insect (digestive, reproductive, excretory, nervous, circulatory and tracheal systems)
- 4 Temporary mounts of different types of appendages of insects
- 5 Observations for types of metamorphosis

Recommended Texts

1. Lohar, M.K. (1998). *Introductory Entomology*, Kashif Publications, Hyderabad, Pakistan.
2. McGavin, G. C. (2001). *Essential entomology: an order-by-order introduction*. USA: Oxford University Press.

Suggested Readings

1. Tonapi, G.T. (1994). *Experimental Entomology, an Aid to Lab. and Field Studies*. Dehli: C.B.S. Publishers and Distributors.
2. Mani, M.S. (1990). *General Entomology* (4th ed.) Dehli: Oxford & IBH Publishing Co. Pvt. Ltd.

Plant pathology is a science that studies plant diseases and attempts to improve the chances for survival of plants when they are faced with unfavorable environmental conditions and parasitic microorganisms that cause disease. As such, plant pathology is challenging, interesting, important, and worth studying in its own right. It is also, however, a science that has a practical and noble goal of protecting the food available for humans and animals. Plant diseases, by their presence, prevent the cultivation and growth of food plants in some areas; or food plants may be cultivated and grown but plant diseases may attack them, destroy parts or all of the plants, and reduce much of their produce, i.e., food, before they can be harvested or consumed. The objective of this course is to acquaint the students with basic concepts and identification of plant pathogens. The course covers all aspects of plant pathogens which include their economic importance, morphology, reproduction and ecology. The course also covers classification of different plant pathogens. In addition to plant pathogens, phanerogamic parasites, viroids and fastidious bacteria will also be covered briefly during this course.

Theory

1. Introduction; economic importance
2. General characteristics (morphology, reproduction and ecology)
3. Identification of plant pathogens including fungi, prokaryotes, viruses, viroids, nematodes, fungus like organisms and phanerogamic parasites
4. Taxonomic position of economically important plant pathogens

Practical

1. Orientation of laboratory equipment
2. Sterilization of glassware
3. Preparation of media and isolation of different plant pathogens
4. Study of characteristics of various plant pathogens through slides
5. Live specimens and their comparative account/study

Recommended Texts

1. Agrios, G. N. (2005). *Plant Pathology* (5th ed.). Burlington, MA. USA, Elsevier Academic Press.
2. Ahmad, I., & Bhutta, A.R. (2005) *Textbook of introductory Plant Pathology*. Islamabad, NBF Publisher.

Suggested Readings

1. Bos, L. (1999). *Plant viruses, unique and intriguing pathogens: a textbook of plant virology*. Netherlands, Backhuys Publishers.
2. Mehrotra, R. S., & Aggarwal, A. (2003). *Plant Pathology* (2nd ed.). India, Tata McGraw Hill Education (India) Private Limited.
3. Ravichandra, N. G. (2013). *Fundamentals of plant pathology*. India, PHI Learning Pvt. Ltd.
4. Windham, M. T., Trigiano, R. N., & Windham, A. S. (2003). *Plant pathology: concepts and laboratory exercises*. UK, Taylor and Francis.

This course is aimed to make the students familiar with the basic information about the study of horticultural plants such as fruits, vegetables and ornamental plants. The course covers all aspects of Horticultural crops. The student will learn the division of horticulture and classification of horticultural plants as well as plant parts and their modifications. This course would help understand students regarding, propagation methods, punning, training and laying out of an orchard, vegetable farm This course will help students to identify the key issues being faced by the growers such as purchasing of plants from nursery, establishing an orchard, pruning, training and wind breaks. Taking this course would broaden their vision regarding the horticulture industry at domestic and international level. Students will be able to identify existing gaps and will be trained to solve those issues.

Contents

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

Practical

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

Recommended Texts

- 1 Christopher, E. P. (2012). *Introductory Horticulture*. New Dehli, India, Biotech books
- 2 Carrol,L., J.R.Shry and H.E. Reily. (2011). *Introductory Horticulture* (8th Ed.) Albany, USA, Delmar-Thomson Learning.

Suggested Reading

- 1 Hartmann, H.T., D.E. Kester, E.T. Davies and R.L. Geneve. (2009). *Plant Propagation–Principles and Practices* (7th Ed.). New Delhi, India, Prentice-Hall India Learning Pvt. Ltd.
- 2 Peter, K.V. (2009). *Basics of Horticulture*. New Dehli, India, New India publishing Agency.
- 3 Reddy, R. and Shanker J.P.A. (2008). *Horticulture*. Commonwealth Publishers.

The Course will introduce the students with the knowledge of rangelands and their importance as major land use in Pakistan. Students will be able know the characteristics of rangelands of the country and complexities associated with management of rangelands. The course describes the range ecosystem, its components and types of range vegetation in different ecological zones of the country with brief discussion of the botany of range grasses, shrubs and trees, range plant ecology, range animal behavior, rangeland stocking rate and selection of grazing system. There is a comprehensive discussion on principles of scientific management of all the components of range ecosystem and its relation with wildlife. The key objectives of this course are to introduce the students with the rangeland resources and associated wildlife of Pakistan, to make the students identify major range vegetation types and wildlife species of the country and to provide information about the problems of rangelands and their scientific management

Contents

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 systems of the world
9. Grazing systems 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.

Practical

1. Identification and preservation of important Grasses and Plant species of a rangeland.
2. Visits to various Rangeland types and Plantations.
3. Quantitative analysis of range vegetation.
4. Identification of important wildlife species.

Recommended Texts

1. Holechek, J. (1989). *Range Management, Principles and Practices*. Newberry. USA, Prentice Hall, Inc.
2. Quraishi, M. A. A., G.S. Khan and Yaqoob, M. S. (1993). *Range Management in Pakistan*, Faisalabad, University of Agriculture.

Suggested Readings

1. Mohammad, N. (1989). *Rangeland Management in Pakistan*. NARC Published by ICIMOD.
2. Stoddard, L.A., A.D. Smith and Box, T.W. (1975). *Range Management*. New York, McGraw Hill Book Co.
3. Quraishi, M.A.A., Ishaque, M. (1995). *Practical Manual of Range Management*. Faisalabad, University of Agriculture.

The objective of this course is to introduce the students to economic principles and the economic way of thinking. This course is helpful for students to teach them the basic economics foundation about the allocation of scarce resources, that scarcity forces choice, tradeoffs exist and that every choice has an opportunity cost. After completing the course, students will develop understanding of the basic concepts of economics and their application in agriculture. Students should read content and complete course assignments prior to deadlines. Students are expected to actively participate in discussions and submit exercises in-time. Students are also expected to complete exams on the date and time allotted. It is their responsibility to be familiar with and understand all previously covered material prior to each new chapter.

Contents

1. Definitions and overview of economics and related terms; Subject Matter & Scope;
2. Contents of consumer behavior; Scale of preferences; Utility, Indifference Curve & related concepts;
3. Demand & Supply analysis; Elasticity of Demand and Supply; Market Equilibrium.
4. Production, factors of production, laws of return and their significance in agriculture;
5. Concept of macroeconomics; approaches to national income estimation;
6. Growth, Unemployment & Inflation;
7. Important macroeconomic issues in agriculture sector of Pakistan.

Recommended Texts

1. Parkin, M. (2010). *Economics*, 10th Edition, Addison Wesley Publishing Company.
2. Penson, J. B., Capps O. Rossen C. P., & Woodward, R. (2013). *Introduction to Agricultural Economics*, 5th Edition. New Jersey, Prentice Hall.

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.

In recent years, community engagement has become a central dimension of governance as well as policy development and service delivery. However, efforts to directly involve citizens in policy processes have been bedeviled by crude understandings of the issues involved, and by poor selection of techniques for engaging citizens. This course will provide a critical interrogation of the central conceptual issues as well as an examination of how to design a program of effective community engagement. This course begins by asking: Why involve citizens in planning and policymaking? This leads to an examination of the politics of planning, conceptualizations of "community" and, to the tension between local and professional knowledge in policy making. This course will also analyze different types of citizen engagement and examine how to design a program of public participation for policy making. Approaches to evaluating community engagement programs will also be a component of the course. Moreover, in order to secure the future of a society, citizens must train younger generations in civic engagement and participation. Citizenship education is education that provides the background knowledge necessary to create an ongoing stream of new citizens participating and engaging with the creation of a civilized society.

Contents

- 1 Introduction to Citizenship Education and Community Engagement: Orientation
- 2 Introduction to Active Citizenship: Overview of the ideas, Concepts, Philosophy and Skills
- 3 Identity, Culture and Social Harmony: Concepts and Development of Identity
- 4 Components of Culture and Social Harmony, Cultural & Religious Diversity
- 5 Multi-cultural society and inter-cultural dialogue: bridging the differences, promoting harmony
- 6 Significance of diversity and its impact, Importance and domains of inter-cultural harmony
- 7 Active Citizen: Locally active, Globally connected
- 8 Importance of active citizenship at national and global level
- 9 Understanding community, Identification of resources (human, natural and others)
- 10 Human rights, Constitutionalism and citizens' responsibilities: Introduction to human rights
- 11 Universalism vs relativism, Human rights in constitution of Pakistan
- 12 Public duties and responsibilities
- 13 Social Issues in Pakistan: Introduction to the concept of social problem, Causes and solutions
- 14 Social Issues in Pakistan (Poverty, Equal and Equitable access of resources, unemployment)
- 15 Social Issues in Pakistan (Agricultural problems, terrorism & militancy, governance issues)
- 16 Social action and project: Introduction and planning of social action project
- 17 Identification of problem, Ethical considerations related to project
- 18 Assessment of existing resources

Recommended Books

- 1 Kennedy, J. K. Brunold, A. (2016). *Regional Context and Citizenship Education in Asia and Europe*. New York: Routledge Falmer.
- 2 Macionis, J. J. Gerber, M. L. (2010). *Sociology*. New York: Pearson Education

Suggested Books

- 1 British, Council. (2017). *Active Citizen's Social Action Projects Guide*. Scotland: British Council
- 2 Larsen, K. A. (2013). *Participation in Community Work: International Perspectives*. Vishanthic Sewpaul, Grete Oline Hole.

SEMESTER-IV

PLBG-5202

Introductory Plant Breeding

3(2+1)

Students will understand: the basis of plant breeding, The application of genetic principals for the improved heredity of plants. How to improve yield, quality, disease-resistance, drought and frost-tolerance and important characteristics of the crops. How to create desired genotypes and phenotypes for specific breeding objectives as per crop. This manipulation involves either controlled pollination, genetic engineering, or both, followed by artificial selection of progeny. The process of creating variation and then utilizing the variation for the plant improvement. Understanding how to exploit the available natural variation and if natural variation is not having selection potential then the method of artificial creation of variation. Understanding the Reproductive mechanisms in major crops, Application of genetic principles in crop improvement, understanding breeding methods in self-pollinated crops and the principal of breeding self-pollinated crops as homozygosity. Comparative advantage of different breeding methods in terms of time required for breeding a crop variety. Understanding breeding methods in cross pollinated crops

Contents Theory

1. Introduction to plant breeding and its role in crop improvement.
2. Reproductive systems in major crop plants.
3. Genetic variation and its exploitation, creation of variation through genetic recombination, mutation and heteroploidy.
4. Breeding self-pollinated crops: introduction, mass selection, pure line selection; hybridization, pedigree method, bulk method and backcross techniques.
5. Breeding cross-pollinated crops: introduction, mass selection, recurrent selection. Development and evaluation of inbred lines.
6. Development of hybrids, synthetic and composite populations.
7. Breeding clonally propagated crops. New trends in plant breeding.

Practical

1. Descriptive study of floral biology.
2. Scientific names, chromosome number and ploidy level of important field crops.
3. Selfing and crossing techniques in major crops.
4. List of approved varieties in major field crops.
5. Field visits of different research organizations.

Recommended Texts

1. Sleper, D. A. & Poehlman, J.M. (2006). *Breeding Field Crops*. (5thed.) Ames, USA, Iowa State University Press.
2. Chahal, G.S. & Gosal, S.S. (2003). *Principles and Procedures of Plant Breeding*. New Delhi, India, Narosa Publishing House.
3. Singh, B. D. (2003). *Plant Breeding: Principles and Methods*. New Delhi, India, Kalyani Publishers.

Suggested Readings

1. Singh, P. (2003). *Essentials of Plant Breeding*. New Delhi, India, Kalyani Publishers.
2. Khan, M.A (Editor). ((1994). *Plant Breeding*. Islamabad, National Book Foundation..
3. Acquaah, G. (2009). *Principles of Plant Genetics and Breeding*. UK, John Wiley & Sons.

The students would be able to acquire the knowledge of different practical aspects of entomology. For instance, they will learn to identify the major insect pest species of agricultural, horticultural and forest crops, vegetables, fruits, stored grains and household pests. Course aims to demonstrate the students about the identification of insect pests, their control methods and pesticide application equipment with basic objective to enhance farmer's productivity through better management and control of insect pests. Moreover, course includes the basic information and introduction related to entomological cottage industries (i.e. honeybee farming, silkworm rearing and lac culture) in order to enhance the productivity of farming community. This course is the continuation of the introductory course which involves the techniques and practices used for the application of the basic entomological knowledge for the control and management of economically important agricultural insect pests and best possible utilization of useful aspects of insects.

Contents

Theory

- 1 Introduction
- 2 Causes of success and economic importance of insects
- 3 Principles and methods of insect control i.e. cultural, biological, physical, mechanical, reproductive, legislative, chemical and bio-technological control
- 4 Introduction to IPM; insecticides, their classification, formulations and application equipment
- 5 identification, life histories, mode of damage and control of important insect pests of various crops, fruits, vegetables, stored grains, household, termites and locust
- 6 Entomological industries: apiculture, sericulture and lac-culture

Practical

- 1 Collection, identification and mode of damage of insect pests of various crops, fruits, vegetables, stored grains and household
- 2 Insecticide formulations, their dilutions and safe handling
- 3 Use of application equipment, instructions in apiculture, sericulture and lac-culture

Recommended Texts

1. Atwal, A.S. (2005). *Agricultural Pests of Southeast Asia and their Management*. Ludhiana: Kalyani Publishers.
2. Pedigo, L. P., & Rice, M. E. (2014). *Entomology and Pest Management* (6th ed.). USA: Waveland Press Inc.

Suggested Readings

1. Duncton, P.A. (2007). *The Insect: Beneficial and Harmful Aspects*. Ludhiana: Kalyani Publishers.
2. Mathews, G.A. (2004). *Pesticide Application Methods* (3rd ed.). New York: John Wiley & Sons, Inc.

Plant Pathology or Phytopathology is the branch of agriculture, which deals with the study of plant diseases. The detailed study includes the importance and occurrence, symptoms, cause, etiology, disease cycle, epidemiology and management of diseases. Disease may be defined as “abnormal changes in physiological processes which disturbs the normal activity of plant organs”. Disease is a condition in which the functions of the organism are improperly discharged or, in other words, it is a state, which is physiologically abnormal and threatens the life of the being or organs. Disease is a variation from normal physiological activity, which is sufficiently permanent or extensive to check the performance of normal functions by the plant or completion of its development. The objective of this course is to acquaint the students with basic concepts of Plant Pathology. The course comprises history of different plant diseases, their symptoms, etiology, epidemiology and management. The course also has brief introduction of different plant pathogens which include fungi, viruses, bacteria and nematodes. The course also covers historical background of different plant pathogens and the discoveries related to management of different diseases.

Theory

1. Introduction and history of plant pathology
2. Basic characteristics of fungi, bacteria, viruses and nematodes
3. Concept of disease in plants; economic importance of plant diseases
4. Nature and cause of (biotic and abiotic) diseases
5. Components of plant disease development
6. Diagnosis of plant diseases
7. Principles of plant disease management
8. Introduction to IDM and IPM; symptoms, etiology
9. Mode of infection, disease cycle and management of representative diseases of agricultural and horticultural crops

Practical

1. Demonstration of lab equipment and reagents
2. Collection, preservation and identification of plant diseases based on symptoms
3. Isolation and inoculation techniques
4. Demonstration of Koch's postulates

Recommended Texts

1. Agrios, G. N. (2005). *Plant Pathology* (5th ed.). Burlington, MA. USA, Elsevier Academic Press.
2. Chaube, H.S., & Singh, R. (2002). *Introductory Plant Pathology*. India, International Book Distributing Co.

Suggested Readings

1. Mehrotra, R.S., & Aggarwal, A. (2003). *Plant Pathology* (2nd ed.). India, Tata McGraw Hill Education (India) Private Limited.
2. Strange, R.N. (2006). *Introduction to Plant Pathology*. USA, John Wiley & Sons.

The objective of this course is to familiarise students with production of horticultural crops such as fruit, vegetables and ornamental crops. Students are expected to understand various stages of fruit, vegetables and ornamental plants phenology and physiology in order to solve related problems for horticultural crops. After completing this course student will be able to grow and manage Horticultural crops successfully on a commercial scale. This course would help understand students regarding the key phenomenon's related with fruits such as incompatibility, fruits set, and biennial bearing. Similarly, students will also learn about disease and insect problem in vegetables and ornamental plants. This course will help students to identify the key issues being faced by the growers such as alternate bearing, fruit drop and possible options to control these issues using different approaches.

Contents

1. Establishment of orchards, vegetable farms and ornamental gardens
2. Site selection, layout methods, wind breaks and their role.
3. Management practices; irrigation, manures and fertilizers, training and pruning, cultivation and weed control.
4. 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

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

Recommended Texts

1. Acquaah, G. (2009). *Horticulture: Principles and Practices* (4th Ed.). New Delhi, India, Prentice-Hall India Learning Pvt. Ltd.
2. Adams, C. R., K.M. Bamford and M. P. Early. (2012). *Principles of Horticulture* (6th Ed.). New York, USA, Routledge.

Suggested Readings

1. Singh, B. (2007). *Horticulture at a Glance*. Ludhiana, New Delhi, India, Kalyani Publishers.
2. Pradeepkumar, T., B. Suma, Jyothibhaskar, K.N. Satheesan, K.V. Peter. 2008. *Management of Horticultural Crops* (Part 1). *Horticulture Science Series Vol. 11*. New Delhi, India, New India Publishing Agency.
3. Yadav, P.K. (2007). *Fruit Production Technology*. Lucknow, India, International Book Distributing Co. (Publishing Division).

This is an introductory course which enables the students to understand the basics of food science and technology. Students will explore and gain an understanding into the history of Food Science and the factors that have shaped Food Science in Pakistan, the organizations involved in Food manufacturing, food regulatory processes, Food composition, its classification depending on sources, consumption pattern and basic analysis of food components. The course is the study of the physical, biological, and chemical makeup of food; the causes of food deterioration; and the concepts underlying food processing. Food scientists and technologists apply scientific disciplines including chemistry, engineering, microbiology, and nutrition to the study of food to improve the safety, nutrition, wholesomeness and availability of food. Depending on their area of specialization, food scientists may develop ways to process, preserve, package, and/or store food according to industry and government specifications and regulations. It could involve enhancing the taste, making it last longer, making sure it's safe to eat, or even boosting its nutritional content.

Theory

- 1 Introduction to food science, food technology, relationship with other disciplines
- 2 Career opportunities. Significance of food science and technology
- 3 Food industry: history, developments, important food industries in Pakistan
- 4 Food sources: plants, animals and marine
- 5 Food constituents and their functions: water, carbohydrates, lipids, proteins, vitamins, minerals.
- 6 Classification of foods on the basis of perishability and pH
- 7 Food spoilage agents: enzymes, microorganisms, pests, physical factors
- 8 Principles of food preservation: prevention or delay of autolysis, microorganisms and pests

Practical

- 1 Use of basic food laboratory equipment.
- 2 Estimation of Moisture, Fat, Protein, Carbohydrates, Fiber and Ash content in food samples.
- 3 Determination of soluble solids, total solids, pH, Acidity, total sugars, Specific gravity and Refractive index.

Recommended Books

- 1 Awan, J. A. (2018). *Food science and technology*. Faisalabad-Pakistan: Unitech Communications.
- 2 Robert, L. S., Ramirez, A. O., Clarke, A. D. (2015). *Introducing Food Science*. 2nd Ed. CRC Press.

Suggested Readings

- 1 Stewart, G. F., & Amerine, M. A. (2012). *Introduction to food science and technology*. Elsevier.
- 2 Potter, N. N., & Hotchkiss, J. H. (2012). *Food science*. Springer Science & Business Media.

This is the general Statistics course designed for under graduate programs of arts and social sciences. Statistics is an integral part of arts and social science research. We live in a world where there is no shortage of numerical data and there is increasing demand for people who know how to make sense of it independent of the field of work. The goal of this course is to turn the students into one of such category. In this course, students will learn the basics of descriptive and inferential statistics and the most commonly used statistical techniques found in arts and social science research. The course is designed to give the students an in depth understanding of how these statistical techniques work but minimizing the mathematical burden on the student. While more focus will be given on the statistical analysis with the help of some statistical softwares SPSS, Excel etc. Moreover, the teacher will also focus on interpretation of statistical data results which are obtained from the statistical softwares. So these activities will improve the analytical and research activities of arts and social science students.

Contents

1. Introduction to Statistics: Descriptive and Inferential Statistics, Limitations of Statistics, Scope of Statistics, Variable, Data, Types of Variable and Data, Scales of Measurements.
2. Display of Data: Tabulation of Data, Graphical Display, Histogram, Bar Charts, Pie Chart, Stem and Leaf Plots.
3. Measures of Central Tendency: Mean Median, Mode, Box Plot, and Application in Real Life.
4. Measures of Dispersion: Range, Quartile Deviation, Mean Deviation, Variance and Standard Deviation, Coefficient of Variation, Z-score and their Application.
5. Normal Distribution: Normal Distribution and its Application,
6. Sampling and Sampling Distribution.
7. Hypothesis Testing: z test, t-test, Chi-square test
8. Regression Analysis: Simple Linear Regression, Multiple Regression.
9. Correlation Analysis: Simple correlation, multiple correlation, partial correlation, partial correlation.
10. Test of independence between qualitative variables
11. All the observational analysis will be carried out using MS Excel and SPSS.

Recommended Texts

1. Weiss, N. A. (2017). *Introductory statistics* (10th ed.). England: Pearson Education.
2. Mann, P.S. (2016). *Introductory statistics* (9th ed.). New York: John Wiley & Sons.

Suggested Readings

1. Ross, S. M. (2010). *Introductory statistics* (3rd ed.). New York: Academic Press.
2. Dunn, D.S. (2001). *Statistics and data analysis for the behavioral sciences*. New York: McGraw Hill
3. Chaudhry, S. M. & Kamal, S. (2010). *Introduction to statistical theory part I &II*. Pakistan: Ilmi Kitab Khana.

SEMESTER-V

AEXT-6408

Communication skills in Agricultural Extension

3(2+1)

The world has now embraced the largest revolution so far in the history of mankind called communication revolution. Everything has been tagged to communication. Where countries are unable to resolve their issues through wars, communication provides the way to resolve mutual conflicts not only between two individuals, groups but also between the countries. Communication has lot more importance in the human growth and development. The main aim of this course is to develop effective communication skills among students. How to develop communication ethics and techniques with other stakeholders in the society is also important to learn. At the end of this course, the students will be able to: define the given concepts of communication, identify the types of communication, conduct interviews and will be able to demonstrate improved communication skills.

Contents

1. Concept, Purpose and scope of communication in Agricultural extension;
2. Forms of communication in the past, present and future;
3. Communication and the concept of global community;
4. Communication as the problem solving approach;
5. Communication process, elements and their role in effective communication;
6. Principles of communication;
7. Basic communication models;
8. Forms of communication: interpersonal, intrapersonal and impersonal; Written, verbal and non-verbal communication;
9. Barriers to communication and measures to overcome these barriers.

Practical

1. The students will be involved in developing and critically analyzing different extension messages. Each student will have to design a project for class presentation
2. Students will have to practice different forms of communication in the class.

Recommended Texts

1. Calvert, P. (2000). *The communicator's Handbook. Tools, Techniques and technology* (4th ed.). USA, Maupin House Publishing.
2. Muhammad, S. (2005). *Communication Skills & Leadership Development*. Faisalabad, Unitech Communications.

Suggested Readings

1. Murphy, H. A., Hildebrandt, H. P. & Thomas, J. P. (2000). *Effective business communication*. International Series. Islamabad, NBF.

About 80,000 to 120,000 species of fungi have been described to date, although the total number of species is estimated at around 1.5 million. This would render fungi one of the least-explored biodiversity resources of our planet. It is notoriously difficult to delimit fungi as a group against other eukaryotes, and debates over the inclusion or exclusion of certain groups have been going on for well over a century. In recent years, the main arguments have been between taxonomists striving towards a phylogenetic definition based especially on the similarity of relevant DNA sequences, and others who take a biological approach to the subject and regard fungi as organisms sharing all or many key ecological or physiological characteristics “the union of fungi”. The objective of this course is to study the basic and applied aspects of fungi and fungi like organisms. The course will cover in detail morphology and classification of fungi and fungi-like organisms belonging to Plasmodiophoromycota, Oomycota, Chytridiomycota, Zygomycota, Glomeromycota, Ascomycota, Basidiomycota and Mitosporic fungi. The course will also cover history and importance of fungi and fungi-like organisms.

Theory

1. History and significance of fungi
2. Methods of reproduction
3. Anamorph, teleomorph and holomorph
4. Evolution of classification of fungi and fungi-like organisms
5. Ecology, genetics and dissemination of fungi
6. Interaction of fungi with hosts/vectors
7. General characters
8. Economic importance of various phyla
9. 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
10. Study of life histories of fungi of agricultural, scientific and industrial importance

Practical

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

Recommended Texts

1. Verekar, S.A., & Deshmukh, S.K. (2017). *Keratinophilic fungi distribution, pathogenicity and biotechnological potentials*. In *Developments in fungal biology and applied mycology*. Singapore, Springer.
2. Johri, R.M. (2005). *A Textbook of Fungi. Dominant Publishers and Distributors*. India, Dominant Publisher.

Suggested Readings

1. Deshmukh, S. K., Misra, J.K., Tewari, J.P., & Papp, T. (2016). *Fungi: Applications and Management Strategies*. UK, CRC Press.
2. Noble, R.T. (2014). *Identifying Moulds: A Practical Guide*. Journal of North Carolina, Carolina, Academy of Science.

Nematodes are an important group of plant parasitic organisms, causing crop losses directly by their parasitic activities on the plants they infect and also indirectly by acting as vectors for plant viruses. There are 17 orders of nematodes but only two contain plant pathogens, the Tylenchida and the Dorylaimida with virus vectors found only in the latter. As an example, *Ditylenchus dipsaci* attacks over 450 different plant species, including many weeds and is one of the most devastating nematode species. Important economic hosts include onion, leek, pea, oats and maize as well as ornamentals such as Narcissus and tulip. When soil is heavily infested losses may be total. The objective of this course is to acquaint the students with basic and applied aspects of plant parasitic nematodes. The course will cover taxonomy of plant parasitic nematodes according to feeding habits, fungivores, omnivores, predators and parasites including cellular changes brought during feeding. The course will also cover study of important nematode diseases, symptoms, etiology and their management.

Theory

1. Introduction to phylum nematoda and related phyla
2. Abundance and importance of plant parasitic nematodes
3. Nematode morphology and anatomy including study of their various systems viz. digestive, reproductive and nervous
4. Taxonomy of plant parasitic nematodes according to feeding habits, fungivores, omnivores, predators and parasites including cellular changes brought during feeding
5. Study of important nematode diseases, symptoms, etiology and their management

Practical

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

Recommended Texts

1. Sergei, A.S., & John, J.C.(2019). *Plant Parasitic Nematodes in Sustainable Agriculture of North America*. USA, Springer.
2. Agrios, G. N. (2005). *Plant Pathology* (5th ed.). Burlington, MA. USA, Elsevier Academic Press.

Suggested Readings

1. Richard, S., Danny, C., Johannes, H., & Patricia, T. (2018). *Plant Parasitic Nematodes in subtropical and tropical agriculture*. UK, CABI.
2. Luc, M., Sikora, R., & Bridge, J. (2005). *Plant Parasitic Nematodes in Tropical and Subtropical Agriculture*. UK, CABI.
3. Ownley, B.H., & Trigiano, R.N. (2016). *Plant Pathology concepts and laboratory exercises*. UK, CRC press.
4. Perry, R.N., & Moens, M. (2006). *Plant Nematology*. UK, CABI.

Bacteria causing plant disease were originally classified in five genera – the Gram-positive *Corynebacterium* and the Gram-negative *Agrobacterium*, *Erwinia*, *Pseudomonas* and *Xanthomonas* – but to these must be added the Actinomycetes. In the last two decades the classification has begun to be extensively revised. For example, the plant pathogenic coryneform bacteria are generally classified in the genera *Curtobacterium*, *Arthrobacter*, *Rhodococcus* and *Clavibacter* although some authors still retain the old nomenclature. Species of *Corynebacterium*, *Curtobacterium*, *Arthrobacter*, *Rhodococcus* and *Clavibacter* cause diseases on a number of crop plants. For example, potatoes are infected by *Clavibacter michiganensis* subsp. *sepedonicus*. Symptoms consist of wilting of leaves which become pale green to yellow and develop necrotic areas but these are easily confused with other wilts and foliage diseases, and natural senescence. The objective of this course is to introduce basic and applied concepts of plant associated bacteria and mollicutes. The course will cover morphology, reproduction, physiology and cultural characteristics of bacteria and mollicutes. The course will also cover different bacterial diseases history, symptoms, etiology, epidemiology and their management. General characteristics of bacteria and mollicutes will also be discussed in detail in this course.

Theory

1. Introduction, economic importance, general characteristics
2. Morphology, reproduction and physiology; cultural characteristics
3. Mode of infection and transmission of bacteria and mollicutes and their management
4. Study of specific prokaryotic plant diseases in Pakistan

Practical

1. Isolation, purification, identification and preservation of plant pathogenic prokaryotes
2. Hypersensitive reactions and pathogenicity tests
3. Inoculum preparation and testing with known concentration

Recommended Texts

1. Thind, B.S. (2019). *Phytopathogenic Bacteria and Plant Diseases*. UK, Taylor and Francis.
2. Agrios, G. N. (2005). *Plant Pathology* (5th ed.). Burlington, MA. USA, Elsevier Academic Press.

Suggested Readings

1. Kannanm, V.R., & Batas, K.K. (2019). *Sustainable Approaches to Controlling Plant Pathogenic Bacteria*. UK, Taylor and Francis.
2. Jackson, R.W. (2009). *Plant Pathogenic Bacteria: Genomics and Molecular Biology*. UK, Caister Academic Press.
3. Janse, J.D. (2008). *Phytobacteriology: Principles and Practice*. UK, CABI.
4. Mukesh, S. (2006). *Introductory Phytobacteriology*. India, Eastern Book Corporation.

There are over 700 known plant viruses, many of which cause catastrophic diseases and have wide host ranges. They have been classified into three families and 32 groups. These are based on morphology, the type of nucleic acid they contain (RNA or DNA), whether the nucleic acid is single- or double-stranded, whether it exists as a single unit or is divided, and the means of transmission. For example, furoviruses are fungal-transmitted, rod-shaped, single-stranded RNA viruses with divided, typically bipartite genomes. Increasingly, serological and nucleic acid techniques are being used to establish the identity or relatedness of plant viruses. The objective of this course is to introduce students to the basic and applied concepts of plant viruses. The course will cover morphology, reproduction, physiology, composition, structure and classification of viruses. The course will also cover different virus diseases history, symptoms, etiology, epidemiology and their management. General characteristics of viruses will also be discussed in detail in this course.

Theory

1. Introduction, history and importance, morphology, composition and structure
2. Classification of plant viruses, their replication, transmission and movement
3. Symptomatology
4. Serology and serological methods
5. Ecology and epidemiology
6. Management
7. Study of specific virus diseases in Pakistan

Practical

1. Field visits and study of virus infected plants
2. Methods of virus transmission (mechanical inoculation, grafting, insect vectors)
3. Virus detection through biological (indicator hosts and host range) and serological methods (ELISA, Immunodiffusion) and molecular methods (polymerase chain reaction)

Recommended Texts

1. Saxena, S., & Tiwari, A.K. (2018) *Begomoviruses: Occurrence and Management in Asia and Africa*. Singapore, Springer, Verlag.
2. Ahlawat, Y.S. (2010). *Diagnosis of Plant Viruses and Allied Pathogens*. India, Stadium Press.

Suggested Readings

1. Rajarshi, K.G. (2019). *Plant Viruses*. UK, Taylor and Francis.
2. Bashir, M., & Hassan, S. (1998). *Diagnostic Methods for Plant Viruses*. Islamabad, Pakistan, Pakistan Agricultural Research Council.
3. Hull, R. (2009). *Comparative Plant Virology* (2nd ed.). New York, Academic Press.
4. Loebenstein, G., & Thottappilly, G. (2004). *Virus and Virus-like Diseases of Major Crops in Developing Countries*. Singapore, Springer Press.

Plant diseases occur in all parts of the world where plants grow. They are more common and more severe, however, in humid to wet areas with cool, warm, or tropical temperatures. Plants in dry areas may not be subjected to as many severe fungal, bacterial, or nematode diseases, but they are often attacked severely by powdery mildew fungi, by xylem inhabiting fastidious bacteria, by phloem-inhabiting phytoplasmas and fastidious bacteria, and by viruses transmitted by certain insect vectors. The objective of this course is to acquaint the students with the basic concepts of abiotic plant diseases and their management. The course will cover different types of abiotic disorders, their symptoms and management. The deficiencies of macro and micronutrients will also be discussed in detail in this course. Other abiotic factors including effect of mineral deficiencies, pollution, lack of oxygen, and toxicities on plant health together with soil problems and their impact on plant health will also be covered in this course.

Theory

1. Difference between biotic and abiotic stresses
2. Types of abiotic stresses, their symptomology and management
3. Macro and micronutrients and their effect on plants
4. Role of abnormal light conditions, soil moisture and temperature on plant health
5. Effect of mineral deficiencies, pollution, lack of oxygen, and toxicities on plant health
6. Soil problems and their impact on plant health; inappropriate cultural practices

Recommended Texts

1. Frost, C. (2019). *Essential Plant Pathology*. USA, Callisto Reference.
2. Haard, N.F., & Salunkle, D.K. (1980). *Symptoms on Post Harvest Biology and Handling of Fruits and Vegetables*. West Post Connecticut, USA, The AUI Publishing Co. Inc.

Suggested Readings

1. Burchett, S. (2018). *Plant Pathology*. UK, CRC Press.
2. Hill, M.K. (2004). *Understanding Environmental Pollution* (2nd ed.). UK, Cambridge Press.
3. Shurtleff, M.C., & Averre, C.W. (1997). *The Plant Disease Clinic and Field Diagnosis of Abiotic Diseases*. Minnesota, USA, American Phytopathological Society Press.
4. Tandov, H.L.S., & Roy, R.N. (2004). *Integrated Nutrient Management. A Glossary of Terms*. Rome, UN Press.

SEMESTER-VI

PLPT-6308

Diseases of Field Crops

3(2+1)

Field crops include wheat, rice, cotton, sugarcane, gram, linseed, maize etc. are attacked by different plant pathogens which cause very notorious diseases in them. The most important diseases of wheat are yellow, brown and black rusts, loose smut of wheat and karnal bunt. Similarly, rice is attacked by bacterial blight of rice, rice foot rot disease and rice blast. The important disease of sugarcane is red rot of sugarcane. The most important diseases of cotton are cotton leaf curl virus disease and bacterial blight of cotton. The most important disease of maize is stalk rot. The important diseases of gram are gram blight and gram wilt. The objective of this course is to study important diseases of field crops and their management. Disease cycle, methods of perpetuation, epidemiology and management of major diseases of cereals, pulses, fodder, oil seed, fiber, tobacco and sugar crops will be discussed in detail in this course. Integrated management of different crop diseases will also be covered in this course. The students will also be told how to conduct surveys of crop disease.

Theory

1. Importance of field crop diseases
2. Detailed study of symptoms, etiology, nature and extent of losses
3. Disease cycle, methods of perpetuation, epidemiology and management of major diseases of cereals, pulses, fodder, oil seed, fiber, tobacco and sugar crops
4. Integrated crop and disease management
5. Field sanitation program and good agricultural practices (GAP)

Practical

1. Field surveys
2. Collection, preservation of diseased specimens
3. Identification of diseases based on symptoms and microscopic studies
4. Isolation of major pathogens of above mentioned crops

Recommended Texts

1. Beales, P., Alphinstone, J., Fox, A., Lane, C., & MacCan, D. (2019). *Plant Diseases and Biosecurity*. UK, Oxford University Press.
2. Dickson, J.G. (2008). *Diseases of Field Crops*. New York, McGraw-Hill, Biotech Books.

Suggested Readings

1. Westcott, C., & Horst, R.K. (2017). *Westcott's Plant Diseases*. Singapore, Springer.
2. Gupta, G.P. (2004). *Textbook of Plant Diseases*. India, DPH.
3. Rangaswami, G., & Mahadevan, A. (2004). *Diseases of Crop Plants in India*. India, Prentice Hall.
4. Zadoks, J.C. (2004). *Modern Crop Protection*. India, International Book Distribution Co.

Nature has blessed mankind and other living organisms by providing a wide range of plant products for our consumption. However, human beings, in their desire to domesticate plants to satisfy their need for food, feed, fiber, timber, and other plant products, have selected plants with high yield potential. Unfortunately, most of the plant species and crop cultivars with high yield potential became increasingly susceptible to diseases and pests that can cause severe epidemics and food famines. Diseases caused by microbial pathogens fungi, bacteria, and viruses account for substantial losses of grains, fruits, and vegetables at both pre- and postharvest stages of crop production. The objective of this course is to study the basic and applied aspects of economically important diseases of fruits and ornamental plants and their management. The course will cover in detail history, symptoms, etiology, epidemiology and management of banana, papaya, guava, mango, citrus, pome, stone and nut fruits, grapes fruits and common ornamental plants. During this course practicals, surveys of citrus orchards and citrus factories will also be conducted.

Theory

1. Importance, symptoms, disease cycle, causal agent, methods of perpetuation.
2. 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

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

Recommended Texts

1. Paul, B., Johan, A., Adrain, F., Charles, L., & Derek, M. (2019). *Plant Diseases and Biosecurity*. UK, Oxford University Press.
2. *Compendium of ornamental plants, Foliage plant diseases*. (1988). Minnesota, USA, American Phytopathological Society Press.

Suggested Readings

1. Balaji A. (2018). *Handbook of Plant Disease Identification and Management*. UK, Taylor and Francis.
2. Gupta, V.K., & Sharma, S.K. (2000). *Diseases of Fruit Crops*. New Delhi, India, Kalyani Publishers.
3. Ploetz, R.C. (2003). *Diseases of Tropical Fruit Crops*. UK, CABI.
4. Reddy, P.P. (2010). *Bacterial and Viral Diseases and their Management in Horticultural Crops*. India, Scientific Publisher.

To understand diseases, student must learn the essentials about fungi, bacteria, viruses, and higher plants that cause disease. There must be information of names of pathogens, specialized terminology of mycology and pathology also. The student must realize that most forest disease problems result from a complex interaction of pathogen, tree, and environment. Usually control must be attained by such practices as selecting the proper tree for each site and regulating density rather than by the use of fungicides or other direct controls. This explains why ecology plays such a vital role in forest pathology and is always stressed. The objective of this course is to introduce students to range and forest diseases and their management. The course will cover in detail identification and etiology of forest disease. Taxonomy of forest diseases will also be discussed. Forest decline diseases including shisham decline, citrus decline, guava decline and mango decline will also be covered. Role of molecular biology and biotechnology to manage forest diseases will also be discussed in detail in this course.

Theory

1. Introduction to rangeland, forest and their diseases, its importance in agriculture
2. Identification and etiology of forest disease. Taxonomy of forest diseases. Decline in forest trees, like shisham decline etc. Use of biotechnology in management of forest disease.

Practical

1. Identification, collection of diseased specimen from forest trees. Isolation and purification of fungi from diseased specimen. Preparation of slides. Field visits and study tour.

Recommended Texts

1. Sharma, M. (2018). *Basic Plant Pathology*. India, CBS Publishers & Distributors.
2. Bhutta, A.R. (2010). *Text book of Introductory Seed Pathology*. Islamabad, HEC.
3. Manion, P.D. (1991). *Tree Disease Concepts* (2nd ed.). USA, Prentice Hall.

Suggested Readings

1. Matteo, G., & Paolo, G. (2018). *Forest Pathology and Plant Health*. Switzerland, MPDI.
2. Sharma, R.C., & Sharma, G.N. (2006). *Challenging Problems in Horticultural and Forest Pathology*. India, Indus Publishing Company.
3. Sharma, V.K. (2004). *Trees and Protection of Environment*. India, Deep and Deep Publication.

Epidemiology is the science that describes the progress of a disease as it becomes epidemic. Depending on the rate of disease progress, diseases are broadly classified as simple interest and compound interest diseases. Several models have been developed to describe the progression of these two kinds of diseases. A widespread temporary increase in the incidence of an infectious disease is called an epidemic. A plant disease is described as epidemic when the amount of disease present increases rapidly from a low level to a high one. This is in contrast to an endemic disease, which is a disease established in moderate or severe form in a defined area. For an endemic disease, the disease level remains almost constant. The objective of this course is to study the development of plant disease epidemics. The course will cover principles and components of epidemics, factors influencing dynamics of epidemics, global climate change and relationship between climate variation and plant disease epidemics. The course will also cover forecasting of epidemics and their modeling. At the end different types of disease warning systems being used in plant disease epidemiology will also be discussed in detailed in this course.

Theory

1. Introduction, history, importance and types of plant disease epidemics
2. Principles and components of epidemics; factors influencing dynamics of epidemics
3. Global climate change and relationship between climate variation and plant disease epidemics
4. Monitoring of plant disease epidemics; epidemic growth curve and growth rate
5. Forecasting of epidemics and their modeling; disease warning systems; Decision support systems; Expert systems; Computer simulation modelling

Practical

1. Determination of meteorological parameters and their correlation with plant diseases
2. Development of disease prediction models; use of expert systems for monitoring epidemic development
3. Crop loss assessment methods

Recommended Texts

1. Laurence, M.V. (2007). *The Study of Plant Disease Epidemics*. USA, APS Press.
2. Agrios, G. N. (2005). *Plant Pathology* (5th ed.). Burlington, MA. USA, Elsevier Academic Press.

Suggested Readings

1. Burchett, S. (2018). *Plant Pathology*. UK, CRC Press.
2. Kranz, J. (2002). *Comparative Epidemiology of Plant Diseases*. Singapore, Springer.
3. Savary, S., & Cooke, B.M. (2006). *Plant Disease Epidemiology: Facing Challenges of the 21st Century*. France, Springer.

Biological control using microbial pesticides has become important in recent years. Introduced microbial biocontrol agents (as opposed to a natural population of microbes) are called “microbial pesticides” according to the Environmental Protection Agency (EPA). Several microbial pesticides are now commercially available. Fungal, bacterial, and viral biocontrol agents are now available. They effectively control fungal, bacterial, and viral diseases. Modes of action of these biocontrol agents will be described in this course. Conditions favorable for effective action of them in controlling diseases will also be discussed. The objective of this course is to acquaint the students with beneficial aspects of microbes. The world is moving towards organic agriculture and beneficial microbial community can play vital role in it. The course will cover introduction to beneficial microorganisms, role of microorganisms in bioremediation and biodegradation of agricultural and industrial by-products/wastes. Symbiotic microbes including nitrogen fixing bacteria and mycorrhizal fungi will also be discussed in detail in this course. Principles and practices being used for controlling the soil microflora to minimum threshold level to get maximum crop yield will also be discussed in detail.

Theory

1. Introduction to beneficial microorganisms; role of microorganisms in bioremediation and biodegradation of agricultural and industrial by-products/wastes
2. Use of microorganisms (bacteria, cyanobacteria, nematodes and fungi inclusive of mycorrhizae) in bio-geochemical cycling and biocontrol of plant diseases
3. 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
4. Introduction to use of cellulose decomposing fungi in paper and textile industry
5. Use of fungi such as *Penicillium* and *Aspergillus* species in food processing including cheese ripening, pickle production etc.
6. Organisms as experimental tools and supplements of human food and animal feed (single cell protein, fodder yeast etc.); Bacteriophages

Practical

1. Isolation and identification of microorganisms from various substrates and screening and mass multiplication of industrially important microbes
2. Demonstration of antagonism, competition and antibiosis; Isolation and identification of nitrogen fixing bacteria

Recommended Texts

1. Sayyed, R.Z., & Tabassum, B. (2019). *Plant Growth Promoting Rhizobacteria for Sustainable Stress Management*. Singapore, Verlag, Springer.
2. Burges, H.D. (1998). *Formulation of Microbial Biopesticides: Beneficial Microorganisms, Nematodes and Seed Treatments*. Netherlands, Kluwer Academic Press.

Suggested Readings

1. Carandang, G.A. (2011). *Grow Your Own Beneficial Indigenous Microorganisms and Bionutrients in Natural Farming* (Kindle ed.). Philippines, Bronze Age Media Publisher.
2. Kumar, A., & Singh, V.K. (2019). *Microbial Endophytes: Prospects for Sustainable Agriculture* Netherlands, Elsevier.
3. Elmerich, C., & Newton, W.E. (2007). *Associative and Endophytic Nitrogen-fixing Bacteria and Cyanobacterial*. Singapore, Springer.

The present course is designed to give a broad but concise overview of the various aspects of plant biochemistry. In this course, students could understand description of the principles of metabolism but also restricted the content in such a way that a student is not distracted by unnecessary details. Industrial applications of plant biochemistry have been pointed out, wherever it was appropriate. Thus special attention was given to the generation and utilization of transgenic plants. The objective of this course is to acquaint the students with basics of chemistry and biochemistry. The course will cover in detail carbohydrates, proteins, lipids and nucleic acids. The course is also comprised of proximate analysis of food/plant materials for moisture, crude protein, crude fiber, ash, ether extract and nitrogen free extract. The practicals including determination of true protein and oil contents of plant materials, estimation of vitamin-c, pectin in fruit juices, estimation of glucose, fructose and starch in plant products will also part of this course.

Theory

1. *Carbohydrates*: Definition and classification; Carbohydrate metabolism, respiration, glycolysis, Krebs's cycle and fermentation. Electron transport chain. Photosynthesis, energy conversion, carbon fixation, C3, C4 and CAM plant photorespiration; phyto- hormones their structure and functions
2. *Proteins*: Definition and classification, classification and structures of amino acids, essential and non-essential amino acids. Biochemical functions of proteins. Enzymes and co-enzymes
3. *Lipids*: Definition and classification, structures and classification of fatty acids, essential and non-essential fatty acids
4. *Nucleic Acids*: Structural and functional differences between DNA and RNA. Structures of DNA and RNA, Central Dogma and its significance. Fundamentals of DNA replication, transcription and translation

Practical

1. Proximate analysis of food/plant materials for moisture, crude protein, crude fiber, ash, ether extract and nitrogen free extract
2. Determination of true protein and oil contents of plant materials. Estimation of Vitamin-C and pectin in fruit juices. Estimation of glucose, fructose and starch in plant products

Recommended Texts

1. Patel, V. U. (2019). *Objective Plant Physiology and Plant Biochemistry*. California, Birrilion Publishers.
2. Buchanan, B.B., Gruissem, W., & Jones, R.L. (2015). *Biochemistry and Molecular Biology of Plants*. USA, Wiley Blackwell.

Suggested Readings

1. Satyanarayana, U. (2019). *Biochemistry*. USA, Generic Publishers.
2. Chesworth, J.M., Stachburry, T., & Scaize, J.R. (1999). *An Introduction to Agricultural Biochemistry*. New York, USA, Chapman and Hall.
3. Goodwin, T.W. & Mercer, P. (1998). *Plant Biochemistry*. Oxford, UK, Pergamen Press.
4. Nelson, D.L., & Cox, M.M. (2004). *Principle of Biochemistry* (4th ed.). New York, USA, W.H. Freeman and Company.

SEMESTER-VII

PLPT-6314

Diseases of Vegetable Crops

3(2+1)

Vegetables are important source of dietary fibers, minerals, antioxidants and vitamins. Shifting from a non-vegetarian diet to vegetarian, global recognition of the importance of vegetables for human health and their medicinal and nutritional value have contributed to a steady upward trend in vegetable production system. Pesticides are valuable tools in sustainable vegetable production, but unfortunately they are often being used irresponsibly, causing hazards to producers, consumers and the environment. In addition, they can exacerbate pests and diseases problems by inducing resistance and suppressing the natural enemies which exert natural biological control. The objective of this course is to study basic and applied aspects of economically important diseases of vegetable crops of Pakistan. The course will cover in detail historical development and importance of plant resistance against fungi, bacteria, viruses and nematodes. The course will also cover different types of resistance mechanisms against pathogens. Integrated management of vegetable diseases using cultural approaches, physical methods and chemical methods will also be discussed in detail. The use of molecular and biotechnological tools being used in improving the resistance of vegetables will also be covered in this course.

Theory

1. 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
2. Mechanism and genetic basis of resistance towards plant pathogens; Gene centers as a source of resistance; host defense system
3. Strategies for gene deployment; Transgenic approaches for crop protection
4. Screening of germplasm and resistance mitigation by using different rating scales/parameters and disease modeling
5. Mechanism and genetic basis of plant resistance towards plant pathogens

Practical

1. Preparation of inoculum; inoculation techniques for various plant pathogens; demonstration of hypersensitive reaction, resistance and susceptibility
2. Screening of germplasm in field and greenhouse against major plant pathogens by using different rating scales/parameters and disease modeling
3. Detection of resistance genes using molecular markers

Recommended Texts

1. Gullino M.L., Albajes, R., & Philippe, C.N. (2019). *Integrated Pest and Disease management in greenhouse crops*. Singapore, Springer.
2. Singh, D.P. (2002). *Breeding for Resistance to Biotic Stress*. India, International Books Distribution Co.

Suggested Readings

1. Gupta, S. K., Sharma, R.C., & Sharma, S. (2017). *Diseases of Vegetables, Spice and Ornamental Crops*. India, Scientific Publishers.
2. Slusarenko, A.J., Fraser, R.S.S., & Van Loon, L.C. (2000). *Mechanisms of Resistance to Plant Diseases*. Netherlands, Kluwer Academic Publishers.
3. Naqvi, S. A. M. H. (2007). *Diseases of fruits and vegetables*. India, Kluwer Academic Publishers.

This course has been designed on basic strategies and tactics of integrated control of plant diseases. The course includes the different facets of biological disease control, its scientific bases, its development in practice, its commercialization and quality control. The course also includes the present situation of integrated disease control in the most important agricultural crops world-wide. Finally, this course also discusses the technology transfer process from research to the consumer. The objective of this course is to introduce the students to plant disease management practices. The course will cover different approaches used for the management of different plant pathogens. Management approaches including avoidance, exclusion, eradication, cultural, physical and chemical will be discussed in detail. Different types of resistance being used by the plants to defend themselves against plant pathogens will also be covered in detail. The role of epidemiology to control different diseases will also be discussed in depth during this course. The last lectures on this course will be on integrated management of different plant pathogens.

Theory

1. Principles and methods of plant disease management based on avoidance, exclusion, eradication of pathogens, protection (preventive and curative) and resistance (types and mechanisms of resistance)
2. Transgenic approaches for crop protection; Screening of germplasm and resistance mitigation by using different rating scales/parameters and disease modeling).
3. Management of plant diseases with emphasis on regulatory, cultural, biological, physical and chemical strategies; Induced systemic resistance
4. Integrated disease management (IDM), seed health certification system
5. Philosophy of TOF (Training of Facilitators) and FFS (Farmer Field School)
6. Epidemiological basis of disease management strategies; Concept of field biodiversity
7. Conservation and crop appraisal

Practical

1. Demonstration of different disease management practices
2. Equipment and machinery used for disease management and their calibration
3. Safety measures for disease managing chemicals
4. Handling and application procedures
5. Crop Agro Ecosystem Analysis

Recommended Texts

1. Balaji, A. (2018). *Handbook of Plant Disease Identification and Management*. UK, Taylor and Francis.
2. Ahmad, I., & Bhutta, A.R. (2005). *Textbook of Introductory Plant Pathology*. Islamabad, National Book Foundation.

Suggested Readings

1. Singh, R.S. (2001). *Plant Disease Management*. India, Science Pub. Inc.
2. Westcott, C., & Horst, R.K. (2017). *Westcott's Plant Diseases*. Singapore, Springer.
3. Helyer, N., Brown, K., & Cattlin, N.A. (2003). *Biological Control in Plant Protection (A Colour Hand Book)*. London, UK, Manson Publication Ltd.
4. Narayanasamy, P. (2008). *Molecular Biology in Plant Pathogenesis and Disease Management*. Singapore, Springer.

Quarantine means legislative or regulatory control that aims to exclude pathogens from areas where they do not already exist. It includes the holding of imported material in isolation for a period to ensure freedom from diseases and pests. Plant pathogens can be excluded from nonendemic areas that extend beyond governmental boundaries where it is possible for quarantine personnel to examine them at a few entry points. The objective of this course is to acquaint the students about plant quarantine rules and sanitary and phytosanitary measures (SPS). In this course the students will be taught issues related to import and export of seeds. Different Acts so far made regarding import and export of plant material will also be taught to the students during this course. Inspection procedures and measures adopted under IPC and NAPHS in Pakistan during import/export of agricultural commodities will also be discussed in detail. Further, the rules and regulations made by World Trade Organization (WTO) and Food and Agriculture Organization (FAO) will also be covered during this course.

Theory

1. What are plant quarantine rules and regulations
2. Issues related to import of seed and plant material
3. National and international quarantine standards
4. Plant quarantine Act 1976 (Rules, 1967) and Seed Act, 1976 (Seed Amendment Bill-2014) and their implementation in plant and seed import/export
5. Outbreak of some important diseases introduced into Pakistan and elsewhere during import of plant, seed and food items
6. Introduction to SPS measure under WTO regime and its relation to bio-security
7. Inspection procedures and measures adopted under IPC and NAPHS in Pakistan during import/export of agricultural commodities

Recommended Texts

1. Frost, C. (2019). *Essential Plant Pathology*. USA, Callisto Reference.
2. Kimatu, J.N. (2018). *Advances in Plant Pathology*. Switzerland, Intech Open.

Suggested Readings

1. Devorshak, C. (2012). *Plant pest risk analysis: concepts and applications*. UK, CABI.
2. Plant Quarantine Act-1976 and Rules 1967. Karachi, Govt. of Pakistan.
3. Ranjan. S. (2007). *Sanitary and Phytosanitary Measures – An Introduction*. India, Lefai Uni. Press.

This course provides comprehensive information to understand the potential of various kinds of microbial pathogens capable of causing serious losses, on a variety of harvested produce and seeds, and the conditions favorable for their development and spread. The physiological functions of the harvested produce and seeds are very different from those that are attached to the mother plants. The objective of this course is to study seed borne and post-harvest diseases and their management. The course will comprehensively cover importance and significant losses caused by seed and post-harvest diseases. All aspects of seed pathology including morphology and anatomy of healthy and diseases seeds, seed borne diseases and their effect on seed germination and planting value, histopathology of infected seed and transmission of seed-borne pathogens and effect of biotic and abiotic stresses on seed will also be discussed in detail. At the end, epidemiology of seed borne diseases in detail will be taught to the students. For practicals, study tours of seed companies and Federal Seed Certification Center will be arranged.

Theory

1. 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
2. Histopathology of infected seed and transmission of seed-borne pathogens
3. Effect of biotic and abiotic diseases during storage/ transit and on shelf life of seeds and perishables
4. Epidemiology of seed-borne diseases; Seed health testing; mycotoxins and their hazards
5. Economic importance of postharvest losses in seeds, fruits and vegetables during processing
6. Factors affecting postharvest losses (physical, physiological, biochemical and pathological)
7. Management of seed and postharvest diseases; methods and structure of storage at farm and public level

Practical

1. Seed health testing; Different techniques for isolation and identification of microorganisms associated with seeds and their effect on germination
2. Postharvest losses estimation/ assessment; Visits to grains, fruits and vegetables store houses
3. Collection and identification of biotic and abiotic diseased specimens/samples of perishables
4. Use of safe chemicals/fumigants for management of seed and postharvest diseases

Recommended Texts

1. Ravindra, K., & Anuja, G. (2019). *Seed Borne Diseases of Agricultural Crops: Detection, Diagnosis & Management*. Singapore, Springer.
2. Agarwal, V.K. (2006). *Seed Health*. India, International Book Distributing Company.

Suggested Readings

1. Balaji A. (2018). *Handbook of Plant Disease Identification and Management*. UK, Taylor and Francis.
2. Barkai-Golan, R. (2001). *Post-harvest Diseases of Fruits and Vegetables: Development and Control*. Netherlands, Elsevier.
3. Bartz, J.A., & Brecht, J.K. (2002). *Post-harvest Physiology and Pathology of Vegetables*. India, Marcel Dekker.

Damages caused worldwide by either emerging, re-emerging or endemic pathogens are significantly important. The International Plant Protection Convention, Regional and National Plant Protection Organizations, have developed phytosanitary measures to prevent the spread of regulated pathogens (particularly quarantine pathogens) between countries in order to protect agricultural and natural plant systems. Safeguarding plant biosecurity relies heavily on the early detection and diagnosis of the pathogen. The objective of this course is to impart knowledge about methodologies and techniques used in Plant Pathology. During this course the students will be taught about how to establish a plant disease clinic and what are diagnostic protocols. Contents like problem identification, hypothesizing, defining objectives, collection, handling, transport, processing, preservation of diseased specimens, and protocols and procedures used for the isolation, identification, purification, multiplication and preservation of plant pathogens will be discussed in detail. Experimental layout, data collection, statistical analysis interpretation and report writing will also be taught to the students during this course.

Theory

1. Plant disease clinic and its requirements; Expert client interaction; Diagnostic protocols
2. 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
3. Koch's postulates
4. Microscopic, histo-pathological, serological and molecular techniques
5. Experimental layout, data collection, statistical analysis interpretation and report writing
6. Pre- and postharvest handling to reduce losses in vegetables and fruits

Practical

1. Methods of collection and preservation of plant disease specimens; Media preparation
2. Equipment, 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
3. Use of haemocytometer; Preparation of questionnaire
4. Designing of survey performas; Maintenance and preservation of cultures
5. Histo-pathological, serological and molecular methods
6. Experimental layout, data collection, statistical analysis interpretation; recommendation and report writing for clients

Recommended Texts

1. Frost, C. (2019). *Essential Plant Pathology*. USA, Callisto Reference.
2. Bonnie, H.O., & Robert, N.T. (2016). *Plant Pathology Concepts and Laboratory Exercises*. UK, CRC Publishers.

Suggested Readings

1. Aneja, K.R. (2003). *Experiments in Microbiology, Plant Pathology and Biotechnology*. New Delhi, India, New Age International (Pvt.) Ltd.
2. Burns, R. (2008). *Plant Pathology; Techniques and Protocols (Methods in Molecular Biology)*. USA, Humana Press.

SEMESTER-VIII

AGEC-6523

Agribusiness, Marketing and Trade

3(3+0)

Students will be involved in learning activities that generally prepare them to apply the economic and business principles involved in the organization, operation, and management of the farm, ranch or agribusiness. Typical instructional activities include hands-on experiences with applying modern economic and business principles involved in the organization, operation, and management of agricultural businesses including the production and marketing of agricultural products and services and knowhow of new trends in international trade of agricultural commodities. After completing the course, students will be well equipped with the basic concepts of Agribusiness and Trade. Students should read content and complete course assignments prior to deadlines. Students are expected to actively participate in discussions and submit exercises in-time. Students are also expected to complete exams on the date and time allotted. It is their responsibility to be familiar with and understand all previously covered material prior to each new chapter.

Contents

1. Definition, concepts, Important features and scope of Agribusiness Management,
2. Elements and Functions of management;
3. Forms of business organizations;
4. Agribusiness financial management;
5. Agricultural Marketing; Marketing channels, functionaries and margins;
6. Role of agri. marketing in economic development;
7. Agricultural marketing problems;
8. The changing world and interdependence;
9. Basis of trade; gains from trade;
10. Concept of absolute and comparative advantage; pattern of trade;
11. Brief introduction of major trade agreements.

Recommended Texts

1. Kohls, R.L., Uhl, J.N. & Hurt, C. (2007). *Marketing of Agricultural Products* (10th ed.). New Jersey, Prentice Hall.
2. Salvatore, D. (2007). *International economics* (9th ed.). New Jersey, Wiley Publisher.

Suggested Readings

4. Hoekman, B. M., Mattoo, A., & English, P. (2002). *Development, Trade and the WTO-A Hand Book*, Washington D.C, The World Bank.
5. Downey, W.D. & Erickson, S. P. (2002). *Agribusiness Management*, Singapore, McGraw Hill Education.

As new technologies have been developed through the years, these have been applied to biological systems to solve problems and further human understanding, and this has been the case in plant pathology. The concept of Mendelian genetics led to breakthroughs in the understanding of how plants resist disease and how this can be used in crop protection. The advent of electron microscopy led to the ability to visualize more microbes and viruses, and to determine where and how these enter and develop inside plants. The objective of this course is to acquaint the students with basic concepts and techniques of molecular plant pathology. During this course, molecular biology of host parasite interaction and biochemical mechanisms of pathogenesis will be discussed in detail. Genes and diseases, gene variability in hosts and pathogens, cell signaling in plant disease development will also be covered in detail. Fungicidal resistance in plant pathogens and their molecular mechanisms will be discussed. Genetics of virulence in pathogens and resistance in host plants will also be covered.

Theory

1. 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
2. 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
3. Functional analysis of MYB transcription factors in *Gibberellazeae*
4. Molecular mechanisms of fungicide resistance in plant pathogenic fungi
5. Pre-existing structural and chemical defenses
6. Defense through lack of essential factors
7. Induced structural and biochemical defenses
8. Resistance gene engineering
9. Vectors for gene engineering; delivering genes to the plant, the use of cloned resistance genes
10. Quorum sensing
11. Programmed cell death; transgenic plants, RNA silencing

Practical

1. 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
2. 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 Texts

1. Wani, S. H. (2019). *Disease Resistance in Crop Plants: Molecular, Genetic and Genomic Perspectives*. Singapore, Springer.
2. Singh, A., & Singh, I.K. (2018). *Molecular Aspects of Plant-Pathogen Interaction*. Singapore, Springer.

Suggested Readings

1. Guar, H.N. (2018). *Physiological and Molecular Plant Pathology*. Singapore, Springer.
2. Lakshman, D. (2007). *Molecular Plant Pathology*. India, Paragon International Publishers.

Soil-borne pathogens cause significant economic losses in agricultural production all over the world. These species can survive for many years in the absence of a host plant by forming persistent structures such as microsclerotia, sclerotia, chlamydospores or oospores. Consequently, soil-borne diseases are particularly difficult to predict, detect, diagnose and successfully control. Over the past 30 years, a fumigant, methyl bromide, has been widely used for their control in many crops. The objective of this course is to acquaint the students with basic concepts of soil-borne plant pathogens and their management. There are numerous soil pathogens which cause economically important diseases in plants. During this course, an introduction of soil-borne pathogens and their role in plant diseases will be covered in detail. Survival mechanisms of soil-borne plant pathogens, interaction between soil-borne plant pathogens, effects of soil edaphic factors on soil borne plant pathogens and their interaction with soil saprophytes will be covered in detail. Conventional and molecular tools used to diagnose soil-borne plant pathogens will also be discussed.

Theory

1. Importance of soil-borne diseases
2. Introduction to soil-borne plant pathogenic fungi, bacteria, nematodes and viruses
3. Survival mechanism of soil-borne plant pathogens
4. Interaction between soil-borne plant pathogens
5. Effect of soil edaphic factors on soil-borne pathogens
6. Interaction of soil borne-pathogens with saprophytic soil microorganisms
7. Management of soil-borne pathogens through chemicals, bio-control agents, plastic mulching and other cultural methods
8. Molecular methods for detecting soil-borne pathogens
9. Conventional, nested and real time PCR

Practical

1. Techniques for isolation and identification of soil-borne pathogens
2. *In vitro* evaluation of chemical, physical and biological methods for the management of soil-borne pathogens
3. Demonstration of different methods for management of soil-borne pathogens

Recommended Texts

1. Gullino, M.L., Albajes, R., & Philippe, C.N.(2019).*Integrated Pest and Disease management in greenhouse crops*. Singapore, Springer.
2. Ashok, P., & Mukerji, K.G. (2007). *Biological Control of Plant Diseases*. UK, CRC Press.

Suggested Readings

1. Balaji A. (2018). *Handbook of Plant Disease Identification and Management*. UK, Taylor and Francis.
2. Jenkins, R., & Jain, C.K. (2010). *Advances in Soil-borne Plant Diseases*. India, Oxford Book Co.
3. Naik, M.K., & Devikarani, G.S. (2008). *Advances in Soil-borne Plant Diseases*. Delhi, India, New India Publishing Agency.

Many pesticides have been developed, and several chemical industries have invested several millions of dollars in developing pesticides. More than 100 active fungicide ingredients have been registered, and several hundred fungicide formulations are available in the market. In contrast, very few bactericides and nematocides are available to control bacterial diseases. The objective of this course is to study pesticides, their application and mode of action in plants. The course will comprehensively cover history of pesticides, major groups of pesticides and their classification, formulation and mode of action, phytotoxic effects of pesticides, equipment used for spraying of pesticides and major hazards associated with pesticides and their safety measures. The students will be given demonstration for applying different fungicides, bactericides and nematocides. Study tours of pesticide companies will be arranged at the end of the course. The course will help the students to learn about different fungicides, bactericides and nematocides and their use in controlling different diseases.

Theory

1. Introduction and history of pesticides
2. Major groups of pesticides and their classification
3. Formulation and mode of action
4. Residues, resistance and phytotoxicity problems of pesticides (fungicides, bactericides, and nematocides etc.)
5. Equipment and different methods of application
6. FAO code of conduct for pesticide use and handling
7. Codex alimentarius, pesticide regulation, registration and distribution in Pakistan
8. Major hazards of pesticides and their safety measures
9. Pesticides compatibility and selectivity
10. Pre-harvest safety intervals

Practical

1. Demonstration of different groups of pesticides used to control plant diseases
2. Preparation, formulation and doses
3. Use of various equipment and calibration and measurement of droplet size
4. *In vitro* comparison of systemic and protectant pesticides
5. Visits to pesticides testing labs and warehouses
6. Protective measures and first aid

Recommended Texts

1. Oliver, R. P., & Hewitt, H. G. (2014). *Fungicides in crop protection*. UK, CABI.
2. Stenersen, J. (2004). *Chemical pesticides mode of action and toxicology*. UK, CRC press.

Suggested Readings

1. Parween, T., & Jan, S. (2019). *Ecophysiology of Pesticides: Interface Between Pesticide Chemistry and Plant Physiology*. USA, Academic Press.
2. Mathews, G.A., & Meladen, M.A. (2000). *Pesticides Application Methods* (3rd ed). New York, Blackwell Science Publication.
3. Parmar, B.S., & Tomar, S.S. (2003). *Pesticides Formulation. Theory and Practices*. India, CBS Publication Co.

Internship opportunities can provide students with unique exposure to research in other environments, including private industries, federal agencies, other countries, or other universities. Because of their value to the graduate student experience, the Department of Plant Pathology offers this course. 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. At the end of the semester, a study tour is arranged of provincial and federal research institutes to acquaint the students with recent research activities going on there. Pesticide companies visits are also arranged time to time for this course during the semester. The core objective of this course is to train the students in such a way that at the completion of this course students may design their future research proposals.

Course Contents

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

Recommended Texts

1. Ghafoor, A. (2016). *Manual for synopsis and thesis preparation*. Faisalabad, University of Agriculture Press.
2. Relevant latest literature on target issues.

Suggested Readings

1. Reviews, research articles
2. Illustrated Manuals, Compendiums
3. Pocket books

M.Sc. (Hons.) Plant Pathology

COURSE CONTENTS

PLPT-7101

Mycology-I

3(2+1)

To study taxonomy and nomenclature of fungi and fungi-like organisms of agricultural importance. The kingdom Protista and its significance and systematic position and distinguishing characters of the genera of Plasmodiophoromycota in nomenclature will provide detail information on fungal systematics. Furthermore, importance and life cycle of plant pathogens from different classifications especially the life cycles of *Plasmodiophora*, *Spongospora*, Peronosporales, Sclerosporales and Pythiales groups are the main focus of this course. The important characters and classification of oomycota will provide comprehensive details of Oomycetes. The biological features of Chytridiales and Synchytrium and evolution of orders into new phyla are also the focus of this course. During the practical, collection, preservation and identification of mycological specimens and use of key for identification of fungi is the main concern of the course. Moreover, keys for the identification of different fungi is also included in the course. The students will be able to identify and classify the fungi at the end of the course.

Contents

- 1 Evolution of classification of Fungi and Fungi-like organisms: the Six Kingdom System
- 2 Kingdom Protista: Significance, general characteristics and systematic position of Myxomycota, Plasmodiophoromycota, Acrasiomycota and Dictyosteliomycota. Distinguishing characters of the genera of Plasmodiophoromycota
- 3 Life cycles of *Plasmodiophora* and *Spongospora*
- 4 Kingdom Straminopila: Importance, morphology, biology, taxonomy and nomenclature of Hyphochytridiomycota, Labyrinthulomycota and Oomycota
- 5 Important characters and classification of Oomycota up to orders and families level
- 6 Importance and life cycles of plant pathogens in Peronosporales, Sclerosporales and Pythiales
- 7 Kingdom Fungi: General characters, importance and classification up to phyla. Chytridiomycota General Characteristics and classification up to orders level
- 8 Biology of *Synchytrium*. Evolution of orders into new phyla

Practical

- 1 Collection, preservation, culturing and identification of mycological specimens with special reference to taxa of agricultural importance
- 2 Use of keys for identification

Recommended Texts

- 1 Kirk, P.M., Stalpers, J.A., Minter, D.W., & Cannon, P.F. (2011). *Dictionary of fungi* (10th ed.). UK, CABI.
- 2 Lemke, P.A., & Esser, K. (2001). *The Mycota, Volume VII, Systematics and Evolution, Part A*. Singapore, Springer.

Suggested Readings

- 1 Kimatu, J.N. (2018). *Advances in Plant Pathology*. Switzerland, Intech Open.
- 2 Liliane, E.P., & Petrini, O. (2013). *Identifying Moulds: A Practical Guide*. UK, Science Publishers.

The main aim of this course is to study the taxonomy and nomenclature of fungi of agricultural importance. General characters and various types of asexual reproductive structures of Zygomycota is included. In addition, the role of fungal hormones in sexual reproduction and evolution of Glomeromycota are the main contents of the course. The morphological characters, reproduction and life cycle of Ascomycota with special emphasis on ascosporeogenesis and conidiogenesis is also included in the course. Moreover, importance of plant pathogens and classification in Pakistan is also the main concern of this course. Principles and systems of classification of fungi and all the developmental stages of fungi are the concerns of the course. During the practical, collection, preservation and identification of mycological specimens and use of key for identification of fungi is the main concern of the course. Moreover, keys for the identification of different fungi is also included in the course.

Contents

- 1 Zygomycota: General characters, various types of asexual reproductive structures
- 2 Zygosporogenesis: role of hormones in sexual reproduction; classification up to order level
- 3 Classification of Mucorales and Endogonales up to families and characteristics of important genera
- 4 Evolution of Glomeromycota
- 5 Ascomycota: Morphology, reproduction, life cycle patterns, sexual compatibility and parasexuality. Types of asci, centra and ascocarps. Ascosporeogenesis and conidiogenesis
- 6 Principles and systems of classification of Ascomycota and mitospore fungi
- 7 Classification and life cycle of plant pathogenic species of agricultural importance in Pakistan. Ascolichens, general characters, anatomy and distribution in Pakistan
- 8 Basidiomycota: Introduction to Basidiomycetes
- 9 Somatic structure, reproduction, basidiocarp developmental patterns, types of basidia and basidiospores
- 10 Principles and systems of classification; life cycle and classification of taxa of agricultural importance. Basidiolichens and their taxonomy

Practical

- 1 Collection, preservation, culturing and identification of mycological specimens with special reference to taxa of agricultural importance
- 2 Use of keys for identification

Recommended Texts

- 1 Burchett, S., & Burchett, S. (2018). *Plant Pathology*. UK, CRC Press.
- 2 Horst, R.K. (2018). *Westcott's Plant Disease Handbook*. Singapore, Springer.

Suggested Readings

- 1 Liliane, E., Petrini-Klieber, L.E., & Petrini, O. (2013). *Identifying Moulds: A Practical Guide*. UK, Science Publishers.
- 2 Webster, J., & Weber, R. (2007). *Introduction to Fungi*. UK, Cambridge University Press.
- 3 Kimatu, J.N. (2018). *Advances in Plant Pathology*. Switzerland, Intech Open.

The main aim of the course is to study taxonomy and nomenclature of fungi of agricultural importance. The introduction to fungal systematics and classification is included in the course to provide the students with recent approaches for fungal studies. The understandings of the rules and principles of fungal nomenclature is also the focus of this course. Moreover, this course was designed to provide the complete information to students on morphological based systems for the identification of fungi and classify it into groups. The advanced applications of DNA technologies and sequence analysis for further phylogenetic studies and diagnosis keys for identification of various fungal groups of fungi is also the part of this course. During the practical, collection, preservation and identification of mycological specimens and use of key for identification of fungi is the main concern of the course. Moreover, keys for the identification of different fungi is also included in the course.

Contents

- 1 Introduction to fungal systematics
- 2 Diversity of fungi and Fungi-like organisms; concept of speciation in fungi
- 3 Rules for fungal nomenclature
- 4 Morphological, physiological and chemical characters as criteria for fungal classification
- 5 Morphology-based systems for classification of fungi and fungi-like organisms
- 6 Application of DNA sequence analysis to phylogenetic studies
- 7 Different tree-making methods for molecular data
- 8 Weighted parsimony; parsimony and phylogenetic inference using DNA sequences
- 9 Statistical methods for testing molecular phylogenies
- 10 Recent classification of fungi and fungi-like organisms on the basis of molecular phylogeny

Practical

- 1 Use of diagnostic keys for the identification of various groups of fungi up to species level
- 2 Speciation on the basis of molecular techniques
- 3 Homology and phylogenetic weighting
- 4 Use and comparison of different tree-making methods for molecular data

Recommended Texts

- 1 Dighton, J., & James, F.W. (2017). *The Fungal Community: Its Organization and Role in the Ecosystem*. UK, CRC Press.
- 2 Sunil, K.D., Misra, J.K., Jalpa, P., & Tewari, T. (2016). *Fungi: Applications and Management Strategies*. UK, CRC Press.

Suggested Readings

- 1 Burchett, S., & Burchett, S. (2018). *Plant Pathology*. UK, CRC Press.
- 2 Rai, M., & Bridge, P.D. (2009). *Applied Mycology*. UK, CABI.
- 3 Webster, J., & Weber, R. (2007). *Introduction to Fungi*. UK, Cambridge University Press.

The main emphasis of this course is to study the fungal pathogens, pathogenesis and their management. This course was designed to provide a comprehensive information to students on the history of fungal disease and losses caused by different plant pathogenic fungi. The clear observations on symptoms caused by fungal pathogens will be illustrated. The infection process and disease development is also the main part of this course. Moreover, this course will provide the effects on plant physiological traits by the attack of fungal pathogens. The relationship between pathogens disease cycle and epidemics formation is also included in the course. Furthermore, students will be equipped with the methods of plant disease management by chemical to biological tools. Mechanisms of host defense, changes in plant structures and physiology by pathogen attacks and variations in fungal pathogens is also the focus of this course. The students will gain all information on fungal plant pathology during the course.

Contents

- 1 History of fungal plant diseases; losses caused by plant pathogenic fungi
- 2 Survival and dissemination of plant pathogenic fungi
- 3 Stages in establishment of infection by fungal pathogens
- 4 Mechanisms of host defense
- 5 Effects of pathogens on plant physiological functions
- 6 Symptoms caused by fungal pathogens
- 7 Relationships between disease cycles and epidemics
- 8 Mechanisms and stages of variation in fungal pathogens
- 9 Genetics of virulence in fungal pathogens and resistance in host plants
- 10 Chemical and non-chemical methods for disease management
- 11 Study and management of important diseases caused by various groups of fungi and fungi-like organisms

Practical

- 1 Symptomatology of fungal plant diseases
- 2 Techniques for isolation, identification, sub-culturing and preservation of fungal plant pathogens; methods for confirmation of pathogenicity of various groups of plant pathogenic fungi
- 3 *In vitro* evaluation of fungicides and bio-control agents against fungal pathogens
- 4 Demonstration of chemical and non-chemical methods of plant disease management

Recommended Texts

- 1 Archana, S., & Indrakant, K.S. (2018). *Molecular aspects of Plant Pathogens*. Singapore, Springer.
- 2 Narayanasamy, P. (2008). *Molecular Biology in Plant Pathogenesis and Disease Management*. Singapore, Springer.

Suggested Readings

- 1 Dighton, J., & James, F.W. (2017). *The Fungal Community: Its Organization and Role in the Ecosystem*. UK, CRC Press.
- 2 Schumann, G., & D'Arcy, C. (2010). *Essential Plant Pathology*. USA, APS Press.

The main aim of this course is to study basic and advanced concepts of plant viruses and the diseases caused by viruses and virus like organisms. This course will provide a detailed knowledge to students about the taxonomy and distribution of plant viruses across the regions and also the effects of viruses on plants. Moreover, virus structures and taxonomy is also the main content of the course. The recent trends in virus transmission and movement in plants is also the concern of this course. The focus of this course is also to discuss physiology of virus infected plants and virus like organisms. The management strategies used for plant viruses will also be studied with special emphasis on economically important plant viruses in Pakistan. Moreover, advanced techniques for the diagnosis and purification of plant viruses will be transferred to students during practical classes. The students will also gain expertise for newly emerging trends viral research.

Contents

- 1 History and scope of plant virology
- 2 Taxonomy and nomenclature; effects of viruses on plants
- 3 Recent trends in virus transmission and movement in plants
- 4 Structure of plant viruses
- 5 Virus purification, replication, gene organization
- 6 Physiology of virus infected plants
- 7 Virus-vector-host interactions
- 8 Natural and acquired resistance to virus infection
- 9 Management of plant viruses
- 10 Study of economically important viral diseases in Pakistan

Practical

- 1 Field diagnosis of plant virus diseases
- 2 Isolation and purification of plant viruses
- 3 Basic virus characterization
- 4 Serological techniques
- 5 Electron microscopy
- 6 Molecular techniques in virus detection

Recommended Texts

- 1 Rajarshi, K.G. (2019). *Plant Viruses*. UK, Taylor and Francis.
- 2 Foster, G.D., Johansen, I.E., Hong, Y., & Nagy, P.D. (2008). *Plant Virology Protocols – From Viral Sequence to Protein Function* (2nd ed.). USA, Humana Press.

Suggested Readings

- 1 Sastry, K.S., Bikash, M., & John, H. (2018). *Encyclopedia of plant viruses and viroids*. Singapore, Springer.
- 2 Hull, R. (2009). *Comparative Plant Virology* (2nd ed.). USA, Academic Press.
- 3 Hull, R. (2002). *Matthews' Plant Virology* (4th ed.). Netherlands, Elsevier.

The main focus of this course is to study basic and applied concepts of plant pathogenic and allied bacteria. The students will gain knowledge of phytobacteriology and allied field of studies such as, pathogenic bacteria and beneficial bacteria. Ecology and spread of bacteria as plant pathogens and plant symptoms is also the focus. The survival mechanisms and communication between bacteria will also be studied during the course. The host defense response and induction of hypersensitive response during the infection of bacterial pathogens will provide genetic level understandings. The students will go through the important bacterial diseases and management approaches. Moreover, beneficial bacteria such as nitrogen fixing, plant growth promoting and effective microorganisms and their functioning is also the part of discussion in this course. During the practical classes, students will learn the basic to advanced techniques to study bacterial isolation and biochemical assays for identification and the symptoms development on plants.

Contents

- 1 History of phytobacteriology
- 2 Economic importance and characteristics of plant pathogenic bacteria
- 3 Taxonomy and nomenclature, morphology, nutrition, growth and reproduction
- 4 Survival mechanism in bacteria
- 5 Bacterial pathogenesis and symptomology
- 6 Hypersensitive reaction and host-specificity
- 7 Ecology and spread of plant pathogenic bacteria
- 8 Bacteriophages and bacteriocins
- 9 Study of important bacterial diseases in Pakistan and their management
- 10 Nitrogen fixing and nitrifying bacteria
- 11 Plant growth promoting rhizobacteria (PGPR)
- 12 Effective microorganisms (EM)

Practical

- 1 Isolation, purification and identification of plant pathogenic bacteria on the basis of morphological, biochemical and molecular techniques
- 2 Inoculation techniques and pathogenicity tests
- 3 Demonstration of plant disease symptoms exhibited by bacteria/fastidious bacteria and mollicutes
- 4 Sensitivity tests
- 5 Characterization of bacteria using phages

Recommended Texts

- 1 Thind, B.S. (2019). *Phytopathogenic Bacteria and Plant Diseases*. UK, Taylor and Francis.
- 2 Sayyed, R.Z., Reddy, M.S., & Antonius, S. (2019). *Plant Growth Promoting Rhizobacteria (PGPR): Prospects for Sustainable Agriculture*. Singapore, Verlag, Springer.

Suggested Readings

- 1 Sayyed, R.Z., & Tabassum, B. (2019). *Plant Growth Promoting Rhizobacteria for Sustainable Stress Management (Vol. 2): Rhizobacteria in Biotic Stress Management*. Singapore, Verlag, Springer.
- 2 Jayarman, J., & Verma, J.P. (2002). *Fundamentals of Plant Bacteriology*. India, Kalyani Publishers.
- 3 Janse, J.D. (2008). *Phytobacteriology: Principles and Practice*. UK, CABI.

The main aim of this course is to acquaint students with the basic and applied concepts of plant parasitic nematodes. The importance of agriculturally important plant parasitic nematodes and their responses to environment during survival and infestation will also be discussed. The morphological characters and anatomical features will be demonstrated for clear understandings on nematode diversity and identification. The students will gain knowledge on the concepts and principles of population dynamics and ecology of plant parasitic nematodes. The nematode density and crop yield losses will be correlated. The plant parasitic nematodes and their interactions with the plants, changes in plant integrity and losses. Moreover, nematode-microbe interactions in natural ecosystem and advanced phyto-nematode research is also the focus. The management approaches for nematodes will also be the part of the course. The students will learn the extraction of nematodes and study their anatomy by staining techniques during the practical sessions.

Contents

- 1 Importance of plant parasitic nematodes
- 2 Plant response to nematodes; environmental factors affecting survival and pathogenicity
- 3 Morphology, anatomy, and reproduction; mode and mechanism of infection
- 4 Concepts and principles of population dynamics
- 5 Ecology of soil nematodes
- 6 Estimation of crop losses
- 7 Nematode-microbe interactions
- 8 Molecular techniques for taxonomy
- 9 Advances in phyto-nematological research with emphasis on nematode density/ plant yield relationships
- 10 Study of specific nematode diseases of Pakistan
- 11 Management of plant parasitic nematodes
- 12 Identification and propagation of entomopathogenic nematodes

Practical

- 1 Isolation, identification and permanent mounting of important plant parasitic nematodes
- 2 Pathogenicity tests
- 3 Collection, handling and diagnosis of diseased plants by symptomatology
- 4 Integrated management of plant parasitic nematodes

Recommended Texts

- 1 Sergei, A.S., & John, J.C. (2019). *Plant Parasitic Nematodes in Sustainable Agriculture of North America*. Western USA, Springer.
- 2 Richard, S., Danny, C., Johannes, H., & Patricia, T. (2018). *Plant Parasitic Nematodes in subtropical and tropical agriculture*. UK, CABI.

Suggested Readings

- 1 Burdon, J.J., & Laine, A.L. (2019). *Evolutionary Dynamics of Plant-Pathogen Interactions*. UK, Cambridge University Press.
- 2 Janse, J.D. (2008). *Phytopathology: Principles and Practice*. UK, CABI.
- 3 Luc, M., Sikora, R.A., & Bridge, J. (2005). *Plant Parasitic Nematodes in Subtropical and Tropical Agriculture* (2nd ed.). UK, CABI.

The main focus of this course is to study the effects of plant pathogens on seed health and their management. The students will acquire the knowledge of important seed-borne fungal and other pathogens. Moreover, histopathological features of healthy and infected seeds will be taught. Mechanisms of seed infection and disease transmission and factors effecting the establishment of pathogens in seed will also be discussed. The important seed-borne disease and forecasting of such diseases will be emphasized. Moreover, seed quality control system for pathogen-free seed and seed health testing for import and export purposes will also be focused in this course. The students will also learn the seed testing techniques and seed health parameters during the practical sessions. Preparation of working sample for seed health testing and visits to seed testing laboratories will also be conducted in this course. This is a special course related to seed pathology to provide best information to students.

Contents

- 1 Introduction to seed pathology
- 2 Importance of seed-borne fungal, bacterial, viral and nematode diseases
- 3 Histopathology of healthy and infected seeds/planting materials
- 4 Mechanism of seed infection and disease transmission
- 5 Factors affecting establishment of pathogens in seed
- 6 Seed abnormalities and losses
- 7 Seed quality control system for disease-free seed production, processing and certification with special reference to Pakistan
- 8 Seed crops and seed standards
- 9 Seed treatment and equipment, Seed processing and storage;
- 10 Seed health testing of consignment during export/import and testing of germplasm material
- 11 Seed-borne pathogens and their health hazards
- 12 Description of important seed-borne diseases, forecasting of seed-borne diseases
- 13 Accreditation of seed health testing/seed pathology labs
- 14 Seed-borne diseases and bioterrorism
- 15 Seed-borne pathogens: identification, preservation, incidence and mode of seed transmission
- 16 Effect of different chemicals and antagonistic microorganisms on seed-borne pathogens and seed germination

Practical

- 1 Field crop inspection for disease assessment; seed sampling according to International Seed Testing Association (ISTA) methods
- 2 Preparation of working sample for seed health testing and visits to seed testing laboratories and seed processing plants
- 3 Maintenance of culture collection of identified seed-borne pathogens

Recommended Texts

- 1 Burchett, S., & Burchett, S. (2018). *Plant Pathology*. UK, CRC Press.
- 2 Frantzen, J. (2007). *Epidemiology and Plant Ecology: Principles and Applications*. USA, World Scientific Publishing Company.

Suggested Readings

- 1 Kimatu, J.N. (2018). *Advances in Plant Pathology*. Switzerland, Intech Open.
- 2 Cooke, B.M. (2004). *The Epidemiology of Plant Diseases*. Singapore, Verlag, Springer.
- 3 Bhutta, A.R. (2010). *Textbook of Introductory Seed Pathology*. Islamabad, Pakistan, HEC.

The special problem is intended to instruct students on proper techniques for scientific research and methodologies. The students are expected to prepare directed assignment and collect information and material related to current research interest. Special problem means an assignment that is expected to be temporary and is designated as a special assignment by the academic supervisor in its sole discretion. The main purpose of special problem is to increase the learning capabilities of students. The more we use our brains, the more they develop. Students learn a lot more when they read or practice something by themselves. Similarly, the purpose of assignments is to increase the practical skills of students. The main objectives of special problem assigned to students are: to enhance the knowledge of a subject, helps to develop writing skills and to enhance time management and organizing skills. It enhances your planning and organizing skills: The special problem make you do your work by prioritizing the needs and time frames. It helps you in completing all your tasks very peacefully instead of creating any panic. Scopes for improvement: Special problem writing work gives students a lot of scopes to improve themselves.

PLPT-7110

Seminar

1(1+0)

The seminar is intended to instruct students on proper techniques for presentation of scientific material. Each student is expected to prepare and present a scientific seminar and to submit written documentation supporting that seminar. A seminar is a form of academic instruction, either at an academic institution or offered by a commercial or professional organization. It has the function of bringing together small groups for recurring meetings, focusing each time on some particular subject, in which everyone present is requested to participate. Seminars provide a chance to interact with experts from the specific field. Discussing about the relevant topics of the particular subject, students tend to learn about the latest information and new skills related to the concerned subject. Seminars are important and beneficial for those who have difficulty learning in a typical classroom setting where reading and writing are required. There is often a sense of friendship associated with seminar attendance, because everyone is attending with a like interest in learning about a subject important to them. Attending a seminar has numerous benefits, including improving communication skills, gaining expert knowledge, networking with others and renewing motivation and confidence.

The main focus of this course is to acquaint the students with integrated plant disease management practices. In this course, students will acquire the information on concepts and principles of integrated disease management and application. In this context, biological and environmental monitoring for sustainable disease management will be targeted. Moreover, role of advanced techniques of biotechnology, remote sensing and information technology will be gathered for the students. The cultural practices and evaluation of biocontrol agents will also be focused during the studies. Plant disease management strategies and application is the focus and biological and environmental monitoring for disease control is also the part of discussion of the course. The bio-safety regulations for the application of biological control agents will also be emphasized. The development of IPDM model will be priority for the students during the course. The students will be able to transfer the integrated technologies to the end users for sustainable agriculture.

Contents

- 1 Introduction, history, concepts, prospects, principles, components and challenges in Integrated Plant Disease Management (IPDM)
- 2 Different plant disease management strategies, their integration and application
- 3 Biological and environmental monitoring for sustainable disease management
- 4 Role of biotechnology, remote sensing and information technology in IPDM
- 5 Disinfection and pesticides application
- 6 Resistance problems
- 7 Production and evaluation of bio-control agents
- 8 Biosafety regulations regarding release of biocontrol agents
- 9 Role of community in IPDM
- 10 Technology transfer in IPDM.

Practical

- 1 Integration of different methods for plant disease control
- 2 Development of IPDM model

Recommended Texts

- 1 Oliver, R., Park, R.F., & Rojas, E.C. (2018). *Integrated Disease Management of Wheat and Barley*. USA, Burleigh Dodds Science Publishing Limited.
- 2 Balaji, A. (2018). *Handbook of Plant Disease Identification and Management*. UK, Taylor and Francis.

Suggested Readings

- 1 Kannan, V.R., & Batas, K.K. (2019). *Sustainable Approaches to Controlling Plant Pathogenic Bacteria*. UK, Taylor and Francis.
- 2 Arya, A.O., & Perello, A.E. (2010). *Management of Fungal Plant Pathogens*. UK, CABI.
- 3 Razdan, V.K., & Sabitha, M. (2009). *Integrated Disease Management: Concepts and Practices*. Singapore, Springer.

The main aim of this course is to study the role of insects in plant disease transmission. The vectors for virus transmission such as nematodes, insects, fungal like organisms and mode of transmission is the focus of the course. The students will acquire the knowledge of mode of transmission of and dissemination of plant pathogens by vectors. Moreover, ecology and vector-plant interactions and factors affecting the vector transmission will be focused. Furthermore, students will work in collaboration with other departments to explore the insect vectors that are responsible to cause plant diseases. The course will also focus on management of plant disease transmitted by vectors. Moreover, methods of rearing and handling of insect vectors for further experiments will also be focused. The demonstration of mode of transmission of plant pathogens by vectors will also be studied. The students will unravel the mechanisms of pathogen acquisition by vectors and find potential ways to manage such vectors.

Contents

- 1 Insects, nematodes and fungus-like organisms as vectors of plant diseases
- 2 Modes of transmission and dissemination of plant pathogens by vectors
- 3 Ecology and vector-plant relationship
- 4 Factors affecting vector transmission
- 5 Symptomatology, etiology, epidemiology and management of major fungal, bacterial and viral plant diseases transmitted by vectors.
- 6 Identification of nematodes and fungus-like organisms as vectors of plant pathogens

Practical

- 1 Methods of rearing and handling insect vectors for plant pathogenic studies
- 2 Demonstration of modes of transmission of plant pathogens by vectors

Recommended Texts

- 1 Paul, B., & Johan, A. (2019). *Plant Diseases and Biosecurity*. UK, Oxford University Press.
- 2 Leach, J.G. (2007). *Insect Transmission of Plant Diseases*. India, Daya Publishing House.

Suggested Readings

- 1 Kumar, R.V. (2019). *Gemini viruses: Impact, Challenges and Approaches*. Singapore, Springer.
- 2 Vaishali, J.P., & Satte, T.V. (2003). *Insect Predator and Pest Management*. India, Daya Publishing House.
- 3 Vanemden, H.F., & Service, M. (2004). *Pest and Vector Control*. UK, Cambridge University Press.

The main focus of this course is to study the forest and shade tree diseases and their management. The forest ranges in Pakistan and departmental setups of forests will be elaborated to students. The students will learn the importance and introduction to forest diseases and the ecology and epidemiology are the main aim of the course. The spread of forest diseases due to biotic and abiotic factors will be studied. The disease relation with epidemiological factors will be forecasted for timely management. The healthy and disease free nursery plants development will be emphasized and management of the diseases by different approaches will be demonstrated during the course. Moreover, disease management systems based on cultural and chemical practices will be the focus. During the practical course, students will learn about the identification of different diseases by visiting different national institutes working in forest and shade tree pathology will be emphasized.

Contents

1. Importance of forest and shade tree diseases
2. Introduction to forest and shade tree diseases and their ecology, epidemiology and quantification of losses
3. Forest operations in relation to development and spread of abiotic and biotic diseases
4. Studies on specific diseases of representative groups
5. Nursery plants and shade trees
6. Management of important diseases

Practical

1. Survey and collection of diseased specimens
2. Study visits to national institutions working in forest and shade tree pathology
3. Identification and preservation of causal agents
4. Disease management based on cultural and chemical methods

Recommended Texts

1. Agrios, G.N. (2005). *Plant Pathology* (5th ed.). Netherlands. Elsevier Academic Press.
2. Bhutta, A.R. (2010). *Introductory Seed Pathology*. Islamabad, Pakistan, Publisher HEC.

Suggested Readings

1. Khan, A.H. (1898). *Pathology of Trees* (2nd Vol.). Faisalabad, Pakistan, University of Agriculture.
2. Manson, P.D. (1991). *Tree Disease, Concepts* (2nd ed.). USA, Prentice Hall Eaglewood Cliff.
3. Strouts, R.G., & Winter, T.G. (1994). *Diagnosis of Ill-health in Trees*. London, UK, H.M.S.O Publishers.

The main aim of this course is to manage Plant pathogens through biological approaches. The importance and application of biocontrol agents for commercial purposes is the main focus. The students will gain the information on types of interactions of biological control agents and factors involved in the development and application of bio-control agents. The mechanisms of antagonism by bio-control agents will also be focused and different approaches for the successful application of such agents will be also delivered. The mass production and marketing of these microbes will be discussed and kept in practical sessions. The students will learn all means of biological control of plant pathogens in which, cultural control, allelopathic chemicals, composts and compost extracts, host defense induction and biofumigation. Furthermore, nutrients management for plant growth will also provide additional information to manage soil fertility for disease control. Moreover, discovery of indigenous biocontrol agents and mass production and commercialization is also the focus of this course.

Contents

1. History and importance of biological control
2. Biological control and types of biological interaction
3. Factors involved in biological control
4. Different biocontrol approaches like antagonistic microorganisms, allelopathy, plant and pathogen-derived resistance
5. Methods for stimulation of indigenous biocontrol agents
6. Mass production and commercialization of biocontrol agents
7. Study of different biological agents, mechanism of biocontrol at macro and molecular level

Practical

1. Isolation, identification, purification and application of biocontrol agents under laboratory and field conditions
2. Preparation of plant products and their evaluation against various plant pathogens
3. Demonstration of mechanisms of biocontrol

Recommended Texts

- 1 Butt, T.M., Jackson, C., & Magan, N. (2001). *Fungi as Biocontrol Agents: Progress, Problems and Potential*. UK, CABI.
- 2 Ravindra, K., & Anuja, G. (2019). *Seed Borne Diseases of Agricultural Crops: Detection, Diagnosis & Management*. Singapore, Springer.

Suggested Readings

- 1 Horst, R.K. (2018). *Westcott's Plant Disease Handbook*. Singapore, Springer.
- 2 Copping, L.G. (2009). *The Manual of Biocontrol Agents: A World Compendium*. UK, CABI.
- 3 Gnanamanickam, S.S. (2002). *Biological Control of Crop Diseases*. New York, USA, Marcel Dekker.

This course designed for MSc (Hons)/MPhil programs of agriculture sciences. This course provides the applied statistics background for survey and experimental work in Agriculture. Case studies and critical examples are used to work through commonly experienced research problems (from sampling designs to the ethical consideration) and to explain how they may be approached, solved or prevented with statistical means. The importance of statistical science in agriculture is obvious, where the collection, analysis and interpretation of numerical data are concerned. Statistical principles apply in all areas of experimental work and they have a very important role in agricultural experiments. Statistics plays an important role in experimentation. While many scientific problems could be solved by different statistical procedures. Furthermore, some statistical softwares knowledge will be provided to the students to improve their analytical skills. These activities are further supports the student's research.

Contents

1. Importance of Statistics in agriculture research
2. Selection of statistical tools based on scale of measurements
3. Analysis of Count and Frequency data
4. Measures of central tendency and dispersion
5. Some concepts of hypothesis testing. T, Z, Chi-square and F tests. Contingency Tables
6. Diversity Indices
7. Concept of ANOVA and its types
8. Correlation Analysis: Simple correlation, multiple correlation, and Partial correlation
9. Regression Analysis: Simple and multiple regression
10. Generalized linear models: logistic regression, Poisson regression, Gamma regression, Inverse Gaussian regression
11. Non-linear regression
12. Dose Response Curves

Recommended Texts

1. Montgomery, D.C. (2017). *Design and analysis of experiments* (9th ed.). New York: John Wiley & Sons.
2. Rao, G.N. (2007). *Statistics for agricultural sciences* (2nd ed.). India, BS Publication.

Suggested Readings

1. Lawal, B. (2014). *Applied statistical methods in agriculture, health and life sciences*. USA: Springer.
2. Sahu, P.K. (2016). *Applied statistics for agriculture, veterinary, fishery, dairy and allied fields*. USA: Springer.
3. Gbur, E.E., Stroup, W.W., McCarter, K. S., Durham, S., Young, L. J., Christman, M., West, M. & Kramer, M. (2012). *Analysis of generalized linear mixed models in the agricultural and natural resources sciences*. USA: Soil Science Society of America.

PhD Plant Pathology

COURSE CONTENTS

PLPT-8101

Ecology and Epidemiology of Plant Diseases

3(2+1)

The main aim of this course is to acquaint the students with the concepts of ecology and plant disease epidemics. The students will gain knowledge of ecological and population dynamics of different plant pathogens and the survival and propagation of plant pathogens during the course. The propagation of plant pathogens; mapping of epidemic growth, analysis of epidemic growth curve and calculation of growth rate; disease progression and pattern of spread in nature (spatial and temporal) are also included in the course. The population dynamic studies of different plant pathogens; influence of meteorological factors, host resistance and human interceptions on the development of epidemics. Moreover, Pre-requisites, visual assessment methods, descriptive and logarithmic scales, standard diagrams, incidence severity relationship, remote sensing, video image analysis will also be focused. Monitoring disease; establishing prediction systems and executing control measures will be focused in practical course. By the end of course, students will gain all necessary information related to ecology of plant pathogens.

Contents

- 1 Definition, history and development of epidemiology, principles and concepts
- 2 Effect of different environmental factors on growth, reproduction and spread of plant pathogens
- 3 Ecological and population dynamic studies of different plant pathogens; influence of meteorological factors, host resistance and human interceptions on the development of epidemics
- 4 Survival and propagation of plant pathogens; mapping of epidemic growth, analysis of epidemic growth curve and calculation of growth rate; disease progression and pattern of spread in nature (spatial and temporal)
- 5 Loss estimation using prediction models
- 6 Pathometry
- 7 Pre-requisites, visual assessment methods, descriptive and logarithmic scales, standard diagrams, incidence severity relationship, remote sensing, video image analysis
- 8 Studies on the role of factors affecting disease development
- 9 Use of different techniques to create artificial epidemics in greenhouse or growth chamber
- 10 Calculation of severity of diseases by different procedures to monitor epidemics
- 11 Plotting the growth curve by using different transformation procedure

Practical

- 1 Monitoring disease; establishing prediction systems and executing control measures
- 2 Use of agri-meteorological equipment and information

Recommended Texts

- 1 Agrios, G.N. (2005). *Plant Pathology* (5th ed.). New York, USA, Academic Press.
- 2 Burchett, S. (2018). *Plant Pathology*. UK, CRC Press.

Suggested Readings

- 1 Frantzen, J. (2007). *Epidemiology and Plant Ecology: Principles and Applications*. USA, World Scientific Publishing Company.
- 2 Kimatu, J.N. (2018). *Advances in Plant Pathology*. Switzerland, Intech Open.
- 3 Leonard, J.F., & Neher, D.A (1997). *Exercises in Plant Disease Epidemiology*. Saint Paul, Minnesota, USA, American Phytopathological Society Press.

The main aim of this course is to study the biochemical and physiological changes in diseased plants. The main concern will be on the biochemical and physiological changes occurs in healthy and diseased plants. The students will acquire the information on influence of plant pathogens on photosynthesis, respiration, translocation, transpiration, cell wall composition and metabolism, nucleic acid and protein metabolism. The changes in plant secondary metabolites and growth regulators and toxins by the attack of pathogens. Moreover, natural and biochemical resistance in plant and gene activation for plant protection are also the main contents the course. The genetic makeup oh host plants will be studied for the synthesis of proteins playing role in defense mechanism and stresses. The illustration of infection process by plant pathogens and biochemical analysis to demonstrate changes induced by biotic and abiotic factors and bioassay of toxin and selection for host resistance will be performed in practical sessions.

Contents

- 1 Infection process of fungi, bacteria, viruses and nematodes
- 2 Comparative analysis of biochemical and physiological changes in diseased and healthy plants
- 3 Influence of plant pathogens on photosynthesis, respiration, translocation, transpiration, cell wall composition and metabolism, nucleic acid and protein metabolism
- 4 Changes in secondary metabolites, membrane alterations
- 5 Growth regulators phytoalexins and toxins; lectin degrading enzymes affecting host cell and cell wall
- 6 Cutin and suberin degrading enzymes; effect of pathogens ontrans-cellular and vascular transport
- 7 Nature of morphological and biochemical resistance in host plants
- 8 Energy use and metabolic regulation in plant-pathogen interactions
- 9 Effects of root infecting fungi on structure and function of cereal roots
- 10 Effects of disease on plant water relations
- 11 Alterations in secondary metabolism
- 12 Gene activation and interaction

Practical

- 1 Experiments to illustrate infection processes by plant pathogens
- 2 Histopathology of infected plant tissue
- 3 Biochemical analysis to demonstrate changes induced by biotic and abiotic factors
- 4 Bioassay of toxin and selection for host resistance

Recommended Texts

- 1 Guar, H.N. (2018). *Physiological and Molecular Plant Pathology*. Singapore, Springer.
- 2 Šutić, D., & Sinclair, J.B. (1991). *Anatomy and Physiology of Diseased Plants*. UK, CRC Press.

Suggested Readings

- 1 Neil, B. (2016). *Molecular Methods in Plant Disease*. UK, CABI.
- 2 Misra, J.R. (2004). *Photosynthesis in Plants*. India, DPH.
- 3 Schumann, G., & D'Arcy, C.J. (2010). *Essential Plant Pathology*. USA, APS Press.

The main emphasis of this course is to study the genetics of plant pathogens. The students will learn the Mechanisms responsible for variation in plant pathogens including mutation, hybridization, heterokaryosis, parasexuality, adaptation, cytoplasmic inheritance and bacterial conjugation, transformation, and transduction and physiological specialization especially in fungi; Formation of new races and biotypes in the course. The mechanisms for the variation in plant pathogens and physiological specialization in different plant pathogens. The host pathogen interactions will be explored by understanding the host recognition events and development of disease. The gene for gene concept in the contest of plant pathogen interactions. Moreover, study of pathogenicity of different pathogens and genetic backgrounds are also the focus of this course. Evolutionary biology of pathogens and phylogenetics (Macroevolution); genetic drift; gene flow and mating types/systems will be discussed in the practical sessions. This course is designed to provide the students with most advanced aspects of plant disease development with emphasis on pathogen genetics.

Contents

- 1 Mechanisms responsible for variation in plant pathogens including mutation, hybridization, heterokaryosis, parasexuality, adaptation, cytoplasmic inheritance and bacterial conjugation, transformation, and transduction
- 2 Physiological specialization especially in fungi; Formation of new races and biotypes
- 3 The gene-for-gene-concept
- 4 Genetics of host-pathogen interaction
- 5 Speciation (species concepts), and population genetics of pathogen (Microevolution)
- 6 Study of pathogenicity of fungi, bacteria, viruses and nematodes
- 7 Study of infection on differential hosts; recognition, colonization and virulence of plant pathogens
- 8 Evolutionary biology of pathogens
- 9 Phylogenetics (Macroevolution); genetic drift; gene flow
- 10 Mating types/systems

Recommended Texts

- 1 Archana, S., & Indrakant, K.S. (2018). *Molecular aspects of Plant Pathogens*. Singapore, Verlag, Springer.
- 2 McDonald, B.A. (2004). *Population Genetics of Plant Pathogens*. St, Paul, Minnesota, USA, American Phytopathology Society Press.

Suggested Readings

- 1 Shabir, H.W. (2019). *Disease Resistance in Crop Plants: Molecular Genetic and Genomic, Perspectives*. Singapore, Springer.
- 2 Sadasivan, S., & Thayumana, B. (2003). *Molecular Host Plant Resistance to Pests*. USA, Marcel Dekker.
- 3 Singh, U.S., Singh, R.P., & Kohmoto, P. (1995). *Pathogenesis and Host Specificity in Plant Disease. Histopathological, Biochemical, Genetic and Molecular Bases* (Vols. 1-3). New York, USA, Elsevier.

The main aims of this course are to study the diseases affecting plants in transit and storage conditions. The damage of grains and perishable products due to biotic and abiotic factors during harvesting and storage. The physiological and biochemical changes in transit and storage due to diseases. The fungal pathogens producing mycotoxicoses of grains and perishables originating from field and during storage conditions. The effect of mycotoxins on human or animal health and chemical nature of these mycotoxins will be discussed. The proper management of post-harvest pathogens and losses occurring will be emphasized. The toxin produced by plant pathogens and the methods of treatment of different items for storage and transportation. Moreover, isolation and identification of such plant pathogens and visits of VHT treatment plant and hot water treatment systems and visits of grains, fruits and vegetables storage houses will be covered during practical sessions. This is the only specialized course of post-harvest pathology to deal with the pathogens during storage conditions.

Contents

- 1 Importance of post-harvest problems and economic losses
- 2 Damage due to biotic and abiotic factors associated with grains and perishables during harvesting, transit and storage
- 3 Physiological and biochemical changes in transit and storage due to diseases
- 4 Mycotoxicoses of grains and perishables originating from field and storage fungi
- 5 Effect of mycotoxins on human and animal health; management of post-harvest losses
- 6 Use of radiation, waxing and other methods and their effect on product health and quality
- 7 Grain storage management and fumigation technology; introduction and significance of commercial treatment including Vapor Heat Treatment (VHT) and Hot Water Treatment of perishable fruits for export to various countries
- 8 Certification system of grains, fruits and vegetables
- 9 Study of important postharvest diseases

Practical

- 1 Visit to storages facilities and cargo centers for sampling
- 2 Isolation and identification of microorganisms from diseased seeds and perishables
- 3 Estimation and management of losses
- 4 Visits of VHT Treatment Plant and Hot Water Treatment Systems
- 5 Visits of grains, fruits and vegetables storage houses

Recommended Texts

- 1 Paul, B., & Johan, A. (2019). *Plant Diseases and Biosecurity*. UK, Oxford University.
- 2 Barkai-Golan, R. (2001). *Post-harvest Diseases of Fruits and Vegetables: Development and Control*. Netherlands, Elsevier.

Suggested Readings

- 1 Sanjeev, S. (2016). *Plant Pathogens and Principles of Plant Pathology*. India, New India Publishing Agency.
- 2 Chakraverty, A., & Mujundar, A.S. (2003). *Handbook of Post-harvest Technology*. New York, USA, Marcel Dekker NC.
- 3 Narayanasamy, P. (2006). *Postharvest Pathogens and Disease Management*. New Jersey, USA, John Wiley & Sons, Inc.

The main emphasis of this course is to acquaint the students with recent trends in plant pathology. The advanced trends and application of plant pathology in the field of agriculture for sustainable production. The students will learn the advanced molecular and biological techniques for identification of plant pathogens and epidemiological studies of plant pathogens such as survival of pathogens and tracking of isolates. The mechanism of genetic variability in pathogens; structure of genomes will be explored by using the advanced molecular biology techniques. The pathogenesis and host parasitic specificity of different plant pathogens will be focused. Moreover, modern molecular based techniques to study the plant pathogens and pathogenesis and the events of host survival during infection process by the induction of defense genes is also included. The students will gain most recent developments in plant pathology and allied field of studies.

Contents

- 1 Recent trends and developments in different disciplines of Plant pathology
- 2 Review of developments and future prospects of plant pathology
- 3 Pathogenesis and host parasite specificity in bacteria, nematodes, fungi and viruses
- 4 Molecular and biological techniques for identification and epidemiological studies of Plant pathogens such as survival of pathogens and tracking of isolates
- 5 Mechanism of genetic variability in pathogens; structure of genomes
- 6 Allele specific and touch down PCR
- 7 Molecular markers
- 8 Molecular resistance
- 9 Review/Special Assignment/Presentation

Recommended Texts

- 1 Sanjeev, S. (2016). *Plant Pathogens and Principles of Plant Pathology*. India, New India Publishing Agency.
- 2 Paul, B., & Johan, A. (2019). *Plant Diseases and Biosecurity*. UK, Oxford University Press.

Suggested Readings

- 1 Chakraverty, A., & Mujundar, A.S. (2003). *Handbook of Post harvest Technology*. New York, USA, Marcel Dekher NC.
- 2 Narayanasamy, P. (2006). *Postharvest Pathogens and Disease Management*. New Jersey, USA, John Wiley & Sons, Inc.
- 3 Prusky, D., & Lodovica, G.M. (2010). *Post harvest Pathology*. Singapore, Springer.

The main aim of this course is to study the advances in virus research especially in the context of biological, physiological, serological and molecular properties of plant viruses and viroids. The students will learn the structure and functioning of plant viruses and events of virus infections in plants. The virus genetic makeup and genome organization are the focus of the course. The recent and concepts concerning biological, physical, serological and molecular properties of plant viruses and viroids will be emphasized. The students will also learn the advanced developments in virology especially the viruses pathogenic to the plants. Moreover, study the viruses by molecular techniques and analysis of testing of transgenic plants for viruses are the practical focus of this course. The molecular biology approaches such as Polymerase Chain Reaction to study the RNA and DNA virus genomes are included in course. Furthermore, production, analysis and field testing of transgenic plants resistant to plant viruses will be focused.

Contents

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

Practical

- 1 Plant virus diagnosis
- 2 Study of viruses using molecular techniques
- 3 Virus nucleic acid isolation and analysis
- 4 Polymerase chain reaction for RNA and DNA virus genomes
- 5 Production, analysis and field testing of transgenic plants

Recommended Texts

- 1 Rajarshi, K.G. (2019). *Plant Viruses*. UK, Taylor and Francis.
- 2 Guar, H.N. (2018). *Physiological and Molecular Plant Pathology*. Singapore, Springer.

Suggested Readings

- 1 Archana, S., & Indrakant, K.S. (2018). *Molecular aspects of Plant Pathogens*. Singapore, Verlag, Springer.
- 2 Hull, R. (2002). *Matthews' Plant Virology* (4th ed.). Netherlands, Elsevier Ltd.
- 3 Hull, R. (2009). *Comparative Plant Virology* (2nd ed.). UK, Academic Press.

The main focus of this course is to study the various molecular interactions of plants and associated microbes. The molecular and genomic variability is microbes and their interactions with the host and different mechanisms of plant-microbe interaction with emphasis on production of microbial compounds for plants. Moreover, advanced techniques to study the plant microbe interactions is the focus of this course. The microbial pathogenesis, host recognition, signal transduction and compatibility, programmed cell death; hypersensitivity, production of antimicrobial compounds, enzymes, toxins and hormones, host and pathogen induced resistance, cross protection versus engineered resistance will be emphasized during the course. The beneficial interactions of microbes with plants for plant growth promotion and disease protection will be focused. This course will provide a comprehensive understanding on plant-microbe interactions. The approaches to study the plant-microbe interactions such as DNA/RNA extraction, PCR analysis, staining techniques and imaging will be demonstrated during the practical classes.

Contents

- 1 Theory of co-existence and co-evolution
- 2 Plant-microbe associations; gradients of host- microbe interactions
- 3 Molecular and genomic variability
- 4 Pathogenesis: host recognition, signal transduction and compatibility
- 5 Programmed cell death; hypersensitivity
- 6 Production of antimicrobial compounds, enzymes, toxins and hormones
- 7 Host and pathogen induced resistance, cross protection versus engineered resistance
- 8 Gene silencing
- 9 Hypo-virulence
- 10 Disease management at molecular level i.e. gene manipulation for disease resistance (horizontal), systemic and local acquired resistances
- 11 Clonal strategy and structural analysis of resistance genes

Practical

- 1 DNA extraction, purification and quantification
- 2 DNA Hybridization
- 3 Pathogenic variability based on molecular approaches

Recommended Texts

- 1 Jeremy, J.B., & Anna-Liisa, L. (2019). *Evolutionary Dynamics of Plant-Pathogen Interactions*. UK, Cambridge University Press.
- 2 Archana, S., & Indrakant, K.S. (2018). *Molecular aspects of Plant Pathogens*. Singapore, Springer.

Suggested Readings

1. Guar, H.N. (2018). *Physiological and Molecular Plant Pathology*. Singapore, Springer.
2. Dickinson, M. (2003). *Molecular Plant Pathology*. London, UK, Bios Science Publishers.
3. Kosuge, T., & Nester, E.W. (1984). *Plant-Microbe Interaction* (Vol. 1& 2). New York, McMillan Publishing Co.

The main focus of this course is to study basic and applied aspects of bioinformatics tools in plant pathology. The students will learn the multiple techniques and analysis of sequences data from different organisms and their interactions with each other. The online data hunting and analysis by using the online pipelines will be the main aim of the course. The different kind of biological data such as microarray data analysis, pre-processing, scatter plots and micro array plots, global and local normalization, ratios and other parameters will be taught in the course. The genetic assembly of genes, promoter and regulatory element prediction in prokaryotes and eukaryotes. The plant resistance genes database (PRGdb), Ribosomal data bank project (RDBP), Protein domains and motifs, protein sequence and structure, the protein data bank, protein structure, prediction and interaction are included in the course. Moreover, learning of online pipelines and softwares for primer designing, sequence alignment, editing and molecular phylogeny of plant pathogens is also the focus.

Contents

- 1 Significance of bioinformatics in Plant Pathology
- 2 Molecular evolution and goals of molecular phylogeny
- 3 Properties and types of trees
- 4 Stages of phylogenetic analysis
- 5 Phylogenetic methods
- 6 Access to biological sequence databases
- 7 Basic local alignment search tool (BLAST)
- 8 Pair-wise and multiple sequence alignment
- 9 Microarray data analysis: pre-processing, scatter plots and micro array plots, global and local normalization, ratios and other parameters
- 10 Gene, promoter and regulatory element prediction in prokaryotes and eukaryotes
- 11 Plant resistance genes database (PRGdb)
- 12 Ribosomal data bank project (RDBP)
- 13 Protein domains and motifs, protein sequence and structure, the protein data bank, protein structure, prediction and interaction

Practical

- 1 Demonstration of bioinformatics tools
- 2 Primer designing, sequence alignment, editing and molecular phylogeny of plant pathogens
- 3 Construction and analysis of phylogenetic trees

Recommended Texts

- 1 Jeremy, J.B., & Anna-Liisa, L. (2019). *Evolutionary Dynamics of Plant-Pathogen Interactions*. UK, Cambridge University Press.
- 2 Acton, Q.A. (2012). *Advances in Biotechnology Research and Application*. USA, Scholarly Editions TM.

Suggested Readings

1. Kimatu, J.N. (2018). *Advances in Plant Pathology*. Switzerland, Intech Open.
2. Mount, D.W. (2004). *Bioinformatics: Sequence and Genome Analysis*. New York, Cold Spring Harbor.
3. Pevsner, J. (2010). *Bioinformatics and Functional Genomics*. USA, Wiley Backwell.

The special problem is intended to instruct students on proper techniques for scientific research and methodologies. The students are expected to prepare directed assignment and collect information and material related to current research interest. Special problem means an assignment that is expected to be temporary and is designated as a special assignment by the academic supervisor in its sole discretion. The main purpose of special problem is to increase the learning capabilities of students. The more we use our brains, the more they develop. Students learn a lot more when they read or practice something by themselves. Similarly, the purpose of assignments is to increase the practical skills of students. The main objectives of special problem assigned to students are: to enhance the knowledge of a subject, helps to develop writing skills and to enhance time management and organizing skills. It enhances your planning and organizing skills: The special problem make you do your work by prioritizing the needs and time frames. It helps you in completing all your tasks very peacefully instead of creating any panic. Scopes for improvement: Special problem writing work gives students a lot of scopes to improve themselves.

PLPT-8110

Seminar

1(1+0)

The seminar is intended to instruct students on proper techniques for presentation of scientific material. Each student is expected to prepare and present a scientific seminar and to submit written documentation supporting that seminar. A seminar is a form of academic instruction, either at an academic institution or offered by a commercial or professional organization. It has the function of bringing together small groups for recurring meetings, focusing each time on some particular subject, in which everyone present is requested to participate. Seminars provide a chance to interact with experts from the specific field. Discussing about the relevant topics of the particular subject, students tend to learn about the latest information and new skills related to the concerned subject. Seminars are important and beneficial for those who have difficulty learning in a typical classroom setting where reading and writing are required. There is often a sense of friendship associated with seminar attendance, because everyone is attending with a like interest in learning about a subject important to them. Attending a seminar has numerous benefits, including improving communication skills, gaining expert knowledge, networking with others and renewing motivation and confidence.

The main aim of this course is to acquaint the students about the environmental issues relevant to plant pathology. The study of environmental factors and plant pathogens for disease development and spread are the focuses of this course. The degradation of natural resources by the activities of environmental pollutants and health hazards effects of chemical pesticides and wastes will be the main concern during the course. The students will learn the environmental impact assessment (EIA) as instrument of environmental management. Moreover, global climate change and its impact on distribution of plant diseases with special emphasis on disease outbreak will be organized to provide environmental concerns to students. The environmental and biosafety hazards of genetically modified organisms (GMOs) and risk assessment studies, biosensors as environmental monitors will be discussed. The environmental monitoring and disease assessment are also the focus of this course. Microorganisms as bio-indicators of environmental pollution will be considered in practical sessions.

Contents

- 1 Introduction to environmental complex
- 2 Role of anthropogenic activities in degradation of natural resources
- 3 Environmental pollution caused by use of pesticides and agricultural/industrial wastes
- 4 Environmental impact assessment (EIA) as instrument of environmental management
- 5 Global climate change and its impact on distribution of plant diseases with special emphasis on disease outbreak
- 6 Environmental and biosafety hazards of genetically modified organisms (GMOs) and risk assessment studies;
- 7 Biosensors as environmental Monitors
- 8 Microorganisms as bio-indicators of environmental pollution
- 9 Bioremediation. Review/Special Assignment/Presentation

Recommended Texts

- 1 Paul, B., Johan, A., Adrain, F., Charles, L., & Derek, M. (2019). *Plant Diseases and Biosecurity*. UK, Oxford University Press.
- 2 Geoffrey, S.A., & Azevedo, P. (2009). *Agricultural Wastes*. New Jersey, USA, Nova Science Publishers, Inc.

Suggested Readings

- 1 Ralph, M., & Ji-Dong, G. (2010). *Environmental Microbiology* (2nd ed.). USA, John Wiley & Sons.
- 2 Saleem, M.A., & Ashfaq, M. (2004). *Environmental Pollution and Agriculture*. Multan, Pakistan, B.Z. University Press.
- 3 Kumar, R.V. (2009). *Geminiviruses: Impact, Challenges and Approaches*. Singapore, Springer.

The main focus of this course is to educate the students on international obligations and agreements with special reference to Plant Pathology. The students will get understandings on the agencies controlling the facts on international trades in which Codex Alimentarius Commission (CAC), Intellectual property right (IPR), International plant protection convention (IPPC), Sanitary and phytosanitary measures (SPS) and their working, Food and agriculture organization (FAO) and its working related to World Trade Organization (WTO) and its working. The issues and problems in import/export relating to phyto-sanitary aspects of agricultural commodities will be focused. The impact of major agreements on economy of Pakistan, requirement of material transfer agreement (MTA) regarding movement of plant genetic materials and their testing for health status will provide the students great understanding on plant resources. The introduction to approved ISPMs by IPPC 1997, Framework for Pest Risk Analysis, ISO certification of Plant Pathology Technical Laboratories version 17025 are also included in the course.

Contents

- 1 International treaties, agreements and their relevance to Plant Pathology
- 2 An overview of Cartagena protocol on bio-safety
- 3 Codex Alimentarius Commission (CAC)
- 4 Intellectual property right (IPR)
- 5 International plant protection convention (IPPC)
- 6 Sanitary and phytosanitary measures (SPS) and their working
- 7 Food and agriculture organization (FAO) and its working related to World Trade Organization (WTO)
- 8 Issues and problems in import/export relating to phytosanitary aspects of agricultural commodities
- 9 Impact of major agreements on economy of Pakistan
- 10 Requirement of material transfer agreement (MTA) regarding movement of plant genetic materials and their testing for health status
- 11 Worldwide major risks of plant diseases
- 12 Introduction to approved ISPMs by IPPC 1997
- 13 Framework for Pest Risk Analysis
- 14 ISO certification of Plant Pathology Technical Laboratories version 17025
- 15 Introduction, importance and significance of alien species in international trade
- 16 Biosecurity and measures to encounter bioterrorism
- 17 Review/Special Assignment/Presentation

Recommended Texts

- 1 Kumar, A., & Singh, V.K. (2019). *Microbial Endophytes: Prospects for Sustainable Agriculture*. Netherlands, Elsevier Science Publishing Co Inc.
- 2 Devorshak, C. (2012). *Plant Pest Risk Analysis: Concepts and Application*. UK, CABI.

Suggested Readings

- 1 OECD. (2003). *The Impact of Regulations on Agro-Food Trade, The Technical Barriers to Trade*. USA, OECD.
- 2 Rangan, S. (2007). *Sanitary and Phytosanitary Measures: An Introduction*. India, University Press.
- 3 Wolfrum, R., & Seibert-Fohr, A. (2007). *WTO: Technical Barriers and SPS Measures*. Netherlands, Martinus Nijhoff Publishers.

This course designed for PhD programs in agriculture sciences. Modern agricultural production is characterized by some particularities and many different activities. So, it arises different problems and different nature of agricultural materials data which require different approaches to the use of statistical methods. Statistics is a discipline which mainly deals with data quantifications. Even in the case of nonnumerical data, statistical methods use transformations to change nonnumerical data to numerical data, with the aim of achieving some level of quantification to make conclusions about the matter of interest. Many data in agriculture are of numerical character which are accompanied with the existence of the variability of data. Statistics can be used as a tool for agricultural research. For these reasons “statistics can, however, help the research worker to design his experiments and to evaluate objectively the resulting numerical data”. So this course is mainly focus on advanced design of experiment tools which will be helpful to find out the factors of output related to agriculture experiments. Moreover, students will also learn some statistical softwares like Minitab, R, Design Expert etc. to analyze their experimental data. The knowledge of statistical software will improve the computational and analytical skills of the students.

Contents

- 1 Basic principles of experimental design.
- 2 Layout analysis of CRD, RCBD, Latin Square Designs.
- 3 Estimation of Missing Observations in RCBD and Latin Square Design.
- 4 BIBD, PBIBD, Split plot Designs and its variations.
- 5 Multiple comparison tests.
- 6 Effect of violation of assumptions of underlying ANOVA.
- 7 Factorial Experiments, 2^n , 3^n ... P^n .
- 8 Mixed levels factorial experiments.
- 9 Confounding and its types. Fractional replication. Application and construction of contrasts.
- 10 Response surface methodology.
- 11 Introduction of multivariate analysis.
- 12 Principle component analysis
- 13 Factor analysis
- 14 Cluster Analysis
- 15 Correspondence analysis.

Recommended Texts

1. Muhammad, F. (2000). *Statistical methods and data analysis*. Pakistan: Ilmi Kitab Khana.
2. Montgomery, D. C. (2017). *Design and analysis of experiments* (9th ed.). New York: John Wiley & Sons.

Suggested Readings

1. Box, G. E. P., W. G., & Hunter, J. S. (1978). *Statistics for experimenters*. New York: John Wiley & Sons.
2. Dillon, W. R., & Goldstein, M. (1984). *Multivariate analysis: Methods and applications*. New York: John Wiley & Sons.
3. Cox, D. R. (2000). *The theory of the design of experiments*. USA: Chapman and Hall.