



COURSE OUTLINE BRIEFS

DEPARTMENT OF
HORTICULTURE



FACULTY OF
AGRICULTURE



OVERVIEW

Horticulture is an intensive subset of agriculture that deals with flowers, landscape plants, vegetables, and fruits. Plants not only beautify urban and rural landscapes and recreate areas but they are also very important in environmental protection. They are used to re-vegetate and restore land disturbed by human or natural activities, they control erosion, and they help to clean the air and water.

The Horticulture Department became full-fledged department of the University in January, 2012. It is offering BSc (Hons), MSc (Hons) and PhD programs and since its establishment, the Department has produced two PhD scholars and number of MSc (Hons) Agriculture major Horticulture and BSc (Hons) Agriculture graduates. The Department is focused to develop skilled manpower.

The Department strives to improve how we use plants, for food and other human purposes, as well as repairing the environment and personal aesthetics. The Department has good citrus nursery and is playing an important role in improving the citrus industry of Pakistan as we are providing more than ten thousand good quality plants to citrus growing community of Punjab especially in Sargodha region.

The Department has highly qualified faculty and well-equipped laboratories. Most of the faculty members are HEC approved supervisors. The faculty focuses on finding new and environmentally-responsible ways of managing plants and pests to help increase crop and ornamental plant viability. They are also involved in research activities for the fruit and vegetable as well as ornamental crop improvement.

Academic Programs Offered

1. BSc (Hons) Agriculture (Major in Horticulture)
2. MSc (Hons) Horticulture
3. PhD Horticulture

BSc (Hons) Agriculture

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

Duration: 04 Year Program (08 Semesters)

Degree Requirements: 136 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/	Intro to Biology-I (for Pre-Engineering students)/	3(3+0)/
MATH-5128	Mathematics (for Pre-Medical students)	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)

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(3+0)

Semester-IV

PLBG-5202	Introductory Plant Breeding	3(2+1)
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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

HORT- 6603	Principles of Fruit Production	3(2+1)
HORT- 6604	Principles of Vegetable Production	3(2+1)
HORT- 6605	Principles of Ornamental Crop Production	3(2+1)
HORT- 6606	Propagation and Nursery Management	3(1+2)
HORT- 6607	<i>In Vitro</i> Propagation	2(1+1)
AEXT-6608	Communication Skills in Agricultural Extension	3(2+1)

Semester-VI

HORT- 6609	Tropical and Sub-Tropical Fruits	3(2+1)
HORT- 6610	Summer Vegetables	3(2+1)
HORT- 6611	Landscape Horticulture	3(2+1)
HORT- 6612	Medicinal and Aromatic Plants	2(1+1)
HORT- 6613	Post-Harvest Horticulture	3(2+1)
HORT- 6614	Business Management in Horticulture	2(2+0)

Semester-VII

HORT- 6615	Research Methods in Horticulture	3(1+2)
HORT- 6616	Temperate Fruits	3(2+1)
HORT- 6617	Winter Vegetables	3(2+1)
HORT- 6618	Commercial Flower Production	3(2+1)
HORT- 6619	Breeding of Horticultural Crops	3(2+1)
HORT- 6620	Project Planning and Scientific Writing	2(1+1)

Semester-VIII

AGEC-6621	Agribusiness, Marketing and Trade	3(3+0)
HORT- 6622	Vegetable and Flower Seed Production	3(2+1)
HORT-6623	Protected Horticulture	3(2+1)
HORT- 6624	Indoor Plant Culture and Interior-scaping	3(2+1)
HORT- 6625	Research Project/Internship	4(0+4)

MSc (Hons) Horticulture

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: 2 Years

Semesters: 4

Degree Requirements: Minimum 30 Credit Hours (24 credit hours course work + 6 credit hours thesis and research)

Course Code	Title of the Course	Credit Hours
HORT-7101	Mineral Nutrition of Horticultural Crops	3(2+1)
HORT-7102	Plant Tissue Culture	3(1+2)
HORT-7103	Prospective Horticultural Crops	3(2+1)
HORT-7104	Rootstocks for Horticultural Crops	3(2+1)
HORT-7105	Citriculture	3(2+1)
HORT-7106	Mango and Date Palm Culture	3(2+1)
HORT-7107	Minor Fruits	3(2+1)
HORT-7108	Solanaceous Crops	3(2+1)
HORT-7109	Special Problem	1(1+0)
HORT-7110	Seminar	1(1+0)
HORT-7111	Spices and Condiments	3(2+1)
HORT-7112	Mushroom Biology and Technology	3(2+1)
HORT-7113	Landscape Designs	3(2+1)
HORT-7114	Horticultural Seed Science and Technology	3(2+1)
HORT-7115	Physiology of Horticultural Crops	3(2+1)
HORT-7116	Post-Harvest Physiology	3(2+1)
HORT-7117	Nursery Management of Horticultural Plants	3(2+1)
STAT-7151	Statistical Methods for Agricultural Research-I	3(3+0)

PhD Horticulture

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

Duration: Minimum 03 Years

Semesters: 06

Degree Requirements: Minimum 18 credit hours course work, comprehensive exam, thesis and research

Course Code	Title of the Course	Credit Hours
Hort-8101	Plant Growth Regulators	3(2+1)
Hort-8102	Environmental Horticulture	3(2+1)
Hort-8103	Fruit Breeding	3(2+1)
Hort-8104	Vegetable Breeding	3(2+1)
Hort-8105	Vegetable Seed Production and Marketing	3(2+1)
Hort-8106	Turf grass Management	3(2+1)
Hort-8107	Advanced Fruit Science	3(2+1)
Hort-8108	Advanced Vegetable Science	3(2+1)
Hort-8109	Special Problem	1(1+0)
Hort-8110	Seminar	1(1+0)
Hort-8111	Landscape Ecology	3(3+0)
Hort-8112	Biotechnology of Horticultural Crops	3(2+1)
Hort-8113	Horticultural Production under Abiotic Stresses	3(2+1)
STAT-8131	Statistical Methods for Agricultural Research-II	3(3+0)



BSc
(Hons)
AGRICULTURE
HORTICULTURE



This is an introductory course designed to introduce the concept and significance of soil science to the students of agriculture at undergraduate level. It provides information to the students about soil science, its branches, their environmental significance, weathering of rocks and minerals, their classification, physical properties of soil and their significance in agriculture. The course would provide awareness to the students about impact of agricultural and industrial wastes on our environment. In addition, this course also teaches the students, skills to collect soil and water samples for physico-chemical analysis. Laboratory exercises are designed to develop skills for analysis of irrigation water and soil samples which would highlight and support the importance of both water and soil quality analysis for judicious use of resources.

Contents

1. Introduction to Soil and environment
2. Definition of earth, geology and soil science
3. Disciplines of soil science
4. Lithosphere, hydrosphere and biosphere
5. Soil forming rocks and minerals: types and their formation
6. Weathering of rocks and minerals: definition. Agents and classification
7. Parent materials: definition and types
8. Soil formation: definitions, processes and factors
9. Soil profile: definition and description
10. Physical properties of soil and their significance
11. Introduction to soil classification and land use capability classes
12. 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., & Bantel, R. (2001). *Soil Science*. Islamabad: National Book Foundation.
2. Brady, N.C., & Weil, R.R. (2007). *The Nature and Properties of Soils* (14th ed.). New Jersey: Pearson Education.

Suggested Readings

1. Brady, N.C., & Weil, R.R. (2009). *Elements of the Nature and Properties of Soils* (3rd ed.). New Jersey, USA: Pearson Education.
2. Hillel, D. (2008). *Soil in the Environment: Crucible of Terrestrial Life*. Burlington: Elsevier.
3. Das, D.K. (2011). *Introductory Soil Science* (3rd ed.). New Delhi: Kalyani Publications.

Basic Agriculture is a course designed to provide the students with the basic knowledge of agriculture. It will enable the students to understand the basic terminologies of agriculture, its different branches, allied disciplines, salient features of agriculture in Pakistan including climate and land resources. There will be detailed discussions about the various agro-ecological zones of Pakistan. Basic knowledge about agricultural inputs such as seed, fertilizer, irrigation and post-harvest technology would be communicated to the students. The students will be able to understand the conventional and international system of land measurements. 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

- 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
- 5 Farming systems
- 6 Tillage: objectives and types
- 7 Seed: types and quality
- 8 Crop nutrients, manures and fertilizers, sources and methods of application
- 9 Irrigation: systems, types and management
- 10 Crop protection measures
- 11 Crop rotation
- 12 Harvesting, processing, storage and marketing of farm produce
- 13 Agro-based industries
- 14 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. & Bantel, R. (2001), *Soil Science*, Islamabad: National Book Foundation.
- 2 Brady, N.C., & Weil, R.R. (2013). *Elements of the Nature and Properties of Soils* (3rd ed.). New Jersey: Pearson Education.

Suggested Readings

- 1 Hillel, D. (2008). *Soil in the Environment: Crucible of Terrestrial Life*. Burlington: Elsevier.
- 2 Singer, M. J., & Munns, D. N. (2002). *Soils- An Introduction* (5th ed.). New Jersey: Prentice-Hall.

The purpose of this course is to produce 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 phenomena (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 the students 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
2. Nature and scope of biology
3. Branches of biology
4. Relationship between biology and psychology
5. Biological molecules: Carbohydrates, Proteins, Fats, Nucleic acids, Water
6. The cell: Structure and function of cell, Cell organelles, Different types of cells
7. Homeostasis: Osmoregulation, Structure and functions of Nephron, Thermoregulation
8. Coordination and control: Structure and physiology of Neuron
9. Introduction to central and peripheral nervous system
10. Hormones
11. Basics of growth and development
12. Embryonic and post embryonic development

Recommended Texts

1. Campbell, M., & Christopher, J.P. (2016). *Organismal homeostasis*. New York: Momentum press.
2. Snow, A. L., & Leonardo, M. J. (Eds.) (2013). *Immune homeostasis: Methods and protocols*. New York: Humana Press.

Suggested Readings

1. Anna, A. S., & Richard, B. P. (2019). *An Introduction to Conservation Biology* (2nd ed.). Oxford: Oxford University Press.
2. Campbell, N. A., Mitchell, L. G., & Reece, J. B. (2009). *Biology: Concepts and connections* (6th ed.). San Francisco: Addison Wesley Longman.
3. Urry, L. A., Cain, M. L., Wasserman, S. A., Minorsky, P. V., & Reece, J. B. (2017). *Campbell biology*. New York: Pearson.

This course is built upon the mathematical concepts, principles and techniques that are useful in almost all undergraduate programs. The main objectives of the course are to enhance student's competency in application of mathematical concepts in solving problems and to improve their level of quantitative approach. Upon the successful completion of this course students would be able to develop understanding about mathematical functions, building and solving linear and quadratic equations, matrices and determinants with application, sequences and series, and basic financial mathematics. This course has been designed to prepare the students, not majoring in mathematics, but with the essential tools of financial mathematics, algebra and geometry to apply the concepts and the techniques in their respective disciplines. The aim of teaching and learning mathematics is to encourage and enable students to recognize that mathematics permeates the world around us, appreciate the usefulness, power and beauty of mathematics, enjoy mathematics and develop patience and persistence when solving problems.

Contents

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

Recommended Texts

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

Suggested Readings

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

The course introduces students to information and communication technologies and their current applications in their respective areas. The students will learn the basic understanding of computer software, hardware, and associated technologies to get maximum benefit related to their study domain. Students will learn how the information and communications systems can improve their work ability and productivity, how Internet technologies like 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 the course. The course will also cover computer ethics, 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)
18. Mobile apps or other similar tools
19. Other IT tools/software specific to field of study

Recommended Texts

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

Suggested Readings

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

The course seeks to develop a 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 helps in developing students' vocabulary building skills as well as their critical thinking skills. The contents of the course are designed based on 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. Helgesen, M., & Brown, S. (2004). *Active listening: Building skills for understanding*. Cambridge: Cambridge University Press.
2. Mikulecky, B. S., & Jeffries, L. (2007). *Advanced reading power: Extensive reading, vocabulary building, comprehension skills, reading faster*. New York: Pearson.

Suggested Readings

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

Islamic Studies is the academic study of Islam and Islamic culture. The basic sources of the Islamic Studies are the Holy Qur'an and Sunnah or Hadith of the Holy Prophet Muhammad ﷺ. The learning of the Qur'an and Sunnah guides the Muslims to live peacefully. It engages the students in the study of Islam as a textual tradition inscribed in the fundamental sources of Islam; Qur'an and Hadith, history and cultural contexts. The subject seeks to introduce 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 provides introduction to foundations of Islam 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. It is one of the best systems of education which grooms a person with the qualities which he/she should have as a human being.

Contents

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

Recommended Texts

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

Suggested Readings

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

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 students who have 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 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, J. S. LL. D. G. (1983). *A manual of ethics*. London: University Tutorial Press.
2. Nadwi, S. S. (1999). *Ethics in Islam*. Karachi: Darul-Ishaat.

Suggested Readings

1. Cahn, S. M., & Markie, P. (2019). *History, theory, and contemporary issues*. Oxford: Oxford University Press.
2. Williams, B. (1972). *Morality: An introduction to Ethics*. Cambridge: Cambridge University Press.

This course will acquaint the students with the basic concepts of Agronomy and crop production. It has been designed to develop understanding among the students about 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

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 (rapes, 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. Balasubramaniyan, P., & Palaniappan, S. P. (2004). *Principles and practices of agronomy*. Jodhpur: Agrobios.
2. Khalil, I.A., & Jan, A. (2002) *Cropping technology*. Islamabad: National Book Foundation.

Suggested Readings

1. Martin, J.H., Waldren, R.P., & Stamp, D.L. (2006). *Principles of field crop production* (4th ed.). New York: The McMillan.
2. Nazir, M.S., Bashir, E., & Bantel, R. (Eds.) (1994). *Crop production*. Islamabad: National Book Foundation.

This course 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 micronutrients from soil environment? This subject also clears the concept of the 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
4. Basic cation saturation percentage
5. Soil pH and its importance
6. Buffering of soil
7. Soil organic matter: sources, composition and significance
8. Elements essential for plant growth: macro and micronutrients, organic and inorganic fertilizers
9. Salt-affected and waterlogged soils: types, reclamation and management
10. Soil erosion: causes and remedies: soil and water conservation
11. 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, E., & Bantel, R. (2001). *Soil Science*. Islamabad: National Book Foundation.
2. Brady, N.C., & R.R. Weil. (2007). *The Nature and Properties of Soils* (14th ed.). New Jersey: Pearson Education.

Suggested Readings

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

Forest and Watershed management 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 different biological and engineering approaches to control and regulate water flow and reduce the sedimentation of the streams and lakes fed by this water.

Contents

1. Introduction to Forest and watershed management
2. Forest resources of Pakistan (description, composition, distribution and status)
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. Watershed Management: Principles, Watersheds of various streams/rivers of Pakistan, their area, distribution, land use patterns, climatic, physiographic, ecological and socio-economic features
8. Hydrological cycle
9. Management problems and potentials of various watersheds, afforestation programmes
10. Watershed as a source of power generation and irrigation
11. 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*. Wallingford: CAB International.
2. Quraishi, M. A. A. (1999). *Basics of Forestry and Allied Sciences*. Lahore: A-One Publishers.

Suggested Readings

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

AEXT-5401 Introduction to Agricultural Extension and Rural Development 3(3+0)

The purpose of this course is to give a 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 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: definition, objectives and importance
2. Types of education, Brief history/recent trends in agricultural extension
3. Organizational setup of agricultural extension in Pakistan
4. Rural development, its definition/concept, objectives, importance and indicators
5. Elements of rural development process
6. Rural development through agricultural extension work in Pakistan
7. Characteristics and problems of Pakistani farmers
8. Current issues and problems of rural development and extension work in Pakistan
9. Roles and duties of extension workers at various organizational levels
10. Extension programs and activities since 1947 to date in Pakistan
11. Role of communication and ICT in extension and rural development work
12. Principles of effective extension work
13. Adoption and diffusion of agricultural innovations
14. Agricultural technology and its application for Pakistani farmers
15. Extension, research and farmer's linkages
16. Basic concept of planning, monitoring and evaluation in agricultural extension

Recommended Texts

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

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: Discovery Publishing House.
3. Leeuwis, C., & Van den Ban, A. (2004). *Communication for rural Innovation: Rethinking Agricultural Extension* (3rd ed.). New Jersey: Wiley-Blackwell.

Academic writing is a formal, structured and sophisticated writing to fulfill the requirements for a 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. Bailey, S. (2011). *Academic writing: A handbook for international students* (3rd ed.). New York: Routledge.
2. 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.

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 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 course 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, J. A. (2004). *Pakistan's Political Economic and Diplomatic Dynamics*. Lahore: Kitabistan Paper Products.

Suggested Readings

1. Hayat, S. (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, I. (1998). *Pakistan: A Modern History*. London: Hurst and Company.

The course provides an overview of Genetics. Genetics is a field of biology that studies how traits are passed from parents to their offspring. The passing of traits from parents to offspring is known as heredity, therefore, genetics is the study of heredity. This introduction to genetics takes you through the basic components of genetics such as DNA, genes, chromosomes and genetic inheritance. Genetics is built around molecules called DNA. DNA molecules hold all the genetic information for an organism. It provides cells with the information they need to perform tasks that allow an organism to grow, survive and reproduce. A gene is one particular section of a DNA molecule that tells a cell to perform one specific task. Heredity is what makes children look like their parents. During reproduction, DNA is replicated and passed from a parent to their offspring. This inheritance of genetic material by offspring influences the appearance and behaviour of the offspring. The environment that an organism lives in can also influence how genes are expressed.

Contents

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

Practical

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

Recommended Texts

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

Suggested Readings

1. Khan, I.A., Azhar, F.M., Ali, Z., & Khan, A.A. (2008). *Solving Numerical Genetic Problems*. Faisalabad: University of Agriculture.
2. Singh, P. (2003). *Elements of Genetics* (2nd ed.). Delhi: Kalyani Publishers.
3. Stansfield, W.D. (1988). *Theory and Problems of Genetics* (4th ed.). New York: McGraw-Hill Book.

This course is aimed to make the students familiar with the basic information about the study of insects. 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. The course briefs about the basic external and internal morphological and anatomical features along with their basic functioning principles. Students will learn about the insect classification and nomenclature so that 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 students to further understand the ways and techniques adopted for the control and management of economically important insect pests.

Contents

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

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*. Hyderabad: Kashif Publications.
2. McGavin, G. C. (2001). *Essential entomology: an order-by-order introduction*. USA: Oxford University Press.

Suggested Readings

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

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. 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.

Contents

1. Introduction and 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: 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.
3. Ravichandra, N. G. (2013). *Fundamentals of plant pathology*. India: PHI Learning.
4. Windham, M. T., Trigiano, R. N., & Windham, A. S. (2003). *Plant pathology: concepts and laboratory exercises*. UK: Taylor and Francis.

Students will learn the fundamentals of plant structure and how cells, tissues, organs and whole plants develop and function. Students will then explore how environmental factors affect growth and development, and how humans manipulate them to produce horticultural crops: fruits, vegetables, flowers and landscape plants. Students will learn the division of horticulture and classification of horticultural plants as well as plant parts and their modifications. This course would help understand 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. Labs are designed to emphasize and reinforce the principles covered in lecture and will give students a hands-on introduction to horticulture.

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
5. Climate (temperature, light, humidity etc)
6. Soil (structure, texture, fertility etc)
7. 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 Carrol, L., Shry, J.R., & Reily, H.E. (2011). *Introductory Horticulture* (8th ed.) Albany: Delmar-Thomson Learning.
- 2 Christopher, E. P. (2012). *Introductory Horticulture*. New Delhi: Biotech books.

Suggested Reading

1. Hartmann, H.T., Kester, D.E., Davies, E.T., & Geneve, R.L. (2009). *Plant Propagation—Principles and Practices* (7th ed.). New Delhi: Prentice-Hall India Learning.
2. Peter, K.V. (2009). *Basics of Horticulture*. New Delhi: New India publishing Agency.

The course will introduce the students with 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 relationship with wildlife. The key objectives of this course are to introduce 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

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

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: Prentice Hall.
2. Quraishi, M. A. A., Khan, G.S., & 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. Quraishi, M.A.A., & Ishaque, M. (1995). *Practical Manual of Range Management*. Faisalabad: University of Agriculture.
3. Stoddard, L.A., Smith, A.D., & Box, T.W. (1975). *Range Management*. New York: McGraw Hill.

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 ed.). Boston: Addison Wesley Publishing.
2. Penson, J. B., Capps O., Rossen, C. P., & Woodward, R. (2013). *Introduction to Agricultural Economics* (5th ed.). New Jersey: Prentice Hall.

Suggested Readings

1. Cramer, G. L., Jensen, C. W., Southgate Jr., D. D. (2001). *Agricultural Economics and Agribusiness* (8th ed.). New Jersey: Wiley Publisher.
2. Mankiw, N. G. (2011). *Principles of Economics* (5th ed.). Mason: South-Western Cengage learning Publisher.
3. Penson, J. B., Capps, O., Rossen C. P., & Woodward, R. (2013). *Introduction to Agricultural Economics* (5th ed.). New Jersey: Prentice Hall.

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. Community engagement seeks to better engage the community to achieve long-term and sustainable outcomes, processes, relationships, discourse, decision-making, or implementation. 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.

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., Sewpaul, V., & Hole, G. O. (Eds.). (2013). *Participation in Community Work: International Perspectives*. New York: Routledge.

This course is designed to help understand the basis of plant breeding and the application of genetic principles for the improved heredity of plants. The objectives of the course include: 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? 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 principle of breeding self-pollinated crops as homozygosity. Students will also learn about comparative advantage of different breeding methods in terms of time required for breeding a crop variety and understand breeding methods in cross pollinated crops.

Contents

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
6. Development and evaluation of inbred lines
7. Development of hybrids, synthetic and composite populations
8. Breeding clonally propagated crops
9. 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* (5th ed.) Ames, USA: Iowa State University Press.
2. Chahal, G.S., & Gosal, S.S. (2003). *Principles and Procedures of Plant Breeding*. New Delhi: Narosa Publishing House.
3. Singh, B. D. (2003). *Plant Breeding: Principles and Methods*. New Delhi: Kalyani Publishers.

Suggested Readings

1. Singh, P. (2003). *Essentials of Plant Breeding*. New Delhi: Kalyani Publishers.
2. Khan, M.A. (Ed.). (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

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.

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.

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.

Contents

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: Elsevier Academic Press.
2. Chaube, H.S., & Singh, R. (2002). *Introductory Plant Pathology*. India: International Book.

Suggested Readings

1. Mehrotra, R.S., & Aggarwal, A. (2003). *Plant Pathology* (2nd ed.). India: Tata McGraw Hill Education.
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: Prentice-Hall India Learning.
2. Adams, C. R., Bamford, K.M., & Early, M. P. (2012). *Principles of Horticulture* (6th ed.). New York: Routledge.

Suggested Readings

1. Singh, B. (2007). *Horticulture at a Glance*. Ludhiana: Kalyani Publishers.
2. Pradeepkumar, T. (2008). *Management of horticultural crops* (Vol. 11). New Delhi: New India Publishing.
3. Yadav, P.K. (2007). *Fruit Production Technology*. Lucknow: International Book.

This is an introductory course which enables the students to understand the basics of food science and technology. Students will study 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. Students will explore and gain an understanding into the history of food science and the factors that have shaped food science in Pakistan, organizations involved in food manufacturing, food regulatory processes, food composition, its classification depending on sources, consumption pattern and basic analysis of food components.

Contents

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 Texts

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

Suggested Readings

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

This course is designed for undergraduate programs of agriculture sciences. The objective of this course is to impart basic and applied knowledge about statistics for collection, presentation, analysis and interpretations of data related to agriculture issues. After completing this course agriculture student will be able to understand the general concepts of basic statistics, to conduct agriculture surveys, to understand design of experiments, and other statistical tools. These statistical concepts are further will be helpful to complete a research related to agriculture sciences. Moreover, over students will also learn some statistical software such as Minitab, SPSS and Design Expert to improve their computational and analytical skills. Through this course, students will be able to understand and analyze the agricultural problems in field as well as in lab conditions.

Contents

1. Definition and importance of Statistics in Agriculture
2. Data, Different types of data and variables
3. Classification and Tabulation of data
4. Frequency distribution, Graphical representation of data
5. Measure of Central tendency and Measure of Dispersion.
6. Calculation of averages, Range, variance, Standard deviation, and coefficient of variation
7. Regression and Correlation Analysis: Simple and Multiple regression, correlation cases
8. Sampling and its types: Probability and non-Probability Sampling, Simple random sampling, stratified random sampling, Systematic sampling, Sampling and non-sampling error
9. Sampling distribution of mean and difference between two means
10. Inference Theory: Estimation and testing of hypothesis, Type-I and type-II error, testing of hypothesis about mean and difference between two means using Z-test and t-test, Paired t-test
11. Test of association of attributes using χ^2 (chi-square) Testing hypothesis about variance
12. ANOVA and its assumptions, One-way ANOVA, Two-way ANOVA

Recommended Texts

1. Muhammad, F. (2000). *Statistical methods and data analysis*. Pakistan: Ilmi Kitab Khana.
2. Rao, G. N. (2007). *Statistics for agricultural sciences* (2nd ed.). Hyderabad: 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. Crawshaw, J. & Chambers, J. A. (1994). *Concise course in A. level statistic with world examples*. USA: Springer.

The objective of this course is to familiarise students with basic principles and practices of fruit production, and physiology of fruit production. Students are expected to understand various stages of fruit plants phenology and physiology in order to solve related problems for fruits crops. After completing this course student will be able to grow and manage fruits 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. 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. 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 to fruit science, fruit-bud formation; initiation, development and controlling factors
2. Rest and dormancy
3. Plant growth regulators (PGRs) and their uses
4. Pollination and fruit setting problems, incompatibility, fruit thinning
5. Parthenocarpy and seedlessness, Bud variations and mutations
6. Physiological disorders; Fruit drop, Biennial bearing etc.; causes and control
7. Maturity and harvesting indices, harvesting methods, ripening and senescence

Practical

1. Identification of various developmental stages of buds, Fruit bearing habits
2. Training and pruning of important evergreen and deciduous fruit trees
3. Thinning of fruits, practices to control irregular bearing
4. Preparation of PGR solutions and their applications
5. Identification of phenological stages in fruit plants

Recommended Texts

1. Chottopadhyay, T.K. (2003). *A Textbook on Pomology, Vol. I: Fundamentals of Fruit Growing*. Ludhiana, New Delhi, India: Kalyani Publishers.
2. Chottopadhyay, T.K. (2000). *A Textbook on Pomology, Vol. II: Tropical Fruits*. Ludhiana, New Delhi, India: Kalyani Publishers.

Suggested Readings

1. Yadav, P.K. (2007). *Fruit Production Technology*. Lucknow, India: International Book.
2. Duggar, B.M. (2010). *Plant Physiology with Special Reference to Plant Production*. South Carolina, USA: BiblioLife.
3. Jackson, D.I., N.E. Looney, M.Morley-Bonker & G. Thiele. (2011). *Temperate and Subtropical Fruit Production*. Wallingford, UK: CAB International Publishing.

The objective of this course is to develop understanding among the students regarding principles and physiology of vegetable production. The production practices, common problems and their solutions. At the end students will be familiar with basic principles behind successful vegetable production on a commercial scale. Students will get theoretical as well as practical knowledge regarding the vegetables growing. They will become familiar with the common vegetables being grown in the country and can compare those with the vegetable grown internationally. Students will be able to diagnose problems with vegetable plants and can suggest possible solutions to the farmers. 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 and importance, Classification of vegetables, Cropping systems; succession, relay and multiple cropping etc.
2. Recent trends in vegetable production; off-season vegetable production, hydro and aero-ponics, organic farming
3. Factors affecting vegetable production, Bulb and tuber formation
4. Crop management and quality assurance; seed selection, nursery raising, hardening and transplanting, mulching, Pruning and staking, irrigation, harvesting etc.
5. Parthenocarpy and seedlessness
6. Physiological disorders, Production problems and their management
7. Use of plant growth regulators

Practical

1. Identification and description of flower, fruit and seed of important cultivars
2. Seed priming, Methods of sowing, Practice in raising nursery, hardening and transplanting of seedlings
3. Pruning and staking practices
4. Visits to vegetable farms

Recommended Texts

1. Kemble, J.M., Auburn, A.L., Meadows, I.M., Jennings, K.M., & Walgenbach, J.F. (2018). *Vegetable Ccrop Handbook*. USA: Southeastern Vegetable Extension Workers.
2. Dhaliwal, M. S. (2008). *Handbook of Vegetable Crops*. Ludhiana, New Delhi, India: Kalyani Publishers.

Suggested Readings

1. Hazra, P., & Som, M.G. (2005). *Vegetable Science*. Ludhiana, New Delhi: Kalyani Publishers.
2. Maynard, D.N., & G.J. Hochmuth. (2007). *Knott's Handbook of Vegetable Growers* (5th ed.). New York: John Willey and Sons.
3. Nonnecke, I.L. (2006). *Vegetable Production*. India: Springer Publishers.

The objective of this course is to provide knowledge of basic principles and physiology of ornamental crop production to the students of Horticulture. Students are expected to have knowledge of basic principles of ornamental crop production, and their utilization. Students will be familiar with the ornamental flowers being grown in the country and can compare those with the flowers grown in other flowers producing countries across the world. They will be able to identify problems of commercial flowers and will be able to suggest farmers about the problems. They will learn all the basic steps involved in commercial flower growing ranging from nursery growing till be harvest and postharvest and marketing of flowers. 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 and importance; present status and future scope
2. Raising techniques of annuals, flowering perennials, foliage plants, succulents and flowering bulbs with their propagation and crop management
3. Seed and bulb dormancy
4. Pruning, training and shaping
5. Use of growth regulators, Manipulation of growth and flowering
6. Concept of Bonsai and topiary, Outdoor and indoor decoration
7. Flower exhibition, Flower arrangements

Practical

1. Seeding, raising and transplanting of nursery
2. Identification of annuals, herbaceous perennials, foliage plants, succulents and flowering bulbs with their propagation methods and management practices (pinching, disbudding, deshooting etc.)
3. Methods of breaking seed and bulb dormancy
4. Visits to ornamental nurseries, parks, cut flower shops, flower exhibitions and growing structures

Recommended Texts

1. Arora, J. S. (2003). *Introductory Ornamental Horticulture* (4th ed.). New Delhi: Kalyani Publishers.
2. Dey, S.C. (2010). *Flowers from Bulbous Plants*. Jodhpur, India: Agribios.

Suggested Readings

1. Larson, R. A. (1980). *Introduction to Floriculture*. New York: Academic Press.
2. Laurie, A., Ries V. S. 2004. *Floriculture: Fundamentals and Practices*. Jodhpur, India: Agribios.
3. Hessayon, D. G. (2007). *The Flowering Shrubs Expert* (3rd ed.). London, UK: Trans-world Publishers.

The objective of this course is to impart technical knowledge about nursery management and certification procedures. Students will be able to manage nurseries and propagate healthy horticultural plants on a commercial scale. This course will help students to start their own business of nurseries as an enterprise. They will learn about the requirements of establishing a nursery, and all the basic steps required for nursery establishment. The selection of plants, growing and establishing and selling out those prepared plants. Nurseries offer a lucrative business and can be taken as an enterprise. This course will help students think and establish their own business, thus improving their livelihood. 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 and importance
2. Types of horticultural nurseries
3. Management practices (water, nutrient, weeds, diseases, insect-pests)
4. Protection against temperature extremities and radiation
5. Important nursery operations, Propagation methods and their importance
6. Rootstocks for horticultural plants, Raising of stock seedlings, Pre-sowing treatments of seeds; Apomixis and polyembryony
7. Stionic interactions, Graft compatibility and incompatibility
8. Use of growth regulators for propagation
9. Certification systems; standards, rules & regulation and procedures, Certification of planting material and nursery plants
10. Marketing of nursery plants

Practical

1. Raising of rootstocks, Identification of rootstocks for different fruit plants
2. Selection and preparation of bud wood
3. Practices in seed collection, seed treatment and propagation methods
4. Plant growing structures, media and mixtures
5. Media sterilization
6. Management of progeny plants
7. Virus indexing
8. Visit to germplasm units

Recommended Texts

1. Adriance, G.W., & Brison, F.R. (2000). *Propagation of Horticultural Plants*. Delhi, India: Biotech Books.
2. Hartmann, H.T., Kesterm, D. E. & Davies, F. T. (2011). *Plant propagation: principles and practices* (8th ed.). New Jersey, USA: Prentice Hall.

Suggested Readings

1. Rajan, S., & Markose, B.L. (2007). *Propagation of Horticultural Crops (Horticulture Science Series)*. New Delhi: New India Publishing Agency.
2. Ray, P. K. (2001). *Plant Nursery Management: How to Start and Operate a Plant Nursery*. Jodhpur, India: Scientific publishers.

3. Sharma, R. R. (2002). *Propagation of Horticultural Crops: Principles and Practices*. Ludhiana: Kalyani Publishers.

The objective of this course is to acquaint the students with modern techniques of plant multiplication. Students will understand the basic tissue culture techniques for in vitro propagation of horticultural crops and its commercial applications. Additionally, this course will help understand the basic requirements to establish a tissue culture laboratory. Students will be able to grow plants through tissue culture technology. They will be able to utilize these learnt techniques for their research work during higher learning. Students will be able to choose crops for tissue culture. They will be able to use tissue culture to solve problem related with horticultural crops propagation on a commercial scale. Taking this is 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 and importance
2. Basic terminology, application and constraints of plant tissue culture
3. Nutritional components of culture media (nutrients, carbohydrates, vitamins, growth regulators, amino acids and antibiotics), their types & functions
4. Aseptic techniques; Initiation and maintenance of cultures; Physical factors for growth; transplanting and acclimatization
5. Preparation of synthetic seed
6. Concepts of plant biotechnology and its role in improvement of horticultural crops

Practical

1. Laboratory safety precautions, sanitation, and introduction to equipment
2. Calculations (preparation of molar, percent, normal, ppm etc solutions)
3. Preparation of stock solutions & media
4. Sterilization techniques, inoculation and culture of explants
5. Acclimatization & transplanting

Recommended Texts

1. Hartmann, H.T., Kester, D.E., & Davies, F.T. (2011). *Plant propagation: principles and practices* (8th ed.). New Jersey, USA: Prentice Hall.
2. Lindsey, K. (Ed). 2007. *Plant Tissue Culture Manual*. Netherlands: Springer.

Suggested Readings

1. George, E. F., Hall, M. A., & Klerk, G. J. (2008). *Plant Propagation by Tissue Culture*. (3rd ed.). Dordrecht, Netherlands: Springer.
2. Razdan, M. K. (2003). *Introduction to Plant Tissue Culture*. USA: Science Publishers.
3. Scoggins, H., & Bridgen, M. (2014). *Plants from Test Tubes: An Introduction to Micro propagation* (4th ed.). New York: Tiber Press.

The world has embraced the largest revolution so far in the history of mankind called communication revolution. Everything has been tagged to communication. 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 development of leadership qualities among the masses of civil society. The aim of this course is to develop the communication and leadership skills among future extensionists. At the completion of this course, the students will be able to conceptualize the concepts communication process and demonstrate improved communication/leadership skills being used for agricultural technology dissemination among different stakeholders.

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*. Islamabad: NBF.

The objective of this course is to accustom students with production technology of major tropical and sub-tropical fruits of Pakistan. Student will be able to manage and produce important tropical and sub-tropical fruit crops. Students will become familiar with the tropical and sub-tropical fruits crops that can be grown, their climatic and cultural requirements. Students will learn the practical issues such as common diseases and insects attacking fruit crops and how those insects and diseases can be controlled in commercial fruit farming. Students will learn and the problems faced in fruit growing and their specific solutions. They will be able to grow and introduce/suggest new unexplored fruits to the farming community to help them uplift their economic status. 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. Classification of tropical and sub-tropical fruits
2. Cultivation with reference to acreage, production, botany, cultivars, rootstocks, propagation, climate, soil, cultural practices (water, nutrition, weeds, diseases, disorders and pest management) of major tropical and sub-tropical fruits of Pakistan
3. Maturity, ripening, harvesting, quality assurance and marketing of major tropical and sub-tropical fruits of Pakistan

Practical

1. Practices in fruit health management
2. Pollination in commercial fruits
3. Cost of production
4. Description and identification of commercial cultivars of important tropical and sub-tropical fruits.
5. Visit to research institutes and commercial orchards

Recommended Texts

1. Bali, S. S. (2003). *Fruit growing*. New Delhi: Kalyani Publishers.
2. Bose, T. K., & Mitra, S. K. (1990). *Fruits: Tropical and Subtropical*. Calcutta: Naya Prokash.

Suggested Readings

1. Paull, R. E., & Durate, O. (2012). *Tropical Fruits: Vol. II. Crop Production Science in Horticulture 24*. UK: CAB International.
2. Chottopadhyay, T. K. (Ed.) (2014). *A Textbook on Pomology, Vol: II. Tropical Fruits*. Ludhiana, New Delhi, India: Kalyani Publishers.
3. Yadav, P. K. (2007). *Fruit Production Technology*. Lucknow, India: International Book.

Vegetables are grown on a commercial scale across the country to fulfil the food requirement of masses. This course will accustom students with production technology of major summer vegetables of Pakistan. Students will be skilled in growing summer vegetables of the region. They will be able to manage and produce vegetable crops on a commercial scale. They will be familiar with the summer crops that can be grown in the country, their insects, pests and how these pests can be controlled on a commercial scale. Students will learn about vegetable ranging from nursery ranging till the harvesting of these vegetables. 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, importance and issues
2. Types of vegetable farming
3. Cultivation of summer vegetables with reference to their acreage
4. Production, botany, cultivars, climate, soil, cultural practices, maturity indices, harvesting, grading, packing, quality assurance, marketing, production problems, important weeds, and insect-pest management for summer vegetables
5. Diseases and their control for summer vegetables

Practical

1. Practice in raising of summer vegetables including mushrooms
2. Eradication of weeds and control measures of insects and diseases
3. Harvesting, grading and packing of vegetables
4. Economics of summer vegetable production
5. Visits to vegetable farms and markets

Recommended Texts

1. Kemble, J.M., Auburn, A.L., Meadows, I.M., Jennings, K.M., & Walgenbach, J.F. (2018). *Vegetable crop Handbook*. USA: Southeastern Vegetable Extension Workers.
2. Biswas, S., *Mushrooms: A Manual* .(2011) .Ngachan, S.V & ,M ,Datta *for Cultivation*. New Delhi, India: PHI learning.
3. Libner, N.S. (2006). *Vegetable Production*. New Delhi, India: Vedams Books.

Suggested Readings

1. Das, P. C. (2003). *Vegetable Crops of India*. New Delhi: Kalyani Publishers.
2. Decoteau, D. R. (2002). *Vegetable Crops*. New Delhi, India: Prentice-Hall of India.
3. Dhaliwal, M. S. (2008). *Handbook of Vegetable Crops*. Ludhiana, New Delhi, India: Kalyani Publishers.

The objective of this course is to provide the students with opportunity to combine science of horticulture and their creative abilities in provision of aesthetically beautiful and functional environment. Students will be able to prepare designs and manage landscape of various premises. By completing this course, student will be able to survey the location, design the landscape plan of a specific place and execute that plan to beautify the land. This course will help them understand the landscaping work thus they can contribute to beautify land in the country at various locations and can earn livelihood. This course will impart trust to the students on their creative abilities, and they will be able to utilize their skills. 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. Classification of landscape plants
2. Growth habits, foliage and flowering effects
3. Propagation and maintenance of important landscape plants and turf grasses
4. Introduction to landscape design, hardscape and softscape
5. Principles, elements and types of landscape
6. Suitability of various plants for different purposes and locations
7. Irrigation systems for different landscapes
8. Landscape planning, installation, maintenance, and budget estimation

Practical

1. Study of various soft and hard landscape designs
2. Aesthetic study of stem, branches, leaves, flowers and fruits
3. Mapping of landscape designs; Landscape designs for individual houses, municipal and national parks
4. Shaping of plants by pruning and training practices.
5. Visits to private and public landscape areas

Recommended Texts

1. Arora, J.S. (2003). *Introductory Ornamental Horticulture* (4th ed.). New Delhi: Kalyani Publishers.
2. Biondo, R.J., & Schroeder, C.B. (2006). *Introduction to Landscaping Design, Construction and Maintenance* (3rd ed.). Lucknow, India: International Book Distributing Company.

Suggested Readings

1. Vasanthakumar, K., & Bulti, M. (2017). *A handbook on floriculture and landscaping*. Oromia, Ethiopia: Haramaya University.
2. Bhattacharjee, S. K. (2004). *Landscape Gardening and Design with Plants*. Jaipur, India: Aavishkar Publishers.
3. Hessayon, D.G. (2007). *Expert Series (Garden Expert, DIY Expert, The Easy-Care Gardening Expert, The Rock and Water Garden Expert)*. London, UK: Transworld Publishers.

The objective of this course is to provide information about medicinal and aromatic values of different plants. Students will be able to identify and grow different condiments, spices and medicinal plants particularly belonging to horticultural crops. They will be able to manage and produce medicinal crops on a commercial scale. Students will become familiar with medicinal properties of different plants and herbs and how those plants or herbs may be used for medicinal purposes. Thus, they can guide growers and stakeholders to manage growing of those plants and earn profits. Medicinal plants offer an alternative to agronomic and fruits crops. Thus, these plants may be grown on a commercial scale. 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 important issues.

Contents

1. Importance of condiments, spices and medicinal plants
2. origin and habitat, classification and botany
3. Climatic requirements
4. Cultivation and production
5. Chemical and pharmacological properties
6. Products and their culinary and medicinal uses
7. Methods of plant collection and extraction
8. Processing, marketing and export potential

Practical

1. Identification, collection and description
2. Introduction, acclimatization and multiplication of economically important plants
3. Parts used and important ingredients
4. Processing and extraction methods
5. Visits to various herbal institutions, "Pansari" markets and herbal gardens

Recommended Texts

1. Bhattacharjee, S. K. (2009). *Handbook of Medicinal Plants*. India: Pointer Publishing.
2. Das, P. C. (2014). *Spice Crops Production Technology*. Jodhpur, India: Scientific publisher.

Suggested Readings

1. Joshi, S. G. (2000). *Medicinal Plants*. India: Oxford; IBH.
2. Farooqui, M.L. H. (2000). *Medicinal Plants of Prophet Muhammad (PBUH)*. Lukhnow; Sidrah Publishers.
3. Bimbraw, A. S. (2006). *Agrotechniques for umbelliferous medicinal and aromatic plants of India*. India: International Book.

The objective of this course is to equip students with the techniques to prolong shelf-life of perishable horticultural produce. Students will have the knowledge of produce physiology and its application to ensure quality and shelf life of horticultural crops such as fruits, vegetables and ornamentals. Students will become familiar with the basic concepts of postharvest handling, starting from the harvest, temporary storage, washing, waxing, drying, sorting and grading and packing. Students will learn about the packing and packaging materials, and storage, and types of stage. They will become familiar with the storage conditions for different fruits, vegetables and ornamental plants. 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 and importance
2. Pre- and post-harvest factors affecting quality
3. Climacteric and non-climacteric commodities
4. Indices of crop maturity / ripening, harvesting and pre-cooling
5. Curing and artificial ripening of horticultural commodities
6. Packing house operations; culling, grading, washing, cleaning, colouring, waxing and packaging of important horticultural commodities
7. Packing materials and containers
8. Storage; principles and types, storage life and factors determining it
9. International standards and quality assurance, sanitary and phyto-sanitary measures
10. Shipment for local and foreign markets

Practical

1. Machinery and equipment used for various operations
2. Demonstration of harvest indices
3. Practices in harvesting, curing, packing and preparation of different fruits, vegetables and cut flowers for marketing
4. Determination of total soluble solids
5. Determination of fruit firmness, starch-iodine test, color determination
6. Visits to the fruit, vegetable and floral markets, packing houses and cold storages etc.

Recommended Texts

1. Bhattacharjee, S. K., & De, L.C. (2005). *Post-Harvest Technology of Flowers and Ornamental Plants*. Jaipur India: Pointer Publishers.
2. Burg, P. S. (2004). *Post-harvest Physiology and Hypobaric Storage of Fresh Produce*. USA: CABI Publishing.

Suggested Readings

1. Choudhry, M. L., & Parsad, K. V. (2003). *Value Addition in Horticulture*. Delhi Agri-Horticultural Society. Pusa, New Delhi: Division of Floriculture and Landscaping, Indian Agricultural Research Institute.
2. Kader, A. A. (2002). *Postharvest Technology of Horticultural Crops*. California, USA: University of California Press.
3. Sadiq, M., Ahmed, J., Lobo, M. G., & Ozadali, F. (2012). *Tropical and Subtropical Fruits: Postharvest Physiology, Processing and Packaging*. New Jersey: Wiley-Blackwell Publisher.

The purpose of this course is to promote entrepreneurship and business management capabilities of horticultural graduates. Students will be able to establish and manage their own enterprise related with agriculture and horticulture. The typical business opportunity includes nurseries, garden centres, fruit and vegetable farms, establishment of import and export companies, food processing and preservation, etc. Students will learn about the requirement of import and export of horticultural commodities, and trading norms. Students will be able to understand regarding the trade agreements between the countries. Additionally, they will learn about the different standards and certification required to facilitate the business and process of getting certifications. 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 and importance of horticultural enterprise
2. Classified business management for fruits, vegetables and ornamental crops
3. National and international marketing channels
4. Market demand and quality control, Export prospects, Procedure/documentation for import and export
5. International standards and product handling for export
6. Processing industry and marketing of value-added commodities
7. Pricing, policy and market regulations
8. Global trade and Pakistan, W.T.O., Opportunities and challenges

Recommended Texts

1. Meena, R.K., & J. Yadev. (2001). *Horticulture Marketing and Post-harvest Management*. Jaipur, Rajasthan: Pointer Publisher.
2. Raju, M.S.S. (2002). *Fruit Marketing in India*. Delhi, India: Daya Publishing House.

Suggested Readings

1. Sharma, K, & Jagmohn, S. (1991). *Marketing Management of Horticultural Produce*. New Delhi, India: Deep & Deep Publications.
2. Labaste, P. (Ed). (2005). *The European Horticulture Market; Opportunities for Sub-Saharan African Exporters*. Washington, DC: The International Bank for Reconstruction and Development/ The World Bank.
3. Raju, M.S.S. (2002). *Fruit Marketing in India*. Delhi, India: Daya Publishing House.

The objective of this course is to develop ability of the students to identify and address the researchable problems in different areas of Horticulture. Students will be able to understand the problems, prepare research proposal and execute under field and laboratory conditions independently. Students will be able to identify researchable issues related with the horticultural crops. They will learn about the layout and execution of experimental trials, trials management, and data taking. They will learn the use of basic laboratory equipment. Additionally, they will learn what kind of parameters would be necessary regarding the nature of the research a trial. This learning would help students in higher studies. 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. Areas of research in Horticulture
2. Preparation of research proposal
3. Research methodology
4. Hypothesis and experimentation
5. Research parameters (morphological, physiological, bio-chemical, growth and yield characteristics)
6. Sampling and data collection
7. Data processing, tabulation, analysis and interpretation of result
8. Computer application, word processing, graphics and data analysis packages

Practical

1. Practices in field layout of experimental design
2. Sampling and data collection
3. Laboratory practices in physico-chemical analyses
4. Use of computer (word processing, data processing and graphics) in horticultural research

Recommended Texts

1. Lake, P., Benestad H. B., & Oslen, B. R. (2007). *Research Methodology in the Medical and ssAcademic pre* :San Diego, USA .*Biological Sciences*.
2. Quinn, G. P., & Keough, M. J. (2002). *Experimental Design and Data Analysis for Biologists*. Cambridge, UK: Cambridge University Press.

Suggested Readings

1. Mukul, G., & Deepa, M. J. (2011). *Research Methodology*. New Delhi, India: PHI Learning.
2. Singh, Y. K. (2006). *Fundamental of Research Methodology and Statistics*. New Delhi, India: New age international.
3. Pearce, S. C. (1976). *Field Experimentation with Fruit and Other Perennial Plants*. *Tech. Communication No. 23*. East Malling, Kent: Commonwealth Bureau of Horticulture and Plantation Crops.

Fruits are an excellent source of food contains high amount of water, vitamins and minerals. The objective of this course is to accustom students with production technology of major temperate fruits of Pakistan. Student will be able to manage and produce important temperate fruits. They will be familiar with the production practices for the temperate fruits. Students will be familiar about the temperate fruits, their growing practices, pests attacking the fruits and how these pests may be controlled using different techniques. Students will be able to grow temperate fruits on a commercial scale and guide farmers. There are several temperate fruits that are grown in other parts of the world but not grown in Pakistan. After completing this course, students will be able to recommend new fruit types to the growers. 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. Classification of temperate fruits
2. Cultivation with reference to acreage, production, botany, cultivars, rootstocks, propagation, climate, soil, cultural practices (water, nutrition, weeds, diseases, disorders and pest management)
3. Maturity, ripening, harvesting, quality assurance and marketing of major temperate fruits of Pakistan

Practical

1. Practices in fruit health management
2. Pollination in commercial fruits
3. Cost of production
4. Description and identification of commercial cultivars of important temperate fruits
5. Visit to research institutes and commercial orchards

Recommended Texts

1. Bali, S. S. (2003). *Fruit Growing*. New Delhi: Kalyani Publishers.
2. Bose, T.K., & Mitra, S. K. (1990). *Fruits: Tropical and Subtropical*. Calcutta : Naya Prokash.

Suggested Readings

1. Mitra, S. K., Rathore, D. S., & Bose, T.K. (1991). *Temperate Fruits*. Calcutta: Horticulture and Allied Publishers.
2. Barooh, S. (1998). *Modern Fruit Culture*. Ludhiana, New Delhi, India: Kalyani Publishers.
3. Chottopadhyay, T. K. (2009). *A Textbook on Pomology, Vol: IV. Temperate Fruits*. Ludhiana, New Delhi, India: Kalyani Publishers.

Vegetables are an important source of food, grown and utilized on a commercial scale. Vegetables are known as protective food as they contain high amount of water, vitamins, minerals and fibre. The purpose of this course is to familiarize students with production technology of major winter vegetables grown in Pakistan. Students will be skilled in growing winter vegetables of the region. Students will learn different steps involved in vegetable's production, starting from nursery raising, transplanting, cultural practices, insects and pests and their control methods. Students will be able to guide farming community to solve their issues related with vegetables growing. 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, importance and issues
2. Types of vegetable farming
3. Cultivation of winter vegetables with reference to their acreage, production, botany, cultivars, climate, soil, cultural practices, maturity indices, harvesting, grading, packing, quality assurance, marketing, production problems, important weeds, and insect-pest management of winter vegetables.
4. Diseases and their control

Practical

1. Practice in raising of winter vegetables including mushrooms
2. Eradication of weeds and control measures of insects and diseases
3. Harvesting, grading and packing of vegetables
4. Economics of winter vegetable production
5. Visits to vegetable farms and markets

Recommended Texts

1. Bose, T.K., Som, M.G., & Kabir, J. (1993). *Vegetable Crops*. Calcutta, India: Naya Prokash.
2. Biswas, S., New *Mushrooms: A Manual For Cultivation* .(S. V. (2011 ,Ngachan & ,M Datta Delhi, India: IPH Learning.

Suggested Readings

1. Libner, N.S. (2006). *Vegetable Production*. New Delhi, India: Vedams Books.
2. Rana, M.K. (2008). *Scientific Cultivation of Vegetables*. Ludhiana, New Delhi, India: Kalyani Publishers.
3. Decoteau, D.R. (2002). *Vegetable Crops*. New Delhi, India: Prentice-Hall of India.

Flower growing is of economic importance for the farmers. It provides livelihood to tens of thousands of people across the globe. The objective of this course is to accustom students with production technology of economically important flowers. Students will be able to grow commercially important flowers of the region. 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. Students will be able to identify the suitable flowering crops for a specific area and location. They will be able to guide farmers about the flowers growing and able to grow flowering crops as a business. They will learn about the common issues being faced during commercial flower production and how those issues may be solved using different techniques.

Contents

1. Introduction and importance
2. Overview of world flower trade
3. Economics and feasibility
4. Environmental simulation
5. Climate and soils, propagation, crop management practices, harvesting, postharvest handling and marketing of important floral crops such as amaryllis, anemone, calendula, carnation, chrysanthemum, crocus, dahlia, freesia, geranium, gerbera, gladiolus, gypsophylla, iris, liliun, marigold, narcissus, nemesia, orchid, poinsettia, roses, stock, sweet pea, snapdragon, statice, tulip, tuberose, and zinnia

Practical

1. Identification, nursery raising, planting, cultural operations, harvesting and packing of important flowers for marketing
2. Visits of production areas and floral markets

Recommended Texts

1. Armitage, A. M., & Laushman, J.M. (2003). *Specialty Cut Flowers* (2nd ed.). Windsor, Australia: Timber Press.
2. Bose, T.K., Yadav, L.P., Pal, P., Parthasarathy, V.A., & Das, P. (2003). *Commercial Flowers* (2nd ed.). Calcutta, India: Naya Udyog.

Suggested Readings

1. Banerjee, U. (2001). *Commercial Flower Production*. Jaipur, India: Mangal Deep Publications.
2. Prasad, S., & Kumar, U. (2005). *Commercial Floriculture*. Jodhpur, India: Agrobios.
3. Dole, J.M., & Wilkins, H.F. (1999). *Floriculture: Principles and Species*. USA: Ball Publishing.

The objective of this course is to teach breeding methods for improvement of horticultural crops for specific objectives such as quality and yields. Students will be able to conduct breeding procedures independently. They will become familiar with the breeding techniques and can use those techniques during their higher learning and research work. They will be able to contribute in the seed sector that is comparatively poor for horticultural crops such as seasonal vegetables and ornamentals across the country. Students will learn different advance approaches involved in crop improvement programs such as somatic embryogenesis, mutagenesis, and marker assisted selection and genetic engineering. 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. Principles of plant breeding
2. Reproductive systems in horticultural crops
3. Self-incompatibility and male sterility; centres of origin, sources of genetic variability
4. Cytological basis of breeding
5. Heterosis, Theories of heterosis
6. Inbreeding depression, Apomixes, Role of mutation and polyploidy in breeding
7. Somatic selection and chimeras
8. Breeding objective, Methods of breeding of self- and cross-pollinated crops
9. Crop improvement and cultivars development, Somaclonal variations
10. Germplasm conservation, Concept of genetic manipulation and transgenic plants

Practical

1. Description of flowers of important fruits, vegetables and ornamentals
2. Emasculation, selfing and crossing techniques
3. Polyembryony tests. Pollen viability tests
4. Inducing polyploidy by chemicals

Recommended Texts

1. Fageria, M.S., Arya, P.S., & Choudhary, A.K. (2000). *Vegetable Crops (Vol. 1): Breeding and Seed Production*. Ludhiana, New Delhi, India: Kalyani Publisher.
2. Bassett, M.J. (1986). *Breeding Vegetable Crops*. Westport, Connecticut: Avi Publishing.

Suggested Readings

1. Shukla, A.K., Shukla, A.K., & Vashishtha, B.B. (2004). *Fruit Breeding: Approaches and Achievements*. Lucknow, India: International Book Distributing.
2. Singh, A.P. (2003). *Vegetable Breeding and Seed Production* (1st ed.). Ludhiana, New Delhi, India: Kalyani Publisher.
3. Ram, H.H. (2005). *Vegetable Breeding, Principles and Practices*. Ludhiana, New Delhi, India: Kalyani Publisher.

The purpose of this course is to develop ability of the students to identify and plan research projects in different areas of horticulture and write their reports. The identification of a researchable is a key step for further working. Thus, students will be particularly trained in this aspect using examples of different researchable issues. Students will be able to plan and execute experiments along with scientific report writing, and research article writing. Students will learn data analysis, significance and scientific write up pattern. Students will learn about the different styles of citing literature and referencing. This course would help them during their higher learning and subsequent research work. 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 by doing research work.

Contents

1. Concept of research, Identification of research problem
2. Planning and essential of research plan
3. Scientific method and experiment
4. Steps in experimentation
5. Writing of research proposal
6. Layout of field experiments
7. Observation of field trials, Measurement of crop growth and yield, Collection, tabulation and analysis of data
8. Measures of experimental variability, Interpretation of data
9. Writing and summarizing of scientific paper, report and thesis

Practical

1. Preparation of research proposal
2. Layout of field experiments
3. Collection and tabulation of data
4. Analysis of data
5. Presentation of data in tables, curves, histograms etc, processing and interpretation
6. Writing of scientific paper

Recommended Texts

1. Awan, J.A. (2003). *Scientific Presentation*. Faisalabad, Pakistan: Uni-tech Communication.
2. Micheal, J.K. (2009). *From Research to manuscript: A guide to scientific writing*. Berlin, Germany: Springer-Verlag.

Suggested Readings

1. Robert, A.D. (2006). *How to write and publish a scientific paper* (6th ed.). Westport, Connecticut, USA: Greenwood Press.
2. Shahzad, W. (2002). *Synopsis and thesis manual* (1st ed.). Rawalpindi: National University of Sciences & Technology.
3. Mathews, J.R., Brown, J.M., & Mathews, R.W. (2000). *Successful Scientific Writing: A Step-by-Step Guide for Bio-Medical Scientists* (2nd ed.). Cambridge, UK: Cambridge University Press,

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., UhI, J.N. & Hurt, C. (2007). *Marketing of Agricultural Products*, (10th ed.). New Jersey: Prentice Hall.
2. Salvatore, D. (2007). *International economics*, (9th ed.). Hoboken, New Jersey: Wiley Publisher.

Suggested Readings

1. Hoekman, B. M., Mattoo, A., & English, P. (2002). *Development, Trade and the WTO-A Handbook*. Washington, DC: The World Bank.
2. Downey, W.D., & Erickson, S. P. (2002). *Agribusiness Management*. Singapore: McGraw Hill Education.

Seed production is a key step for the successful growing of any horticultural crop in the country. The purpose of this course is to provide technical knowledge about pure and hybrid seed production of horticultural crops. Students will be able to produce pure and hybrid seed of important vegetables and flowers. Students will be able to identify suitable crops for seed production. They will learn techniques of seed production, procurement and storage. Students will learn about the testing and monitoring quality of seeds. They can utilise learnt knowledge to start seed business or can serve in the public and private seed sector. 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 and importance
2. Principles of seed production
3. Seed classes, Pre-basic, basic, certified and approved seed
4. Reproductive systems, modes of pollination and seed production
5. Pure and hybrid seed production
6. Methods and procedures for seed production of important vegetables and flowers
7. Seed handling technology, Seed testing, Packing and storage
8. Seed certification and registration

Practical

1. Pollination techniques
2. Maintenance of self- and cross-pollinated lines
3. Methods of seed collection, cleaning, grading, desiccation, treatments and storage
4. Seed testing and packing techniques

Recommended Texts

1. Desai, B.B., Kotecha, P.M., & Salunkhe, D.K. (1997). *Seeds Handbook – Biology, Production, Processing and Storage*. New York: Marcel Dekker.
2. McDonald, M.B., & Copeland, L.O. (1998). *Seed Production – Principles and Practices*. New Delhi: CBS Publishers.

Suggested Readings

1. Singh, A.P. (1999). *Vegetable Seed Production Principles* (1st ed.). Ludhiana, New Delhi, India: Kalyani Publisher,
2. Khare, D., & M.S. Bhale. (2005). *Seed Technology*. New Delhi, India: Scientific Publishers.
3. Singh, P., & Asati, B.S. (2008). *Seed Production Technology of Vegetables*. Delhi, India: Daya Publishing Home.

The purpose of this course is to make student familiar with modern technology for production of high-quality horticultural commodities round the year. Students will learn about the selection of suitable plants to be grown under protected environment. They will learn about the environmental controls, impact of supplemental light and carbon dioxide on the growth, yield and quality of produce. Students will learn about the nutritional management of plants grown under protected environment. They will learn the techniques to supply nutrients to the growing plants. Students will be able to produce various important horticultural crops particularly vegetables and small fruits under controlled environmental conditions. 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 and economic importance
2. Different structures and their construction
3. Selection of site and orientation
4. Environment control and maintenance
5. Seed and nursery raising
6. Crops/cultivars suitable for forcing
7. Production technology of different crops
8. Soilless culture, Media, Soil mixtures, containers, nutrient management and irrigation systems
9. Pruning, training and staking, Insects, diseases, disorders and problem management
10. Economics of protected and conventional production

Practical

1. Structural demonstration of greenhouses, plastic tunnels and other types
2. Study of environmental control systems
3. Preparation of growing media
4. Tools and types of containers, Raising of crops
5. Pruning, training and staking techniques, pests and diseases management
6. Visits to commercial greenhouses and plastic tunnels

Recommended Texts

1. Abbasi, N.A., & Habib, U. (2008). *Protected Horticulture*. Rawalpindi, Pakistan: Dept. of Horticulture, PMAS-Arid Agriculture University.
2. Arunkumar, R., Vijayalatha, K.R., Kannan, K., Thirumalmurugan, V., Latha, K., & Kumar, S.N. (2008). *Innovative Horticulture*. New Dehli, India: New India publishing Agency.

Suggested Readings

1. Manohar, K.R. & Igathinathane, C. (2007). *Greenhouse Technology and Management* (2nd ed.). Hyderabad, India: BS Publications.
2. Prasad, K., & Kumar, U. (2005). *Greenhouse Management for Horticultural Crops* (2nd ed.). Jodhpur, India: Agrobios.
3. Resh, H.M. (1989). *Hydroponic Food Production*. Santabarbara, California, USA: Woodbridge Press Publishing.

The purpose of this course is to impart knowledge about Interiorscaping by using foliage plants inside the building for making the environment pleasing. Interiorscaping is getting popularity and is indispensable particularly high-rise buildings and business centres. Plants help purify indoor environment by increasing the level of oxygen and absorbing pollutants. Students will be able to identify the suitable plants for growing in indoor environment considering client's requirements. Students will be able to manage indoor/house plants for Interiorscaping. They will be able to identify the problems faced by plants under indoor conditions because there is low light availability and the air quality is also not up the mark. Students can use the learnt knowledge and provide professional service to the companies and real estate sector. Taking is 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 and importance
2. Environmental requirements: light, temperature, humidity and moisture
3. Air pollutants and other hazards in growing indoor plants
4. Cultural requirements
5. Production of flowering and foliage plants for shade and semi-shade area
6. Growing media; essential nutrients, watering, pests and diseases
7. Acclimatization and management practices for important indoor plants
8. Decorative and functional uses of indoor plants
9. Principles and guidelines for Interiorscaping
10. Planters, Terrarium and other scaping types

Practical

1. Identification of indoor plants
2. Practices in propagation, watering and nutrient management, preparation of soil mixtures, potting and re-potting
3. Diagnosis of problems and solutions
4. Visits of nurseries and garden centres

Recommended Texts

1. Dole, J.M., & Wilkins, H.F. (1999). *Floriculture: Principles and Species*. USA: Ball Publishing.
2. Hessayon, D.G. (2007). *House Plant Expert*. London, UK: Transworld Publishers.

Suggested Readings

1. Hessayon, D.G. (2007). *Indoor Plant Spotter*. London, UK: Transworld Publishers.
2. Davidson, W. (1991). *House Plants*. London: Tiger Books International.
3. Zachos, E. (2005). *Tempting Tropical: 175 Irresistible Indoor Plants*. Portland, Oregon: Timber Press.

Training of the student in study and evaluation of problems of horticultural industry and to find their solutions through research is the key objective of this important course. Students must be able to identify problems, conduct independent research work, sampling and data collection, analysis of the data and write the report. Alternatively, if students go to the private or public sector to get practical training during the internship period, they will be able to learn about the different sectors involved in horticulture industry such as seed sector, fertilizer sector, pesticide sector, commercial farms and research institutions. Taking this course would broaden the vision of students regarding the horticulture industry at domestic and international level. Students will be able to identify existing gaps and will be trained to solve those important issues.

Practical

1. Identification of research problem.
2. Consulting the relevant literature.
3. Planning and essentials of research plan.
4. Execution of project; data collection, analysis, formulation of tables & figures and interpretation of results & discussion, conclusion, recommendations.
5. Report writing, submission and presentation.

Recommended Texts

1. Anonymous. (1999). *Instructions to Authors*. Alexandria, Virginia: Amer. Soc. HORT- Sci.
2. Day, R.A. (1983). *How to write and publish a scientific paper* (2nd ed.). Philadelphia: ISI Press.

Suggested Readings

1. Petersen, R.G. (1994). *Agricultural Field Experiments—Design and Analysis*. New York: Marcel Dekker.
2. Mukul, G. (2011). *Research Methodology*. New Delhi, India: PHI Learning.
3. Singh, Y. K. (2006). *Fundamental of Research Methodology and Statistics*. New Delhi, India: New age international.



MSc
(Hons)
HORTICULTURE

The aim of this course is to develop understanding among students about role of nutrients, their uptake and utilization in horticultural crops. In addition to water, sunlight, and carbon dioxide from the air, plants require 13 mineral nutrients that are typically derived from the soil. The macronutrients nitrogen (N), phosphorus (P), potassium (K) are needed by plants in relatively large amounts and often have to be added to the soil. Intermediate amounts of secondary nutrients magnesium (Mg), calcium (Ca), and sulfur (S) are needed by plants. Trace or micronutrients [boron (B), chlorine (Cl), copper (Cu), iron (Fe), manganese (Mn), molybdenum (Mo) and zinc (Zn)] are needed in small amounts. Nutrition has important role for the production, yield and quality of horticultural crop. The students will be able to diagnose specific nutrient deficiency and toxicity symptoms and suggest their remedies.

Contents

1. Nutrient elements in plants and their classification
2. Criteria of essentiality and role of mineral nutrients in plants
3. Requirements and plant composition
4. Mechanism and factors affecting absorption and translocation of nutrients
5. Ion interactions
6. Nutrient concepts
7. Methods for evaluation of nutrients and their application
8. Deficiencies and toxicities
9. Growth yield and quality as affected by nutrient status

Practical

1. Relevant field and laboratory studies
2. Survey for deficiency/toxicity symptoms (Identification and sample collection) of fruits, vegetables and ornamental plants
3. Techniques for evaluations of nutrients
4. Practice of nutrient application (spreading, dressing, foliar application, fertigation etc.), Visit of nutrient analytical laboratories

Recommended Texts

1. Alloway, B. J. (2008). *Micronutrient Deficiencies in Global Crop Production*. UK: CPL Scientific Publishing.
2. Emanuel E., & Arnold. J.B. (2005). *Mineral Nutrition of Plants: Principles and Perspectives*. Sunderland, USA: Academic Press.

Suggested Readings

1. Mengel, K., & Kirkby, E.A. (2001). *Principles of Plant Nutrition*. Bern, Switzerland: International Potash Institute.
2. Kumar, D.D. (2000). *Micronutrients-Their Behaviour in Soil and Plants*. New Delhi: Kalyani Publisher.
3. Allen, V.B., & Pilbeam, D.J. (2007). *Handbook of Plant Nutrition*. Boca Raton, Florida: CRC Somerset Press.

The objective of this course is to acquaint students with modern techniques of plant multiplication. Students will understand the basic tissue culture techniques for in vitro propagation of horticultural crops and its commercial applications. Additionally, this course will help understand the basic requirements to establish a tissue culture laboratory. Students will be able to grow plants through tissue culture technology. They will be able to utilize these learnt techniques for their research work during higher learning. Students will be able to choose crops for tissue culture. They will be able to use tissue culture to solve problem related with horticultural crops propagation on a commercial scale. Taking this is 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 and importance
2. Tissue culture media, Asepsis
3. Types of culture (organ, callus, cell suspension, protoplast culture etc.)
4. Types of regeneration (Callogenesis, organogenesis and embryogenesis), Micro-propagation, micro-grafting
5. Synthetic seed technology, indexing of tissue cultured plants for pathogens
6. Physiology and anatomy of tissue cultured plants
7. Germplasm conservation, Secondary plant products

Practical

1. Laboratory equipment and supplies
2. Stock solutions and media preparation
3. Maintenance of asepsis
4. Different types of explants culture (shoot-tip, nodal segments, leaf disks, embryo, ovule, anther/pollen, callus, cell suspension
5. Protoplast fusion, Plantlet regeneration)
6. *In vitro* grafting, Production and testing of virus free plants
7. Transfer of plantlets from tissue culture to greenhouse and field
8. Preparation of synthetic seeds
9. Visits to tissue culture laboratories

Recommended Texts

1. Kumar, U. (2005). *Methods in Plant Tissue Culture*. Jodhpur, India: Agrobios.
2. Lindsey, K. (2007). *Plant Tissue Culture Manual*. New Delhi, India.: Springer – Kluwer Academic Publishers.

Suggested Readings

1. Kumar, B. (2014). *Culture of Plant Cells, Tissues and Organs*. New Delhi, India: Random Publications.
2. Scoggins, H., & M. Bridgen. (2014). *Plants from Test Tubes: An Introduction to Micro propagation* (4th ed.). New York: Tiber Press.

The objective of this course is to familiarise students with basic principles and practices of horticultural crop production. Students are expected to understand various stages of fruit plants phenology and physiology in order to solve related problems for fruits crops. After completing this course student will be able to grow and manage fruits crops successfully on a commercial scale. This course would help understand students regarding the key phenomena related with minor fruits such as soil and climatic requirements, propagation and cultural practices as well as physiological problems such as incompatibility, fruits set, and biennial bearing. 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. Taking this course would broaden their vision regarding the horticulture industry at domestic and international level.

Contents

1. Introduction, importance, present status and future scope
2. Soil and climatic requirements
3. Propagation
4. Cultural operations
5. Harvesting, processing and marketing of following crops: oil palm, jojoba, amla, avocado, pecans, hazel nut, jack fruit, cashew nut, kiwi fruit, kionda, tea, saffron, leek, celery, asparagus, and Brussel's sprout etc.

Practical

1. Identification of plants
2. Propagation, raising of nursery
3. Management practices
4. Harvesting and handling

Recommended Texts

1. Bose, T.K., & S.K. Mitra. (1990). *Fruits: Tropical and Subtropical*. Calcutta: Naya Prokash.
2. Mazumdar, B.C. (2004). *Minor Fruit crops of India: Tropical and Subtropical*. India: Daya Publishing.

Suggested Readings

1. Singh, A.P. (2002). *Vegetable Growing in India*. New Delhi: Kalyani Publisher.
2. Das, P.C. (2003). *Vegetable Crops of India*. New Delhi: Kalyani Publisher.
3. Das, B.C., & Das, S. N. (2000). *Cultivation of Minor Fruits*. New Delhi: Kalyani Publisher.

Rootstocks play a crucial role in determining orchard efficiency in fruit crops. Combining the desirable attributes of two different plants by budding or grafting can produce different growth effects. The effect of rootstock on fruit quality in terms of physical traits and internal chemical compositions is well demonstrated in temperate fruit crops (Apple, Pears, Cherry etc.) as compared to tropical and subtropical fruit crops. This difference can be illustrated by comparing the relative importance of rootstocks for precocity, yield, and tree size control, and through contrasts in annual phenological cycles, fruit respiratory behavior, crop load and canopy management techniques. But these effects on physiological, biochemical and molecular fronts are still not understood. The course will make students familiar with various rootstocks and stionic interaction in horticultural crops.

Contents

1. Introduction and importance
2. Types of rootstocks, Role of rootstocks in fruits and ornamental plants
3. Factors affecting stock-scion relationship
4. Compatibility and incompatibility, types and their impact on rootstock efficiency
5. Rootstock adaptability under various soils and climatic conditions
6. Rootstock of major fruits and ornamental plants in relation to vigor, quality, longevity, fruitfulness and resistance to drought, salinity, pest and diseases
7. Improvement of rootstocks in changing climate scenario
8. Role of rootstocks in high density plantation

Practical

1. Identification, selection and multiplication of important rootstocks
2. Identification of different types of incompatibility
3. Survey of rootstocks used in various commercial gardens, research stations and plant nurseries

Recommended Texts

1. Adriance, G.W., & Brison, F.R. (2000). *Propagation of Horticultural Plants*. Delhi, India: Biotech Books.
2. Hartmann, H.T., Kester, D.E., Davies, E.T., & Geneve, R.L. (2009). *Plant Propagation: Principles and Practices* (7th ed.). New Delhi, India: Prentice-Hall India Learning.

Suggested Readings

1. Rajan, S., & Markose, P.L. (2007). *Propagation of Horticultural Crops*. India: New India Publishing Agency.
2. Sharma, R.R. (2002). *Propagation of Horticultural Crops: Principles and Practices*. Ludhiana, New Delhi, India: Kalyani Publishers.
3. Sharma, R.R., & Srivastav, M. (2004). *Plant Propagation and Nursery management*. Lucknow, India: International Book.

This course is very important for citrus growing region such as Sargodha. Citrus is a major fruit crop of Sargodha as well as Pakistan. All the processing units are established in Sargodha. This course will help students to identify the key issues being faced by the growers such as alternate bearing, fruit drop, unfruitfulness and possible options to control these issues using different approaches. 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. This course will help students to identify the key issues being faced by the citrus industry of Pakistan and possible options to control these issues using different approaches. The course will inculcate awareness of scientific knowledge about citrus fruits and induce aptitude of research.

Contents

1. Introduction; Present status and future prospects, history and species concept
2. Botany; Pomological classification; Phenology
3. Mineral nutrition; Rootstocks; Spacing of trees
4. Water relations
5. Pests, disease and weed control
6. Pre and Post -harvest physiology
7. Production problems (decline, alternate bearing, fruit drop and unfruitfulness) and export issues
8. Varietal improvement
9. Modern trends in Citriculture
10. Measures for the improvement of Citrus Industry in Pakistan

Practical

1. Morphological studies of flowers, leaves and fruits of different citrus species and their varieties
2. Identification of different physiological disorders
3. Diagnosing various nutritional deficiencies
4. Insects and diseases effect
5. Crossing for inter- and intra-specific hybridization

Recommended Texts

1. Albrigo, L.G., Timmer, L.W., & Rogers, M.E. (2014). *Citrus, Vol: II. Crop Production Science in Horticulture*. Wallingford, UK: Centre for Agriculture and Bioscience International.
2. Davies, F.S., & Albrigo, L.G. (2003). *Citrus Fruits*. Wallingford, UK: CAB International.

Suggested Readings

1. Mukhopadhyay, S. (2004). *Citrus Production, Postharvest, Diseases and Pest Management*. New Delhi, India: Oxford and IBH Publishing.
2. Khan, I. (2007). *Citrus Genetics, Breeding and Biotechnology*. CAB International, London, UK.
3. Singh, S., Shivanker, V.J., Srivastava, A.K., & Singh, I.P. (2004). *Advances in Citriculture*. New Delhi, India: Jagmander Book Agency.

Mango and date palm are two major fruit crop of Pakistan. Both fruits are growing in tropical and sub-tropical area of Pakistan. Mango and date palm also have postharvest issues. However, Pakistan is the largest producer of mango and Date palm. To equip the students with scientific knowledge about the most important fruits of the region. 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. This course will help students to identify the key issues being faced mango and date palm industry of Pakistan and possible options to control these issues using different approaches. Students will be able to identify existing gaps and will be trained to solve those issues.

Contents

1. History and distribution; Importance
2. Present status and future prospects
3. Botany, classification, phenology, climate and environments
4. Vegetative and reproductive physiology
5. Orchards management operations and practices
6. Curing and post-harvest handling
7. Post-harvest chemistry and physiology
8. Physico-chemical changes
9. Production problems and disorders
10. Export issues

Practical

1. Identification of different varieties of mango and date palm
2. Fruit description Propagation techniques
3. Date palm pollination
4. Maturity indices and Curing of mango and date palm
5. Preparation for export market

Recommended Texts

1. Singh, H.S., Nath, V., Singh, A., & Mandal, S. (2008). *Mango: Preventive Practices and Curative Measures*. Delhi, India: Satish Serial Publishing House.
2. Yadav, P.K. (2007). *Fruit Production Technology*. Lucknow, India: International Book.

Suggested Readings

1. Srivastava, R.P. (1998). *Mango Cultivation*. Lucknow, India: International Book.
2. Litz, R.E. (2009). *The Mango: Botany, Production and Uses* (2nd ed.). Wallingford, UK: CAB International.
3. Ahmad, S. (2004). *Mangoes in Pakistan*. Islamabad: The Horticultural Foundation of Pakistan.

The objective of this course is to familiarize students with production technology of minor fruits of Pakistan. There are many minor fruits of Pakistan such as ber, berries, chiku, coconut, custard apple, fig, falsa, jaman, loquat, mulberry, olive, papaya, pecan pineapple and quince etc. Pakistan has great potential of these fruits, but we have to focus on these fruits. By taking this course, students will become familiar with the minor fruits of Pakistan that can be grown, their climatic and cultural requirements. They will be able to grow and introduce/suggest new unexplored fruits to the farming community to help them uplift their economic status. 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 and importance
2. Acreage, production, botany
3. Composition and uses
4. Climate, soil, propagation, rootstocks, cultural practices, cultivars
5. Important insect-pests and diseases
6. Harvesting, post-harvest handling and marketing of fruits such as ber, berries, chiku, coconut, custard apple, fig, falsa, jaman, loquat, mulberry, olive, papaya, pecan pineapple and quince etc.

Practical

1. Identification of minor fruit plants and their fruits
2. Layout systems
3. Propagation methods
4. Pruning, harvesting and handling techniques

Recommended Texts

1. Alford, D.V. (2007). *Pests of Fruit Crops*. Delhi, India: Manson Publishing.
2. Das, D.C., & Das, S.N. (2006). *Cultivation of Minor Fruits*. Ludhiana, New Delhi, India: Kalyani Publishers.

Suggested Readings

1. Philip, S. (2002). *Fruit Crops*. Ludhiana, New Delhi, India: Kalyani Publishers.
2. Singh, S.P. (2005). *Commercial Fruits*. Ludhiana, New Delhi, India: Kalyani Publishers.
3. Steferud, A. (2005). *Diseases of Fruits and Nuts*. Delhi, India: Publisher Biotech Books.

The objective of this course is to develop understanding among the students regarding principles and physiology of Solanaceous vegetables production. The production practices, common problems and their solutions. At the end students will be familiar with basic principles behind successful vegetable production on a commercial scale. Students will get theoretical as well as practical knowledge regarding the vegetables growing. They will become familiar with the common vegetables being grown in the country and can compare those with the vegetable grown internationally. Students will be able to diagnose problems with vegetable plants and can suggest possible solutions to the farmers. 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, Botany
2. Classification
3. Centers of origin
4. Distribution in the world
5. Physiology
6. Nursery raising and crop establishment
7. Production problems
8. Seed production and supply of certified seed
9. Breeding and improvement of the following crops: potato, tomato, brinjal (aubergine), chilies and peppers

Practical

1. Morphology
2. Identification and handling of the seed materials
3. Seed diseases
4. Planting methods
5. Varietal evaluation
6. In vitro pre-basic seed production

Recommended Texts

1. Rai N., & Yadav, D.S. (2005). *Advances in Vegetable Production*. New Delhi: Research Co. Book Centre.
2. Singh, D.K. (2007). *Modern Vegetable Varieties and Production Technology*. Lucknow, India: International Book.

Suggested Readings

1. Razdan, M.K. & Mattoo, A. K. (2005). *Genetic Improvement of Solanaceous Crops. Vol. 1: Potato*. Enfield, NH: Science Publishers.
2. Razdan, M.K. & Mattoo, A. K. (2006). *Genetic Improvement of Solanaceous Crops, Vol. 2: Tomato*. Enfield, NH: Science Publishers.
3. Libner, N.S. (2006). *Vegetable Production*. New Delhi, India: Vedams Books.

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, develop writing skills, enhance time management and organizing skills. The special problem makes you do your work by prioritizing the needs and time frames completing all your tasks peacefully avoiding panic. Special problem writing work provides students a lot of scope to improve themselves.

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 an 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.

Spice means any dried, fragrant, aromatic or pungent, edible vegetable or plant substance, in the whole, broken or ground form, which contributes flavor; whose primary function in food is seasoning rather than nutrition, and which may contribute relish or piquancy to foods or beverages that is true to name, and from which no portion of any volatile oil or other flavoring principle has been purposely removed, or which no additive or spent spice has been added. Spices may be either the dried, bark, buds, bulbs, flowers, fruit, leaves, rhizome, roots, seeds, stigmas and styles or the entire plant tops. To create awareness of the potential spices and condiments in our daily life, this course will help students to identify the key issues being faced by the growers of condiments and spices as well as possible options to control these issues using different approaches. Taking this course would broaden their vision regarding the condiments and spices industry at domestic and international level.

Contents

1. Introduction and importance
2. Individual condiment and spices (History, distribution, cultivation, diseases, pests, improvement)
3. Products and end use
4. Processing and manufacturing
5. Standard specification, production
6. Trade and marketing of following condiments and spices: Chilies, coriander, garlic, ginger, mint, onion, tamarind, turmeric, black pepper, cardamom, cinnamon, clove, cumins etc.

Practical

1. Identification, cultivation
2. harvesting, drying, cleaning, processing and storage of spices
3. Visits to relevant markets and Spices manufacturing units

Recommended Texts

1. Shanmughavelu, K.G., Kumar, N., & Peter, K.V. (2005). *Production Technology of Spices and Plantation Crops*. India: Agrobios Publishers.
2. Das, P.C. (2014). *Spice Crops Production Technology*. Jodhpur, India: Scientific publisher.

Suggested Readings

1. Paul W, B., & Votava, E. J. (2012). *Peppers: Vegetable and spice capsicum*. Wallingford, UK: CAB International.
2. Serdar, O. & Milan, M. (2007). *Medicinal and Aromatic Crops*. New York: Haworth Food & Agric. Products Press.
3. Bogers, R.J., Craker, L.E., & Lange, D. (2006). *Medicinal and Aromatic Plants*. New York: Haworth Food & Agric. Products Press.

The mushroom industry world-wide currently has a turnover of £3,000 million. This industry is by far the most economically important industry based on a solid-state fermentation. This industry is also developing in Pakistan. We need to introduce this industry to our farmers, processor and producers and impart knowledge about the mushrooms and develop skills about production technology of commercially important mushrooms. Mushroom industry of Pakistan is improving and farmers as well as processor are taking interest for growing mushroom because it has nutritional as well as medicinal value. Taking this course would broaden students vision regarding the mushroom industry at domestic and international level. Students will be able to grow mushroom and identify problems as well as production gaps and will be trained to solve those issues.

Contents

1. Introduction; present status and future prospects, Nutritional and medicinal values
2. Classification, morphology and general biology
3. Spawn preparation
4. Growing structures and systems
5. Substrates; Fruiting body formation
6. Cultivation technology with emphasis on *Agaricus*, *Pleurotus*, *Lentinus* and *Volvariella* species etc.
7. Production problems and disorders
8. Postharvest handling and value addition
9. Economics of mushroom production

Practical

1. Media and substrate preparation
2. Isolation of pure culture for spawn
3. Structural demonstration of mushroom houses
4. Environmental control systems
5. Compost preparation
6. Practices in growing methods of different cultivated mushrooms

Recommended Texts

1. Biswas, S., Datta, M., & Ngachan, S.V. (2011). *Mushrooms: A Manual for Cultivation*. New Delhi, India: PHI learning.
2. Chang, S.T., & Miles, P.G. (2004). *Mushrooms. Cultivation, Nutritional Value, Medicinal Effects, and Environmental Impact* (2nd ed.). Boca Raton, Florida, USA: CRC Press.

Suggested Readings

1. Stamets, P. (1993). *Growing Gourment & Medicinal Mushrooms*. Berkeley, CA: Ten Speed Press.
2. Bahl, N. (1994). *Handbook on Mushrooms* (3rd ed.). New Delhi: Oxford & IBH Publishing.

The objective of this course is to provide knowledge of basic principles and physiology of ornamental crop production to the students of Horticulture. Students are expected to have knowledge of basic principles of ornamental crop production and their utilization. Students will be familiar with the ornamental flowers being grown in the country and can compare those with the flowers grown in other flowers producing countries across the world. They will be able to identify problems of commercial flowers and will be able to suggest farmers about the problems. They will learn all basic steps involved in commercial flower growing ranging from nursery growing till be harvest and postharvest and marketing of flowers. 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. Importance of landscape gardening and design
2. Principles and elements of landscape design
3. Landscape design materials
4. Types of designs; formal and informal garden designs
5. Rockeries, terrace, roof and aquatic gardens, different landforms and their manipulation; functional, architectural and aesthetic uses of plants
6. landscape design for parks, play fields, highway and roadside plantations
7. Efficient irrigation system
8. Cost estimates for landscape
9. Recent trends in modern landscape

Practical

1. Design process; site inventory and analysis; client interview; base map; master plan; scale drawings
2. Introduction to computer added designs
3. Small projects of landscape design (self-designed and executed)
4. Water features (ponds, fountains, waterfalls) design and execution
5. Demonstration of water efficient irrigation systems
6. Visits to different parks and gardens

Recommended Texts

1. Biondo, R.J., & Schroeder, C.B. (2006). *Introduction to Landscaping Design, Construction and Maintenance* (3rd ed.). Lucknow, India: International Book.
2. Simonds, J.O., & Strake, B. (2006). *Landscape Architecture: A Manual of Land Planning and Design* (4th ed.). New York, USA: McGraw Hill.

Suggested Readings

1. Robinson, P. (2005). *The Practical Rock and Water Garden*. London, UK: Anness Publishing.
2. Bhattacharjee, S.K. (2004). *Landscape Gardening and Design with Plants*. Jaipur, India: Aavishkar Publishers.
3. Sovinski, R.W. (2009). *Materials and their applications in Landscape Design*. Hoboken, New Jersey, USA: John Wiley and Sons.

The objective of this course is to provide knowledge of basic principles of seed production of horticultural crops. The seeds of some species perish at low temperatures and on drying these are classified as 'recalcitrant'. The economies of many developing countries depend on such crops. Because of the short life span of recalcitrant seeds, short term storage presents great problems and long-term storage is not at present possible. The students will learn about modern seed production, processing and handling techniques. They will learn all the basic steps involved in commercial flower growing ranging from nursery growing till the harvest and postharvest and marketing of flowers. 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 and importance
2. Seed classification
3. Pre and post-harvest factors affecting seed quality
4. Seed harvesting techniques
5. Conditioning and handling
6. Quality control
7. Seed dormancy, after ripening and their treatments
8. Seed moisture and desiccation in relation to seed quality
9. Storage and longevity
10. Seed testing; Ageing and deterioration
11. Priming, Coating, their merits and demerits
12. Seed certification and registration systems

Practical

1. Seed identification of horticultural crops
2. Demonstration on cross sectional diagrams of seed structures
3. Harvesting and extraction
4. Handling of seed
5. Drying and storage of seed
6. Seed desiccation and moisture determination methods
7. Seed viability and vigor tests

Recommended Texts

1. Basra, A.S. (2006). *Handbook of Seed Science and Technology* (1st ed.). Boca Raton, Florida, USA: CRC Press.
2. Chakrabarti, S.K. (2010). *Seed Production and Quality Control*. Ludhiana, India: Kalyani Publishers.

Suggested Readings

1. McDonald, M.B., & F.Y. Kwong. (2005). *Flower Seeds: Biology and Technology*. Wallingford, UK: CAB International.
2. Vanangamudi, K., Natarajan, N., Bharathi, A., Umarani, R., Natrajan, K., & Saravanan, T. (2006). *Advances in Seed Science and Technology, Vol. 1: Recent Trends in Seed Technology and Management*. India: Agrobios.
3. George, R.A.T. (2009). *Vegetable Seed Production* (3rd ed.). Wallingford, UK: CAB International.

The objective of this course is to equip students with the techniques to prolong shelf-life of perishable horticultural produce. Students will have the knowledge of produce physiology and its application to ensure quality and shelf life of horticultural crops such as fruits, vegetables and ornamentals. Students will become familiar with the basic concepts of postharvest handling, starting from the harvest, temporary storage, washing, waxing, drying, sorting and grading and packing. Students will learn about the packing and packaging materials, and storage, and types of stage. They will learn about the different options of storage and underlying mechanisms. They will become familiar with the storage conditions for different fruits, vegetables and ornamental plants. 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 and importance
2. Physiological basis of growth and crop productivity
3. Crop responses to various environmental factors (light, temperature, water and nutrient regimes etc.)
4. Source-sink relationship
5. Dormancy; important types, mechanism and management
6. Floral development mechanism
7. Physiology of fruit setting, development, maturation, ripening, abscission and senescence
8. Pigmentation, Physiology of climacteric and non-climacteric commodities in relations to respiration
9. Photosynthetic efficiency of C₃, C₄ and CAM plants
10. Physiological responses in relation to drought, water logging, temperature and salinity, Crop responses to CO₂ fertilization

Practical

1. Experiments to study the effects of drought, water logging, temperature (high and low) and salinity on germination, growth, yield and quality
2. Study of cell membrane stability under stress conditions through conductivity meter, Studies on vegetative and reproductive buds development stages in various horticultural crops
3. Physiology of ripening stages of fruits and vegetables
4. Visit to horticulture fields and laboratories of advance research

Recommended Texts

1. Bleasdale, J.K.A. (2014). *Plant Physiology in Relation to Horticulture* (2nd ed.). Jodhpur, India: Scientific publishers.
2. Dugger, B.M. (2009). *Plant Physiology with special reference to plant production*. Charleston, South Carolina: Bibliobazaar.

Suggested Readings

1. Salisbury, F.B., & Ross, C.W. (2007). *Plant Physiology* (4th ed.). Noida UP, India: Thomson Wadsworth; Anubha printers.
2. Trivedi, P.C. (2006). *Advances in Plant Physiology*. Ludhiana, India: ICAR, Punjab Agricultural University.
3. Taiz, L., & Zeiger, E. (2002). *Plant physiology* (4th ed.) Sunderland, Massachusetts: Sinauer Associates.

The objective of this course is to equip students with the techniques to prolong shelf-life of perishable horticultural produce. Students will have the knowledge of produce physiology and its application to ensure quality and shelf life of horticultural crops such as fruits, vegetables and ornamentals. Students will become familiar with the basic concepts of postharvest handling, starting from the harvest, temporary storage, washing, waxing, drying, sorting and grading and packing. Students will learn about the packing and packaging materials, and storage, and types of stage. They will learn about the different options of storage and underlying mechanisms. They will become familiar with the storage conditions for different fruits, vegetables and ornamental plants. 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, Factors affecting produce quality and shelf-life
2. Perishable and non-perishable commodities
3. Compositional changes
4. Physiological and biochemical processes in horticultural commodities under different types of storage in relations to maturation, ripening and senescence
5. Role of ethylene in ripening
6. Ethylene scrubbers
7. Role and regulation of environmental factors in storage, temperature, humidity, oxygen, carbon dioxide and ethylene
8. Physiological and pathological disorders in storage

Practical

1. Methods of assessing maturity indices of horticultural produce
2. Starch iodine test
3. Firmness, TSS, sugars and ascorbic acid
4. Calculation of titratable acidity
5. Vase life of cut flowers
6. Identification of postharvest physiological disorders
7. Electrolyte Leakage
8. Packaging methods of different horticultural commodities
9. Other Relevant field and laboratory studies
10. Visit of grading and processing plant and cold stores

Recommended Texts

1. Bleasdale, J.K.A. (2014). *Plant Physiology in Relation to Horticulture* (2nd ed.). Jodhpur, India: Scientific publishers.
2. Kader, A.A. (2002). *Postharvest Technology of Horticultural Crops*. California: Oakland University of California, Division of Agriculture and Natural Resources Publication.

Suggested Readings

1. Kays, S.J. (1998). *Postharvest Physiology of Perishable Plant Products*. New Delhi, India: CBS Publishers.
2. Kumar, P.S., & Kanwat, M. (2009). *Post-harvest Physiology and Quality Management of Fruits and Vegetables*. India: Agrotech Books.
3. Sadiq M., J. Ahmed, Lobo, M.G., & Ozadali, F. (2012). *Tropical and Subtropical Fruits: Postharvest Physiology, Processing and Packaging*. New Jersey: Wiley-Blackwell Publisher.

The objective of this course is to impart technical knowledge about nursery management and certification procedures. Students will be able to manage nurseries and propagate healthy horticultural plants on a commercial scale. This course will help students to start their own business of nurseries and enterprise. They will learn about the requirements of establishing a nursery, and all the basic steps required for nursery establishment. The selection of plants, growing and establishing and selling out those prepared plants. Nurseries offer a good business and can be taken as an enterprise. This course will help students think and establish their own business, thus improving their livelihood. 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 to plant propagation; Methods of propagation
2. Sexual and asexual methods of propagation
3. Techniques of seed production and propagation
4. Seed production system, Nurseries for transplant production
5. Asexual propagation; Clonal propagation, Cutting, Grafting, Layering Propagation Clonal propagation by specialized structures (root and stem), Micro propagation
6. Propagation structure
7. Choosing a green house, shade house and their application
8. Nursery establishment and management: establishing a modern nursery, Record keeping of plants, managing business

Practical

1. Practices in cutting, grafting, layering, propagation by specialized structures (roots and stems)
2. Training in green house production, micro propagation
3. Visits of commercial nurseries, visits of commercial green house

Recommended Texts

1. Hartmann, H. (1996). *Plant Propagation: Principles and Practices*. India: Prentice Hall of India.
2. Hawthorne, L., Bird, R., Brown, D., Stickland, S., & Arbury, J. (2004). *The complete book of plant propagation*. London.

Suggested Readings

1. Kays, S.J. (1998). *Postharvest Physiology of Perishable Plant Products*. New Delhi, India: CBS Publishers.
2. Kumar, P.S. & Kanwat, M. (2009). *Post-harvest Physiology and Quality Management of Fruits and Vegetables*. India: Agrotech Books.
3. Sadiq M., Ahmed, J., Lobo, M.G., & Ozadali, F. (2012). *Tropical and Subtropical Fruits: Postharvest Physiology, Processing and Packaging*. New Jersey: Wiley-Blackwell Publisher.

This course designed for MSc (Hons)/MPhil programs of agriculture sciences 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 as many scientific problems could be solved by different statistical procedures. Furthermore, some statistical software knowledge will be provided to the students to improve their analytical skills. These activities will further support 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.). Hyderabad: 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
HORTICULTURE

The objective of this course is to impart technical knowledge about plant growth regulators. Plant growth regulators are widely used in modern agriculture as well as in horticulture for improving fruit set, production, yield and quality. Plant growth regulators play an important role in the production of horticultural crop. However, farmers are not using the PGRs. They are represented by plant hormones or their synthetic analogs, by inhibitors of hormone biosynthesis or translocation and by hormone receptor blockers. To acquaint the students with growth manipulation in horticultural crops. They will be able to use PGRs to solve problem related with horticultural crops such as propagation on a commercial scale. Taking this course, students will be able to solve the problems related to plant growth regulators and increase the production of horticultural crops.

Contents

1. Introduction, History, classification of growth regulators (PGRs)
2. Biosynthetic pathways
3. Source sink relationship in relation to PGR
4. Occurrence and role of growth regulators in plants,
5. Chemical nature of plant regulators and its relationship with physiological activities, Theories of action and interactions of growth regulators
6. Interrelationships between growth regulators and other organic and inorganic plant substances
7. Applications in horticulture; growth, propagation, parthenocarpy, flower and fruit thinning, control of pre-harvest drop
8. Fruit maturity, dormancy and storage
9. Seed treatment and weed control
10. Uses in vegetable and flower nursery
11. Advances in PGR's

Practical

1. Relevant field and Laboratory studies
2. surveys and assignments
3. Study of effects of PGRs in propagation
4. Physiology, growth, flower manipulation, ripening and yield of different horticultural plants

Recommended Texts

1. Arteca, R.N. (1997). *Plant Growth Substances: Principles and Applications*. New Delhi, India: CBS Publishers.
2. Basra, A.S. (2007). *Plant Growth Regulators in Agriculture and Horticulture: Their Role and Commercial Uses*. Boca Raton, Florida: CRC Press.

Suggested Readings

1. Nickell, L.G. (2011). *Plant Growth Regulators: Agricultural Uses*. Springer, London, UK.
2. Hayat, S., & Ahmad, S. (2007). *Salicylic Acid: A Plant Hormone*. Dordrecht, The Netherlands: Springer.
3. Srivastava, L.M. (2002). *Plant Growth and Development: Hormones and Environment*. Massachusetts, USA: Academic Press.

The objective of this course is to provide the students with opportunity to combine science of horticulture and their creative abilities in provision of aesthetically beautiful and functional environment. Students will be able to prepare designs and manage landscape of various premises. By completing this course student will be able to survey the location, design the landscape plan of a specific place and execute that plan to beautify the land. This course will help them understand the landscaping work thus they can contribute to beautify land in the country at various locations and can earn livelihood. This course will impart trust to the students on their creative abilities, and they will be able to utilize their skills. 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 and importance
2. Plant and their environments
3. Biodiversity and conservation
4. Ecologically sound and sustainable designs
5. Functional uses of plants; plants for the control of environment and bio-remediation; Pollutants types and role of plants to minimize pollution
6. Selection of plants for various environments
7. Environmental problems caused by plants
8. Horticultural science in sociosphere
9. Aesthetic horticulture
10. Amenity horticulture
11. Phyto-remediation, types and uses

Practical

1. Identification of plants for control of environmental hazards
2. Monitoring plant health in polluted areas (industries and motorways etc.) and their comparison with field grown plants
3. Vegetation impact on microclimate
4. Visits to industrial areas causing pollution
5. Morphological changes in plants due to pollution
6. Environmental impact studies
7. Poster preparation about environmental hazards and role of plants

Recommended Texts

1. Saliba, C. (2009). *A Book about Environmental Toxins*. Canada: Knopf.
2. Kaushik, A., & Kaushik, C.P. (2006). *Perspectives in Environmental Studies*. New Delhi, India: New Age International Publishers.

Suggested Readings

1. Hussain, M. (1998). *Environmental Degradation: Realities and Remedies*. Lahore: Feroz Sons.
2. Hussain, S.S. (1992). *Pakistan Manual of Plant Ecology*. Islamabad: National book foundation.
3. McKinney, M.L. & Schoch, R.M. (1998). *Environmental Science: Systems and Solutions*. Sudbury: Jones and Bartlett Pub.

Fruit breeding is an ancient technology with dynamic current technology and an exciting future. In its broadest sense, fruit breeding refers to the purposeful genetic improvement of fruit crops through various techniques including selection, hybridization, mutation induction, and molecular techniques. Its origins trace to the domestication process in prehistory and antiquity, where useful species were chosen and cultivated, and improved by continuous selection. To make students familiar with breeding techniques and methodologies in fruit crops. This course will impart trust to the students on their creative abilities, and they will be able to utilize their skills. 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. Objectives of fruit breeding
2. Importance of germplasm and its maintenance
3. Breeding techniques
4. Pollen and seed management
5. Hybridization and handling seedling population
6. Breeding of regionally important fruits
7. Breeding for disease and stress resistance
8. Mutation breeding

Practical

1. Study of floral characters of various fruits
2. Crossing techniques of important fruits
3. Selectable markers for fruit breeding
4. Study of different types of chimera
5. Visits to germplasm units

Recommended Texts

1. Janick, J., & Moore, J.N. (1975). *Advances in Fruit Breeding*. West Lafayette, Indiana: Purdue Univ. Press.
2. Moore, G.N., & Janick, J. (1983). *Methods in Fruit Breeding*. West Lafayette, Indiana: Purdue Univ. Press.

Suggested Readings

1. Hancock, J.F. (2008). *Temperate Fruit Crop Breeding*. The Netherlands: Springer.
2. Badenes, M.L., & Byrne, D.H. (2010). *Handbook of Plant Breeding Series. Fruit Breeding Vol. 8*. (1st ed.). The Netherlands: Springer.
3. Shukla, A.K., Shukla, A.K., & Vashishtha, B.B. (2004). *Fruit Breeding: Approaches and Achievements*. Lucknow, India: International Book.

To assure the continued development of improved vegetable breeding lines and varieties to meet future needs of the vegetable industry and the general public. To encourage the transition of basic and applied research findings into usable germplasm and methodologies for use by private sector plant breeders. To support applied vegetable breeding programs in which both graduate and undergraduate students may train to become capable vegetable breeders of the future. To provide a forum in which a continuing dialogue is encouraged between plant breeders in the private and public sectors. To make students familiar with breeding techniques and methodologies in fruit crops. This course will impart trust to the students on their creative abilities, and they will be able to utilize their skills. 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. Objectives of vegetable breeding
2. Planning breeding programmes
3. Development of inbred lines
4. Combining ability
5. Exploitation of male sterility
6. Hybrid seed production
7. Breeding for diseases and stress resistance
8. Breeding of commercially important vegetables
9. Improvement of asexually propagated vegetables

Practical

1. Study of floral characters of self and cross-pollinated vegetables
2. Crossing techniques for important self- and cross-pollinated vegetables
3. Selection procedure in cultivars development
4. Methods of hybrid seed production

Recommended Texts

1. Singh, P.K, Dasgupta, S.K., & Tripathi, S.K. (2005). *Hybrid Vegetable Development*. Boca Raton, USA: CRC Press.
2. Ram, H.H. (2005). *Vegetable Breeding, Principles and Practices*. New Delhi: Kalyani Publisher.

Suggested Readings

1. Peter, K.V., & T ,Pradeepkumar . (2008). *Genetics and Breeding of Vegetable Crops*. New Delhi, India: Indian Council of Agricultural Research.
2. Acquaah, G. (2012). *Principles of Plant Genetics and Breeding*. Oxford, UK: Blackwell publishing.
3. Kumar, N. (2006). *Breeding of Horticultural Crops: Principles and Practices*. New Delhi, India: New India publishing Agency.
4. Rai, N. & aIndi New :New Delhi, India .Heterosis Breeding in Vegetable Crops .(2006) .M. Rai Publishing Agency.

To assure the continued development of improved vegetable breeding lines and varieties to meet future needs of the vegetable industry and the general public. Successful seed supplies are vital in maintaining vegetable production and availability, and for ensuring food security for many subsistence farmers in developing countries. Providing a broad and expert coverage of the horticultural production of vegetables grown from seed, this fully updated new edition includes new coverage of the production of genetically modified crops, organic seed production, packaging, and honey bee population, as well as updated references and further reading. It is an essential text for horticulturists, researchers, seed scientists, vegetable producers, students, technicians and practitioners in vegetable seed production in both developed and developing countries. This course will make students familiar with techniques and methodologies of seed production, handling, storage, certification, quality control and marketing of vegetable crops.

Contents

1. Concept and benefits
2. Issues in seed production
3. Ecological aspects of seed production
4. Seed production and its problems in Pakistan
5. Seed Production planning and Methods
6. Seed formation and Development
7. Hybrid Seed Production
8. Seed Harvesting Techniques
9. Seed conditioning and Handling
10. Quality control and seed marketing
11. Pests, diseases and their Control

Practical

1. Seed identification
2. Pollination techniques
3. Seed production techniques
4. Rouging and maintaining isolation
5. Seed harvesting
6. Seed extraction, drying and storage

Recommended Texts

1. George R.A.T. (2009). *Vegetable Seed Production* (3rd ed.). UK: CAB International.
2. Singh, P., & Asati, B.S. (2008). *Seed Production Technology of Vegetable Crops*. Delhi, India: Daya Publishing.

Suggested Readings

1. Kumar, V., Singh, N., Singh, Y.K., & Kumar, S. (2006). *Vegetable Seed production technology*. Lucknow, India: International Book.
2. Doijode, S.D. (2002). *Seed Storage of Horticultural Crops*. India: CBS Publishers.
3. Copeland, L.O., & McDonald, M.B. (2005). *Principles of Seed Science and Technology* (4th ed.). New Delhi, India: Springer.

The objective of this course is to provide the students with opportunity to combine science of horticulture and their creative abilities in provision of aesthetically beautiful and functional environment using different turf grasses. This concentration integrates scientific *Contents* with practical experience and covers such topics as grass and seed identification, turfgrass culture and physiology, pest control, and equipment maintenance. To make students familiar with techniques and methodologies of Turf-grass production and handling as well as marketing. This course will impart trust to the students on their creative abilities, and they will be able to utilize their skills. 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 and Importance
2. Types of grasses and their comparisons for different purposes (lawns, golf courses, playfields)
3. Climate and grass growth
4. Land preparation
5. Soil test and soil amendments
6. Propagation, seeding, sodding/plugging and carpeting
7. Care for lawn grasses
8. Cultural practices; watering, mowing, fertilization, weeding, insects-pests, diseases and their control, thatching and aeration etc.

Practical

1. Identification of lawn grasses
2. Establishing lawn plots by seed, sodding and carpeting, Growth monitoring
3. Mowing regimes, Aeration, thatching and other management practices
4. Identification of turf insects, pests and diseases

Recommended Texts

1. Christians, N. (2003). *Fundamentals of Turfgrass Management* (2nd ed.). New Jersey: John Wiley and Sons.
2. Puhalla, J., Krans, J., & Goathley, M. (1999). *Sports Fields: A Manual for Design, Construction and Maintenance*. New Jersey, USA: John Wiley and Sons.

Suggested Readings

1. Quast, D.H., & Otto, W. (2004). *Golf Course Turf Management: Tools and Techniques*. USA: McGraw Hill Book.
2. John, R. (2003). *Turfgrass Installation, Management and Maintenance*. USA: McGraw Hill.
3. Turgeon, A.J. (2007). *Turfgrass Management* (8th ed.). New Jersey: Prentice-Hall.

The objective of this course is to familiarise students with basic principles and practices of fruit production, and physiology of fruit production. Students are expected to understand various stages of fruit plants phenology and physiology in order to solve related problems for fruits crops. After completing this course student will be able to grow and manage fruits 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. 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. 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. Present status and future scope of fruit industry
2. Recent advances in fruit science
3. Plant relations with water, nutrition, light, temperature etc.
4. Tree phenology; vegetative and reproductive physiology
5. Source sink manipulation
6. Problems related to fruitfulness
7. Fruit setting and development
8. High density planting and its management
9. Commercial uses of growth substances

Practical

1. Relevant field and laboratory studies, surveys and assignments
2. Identification of fruit production problems
3. Nutrition management
4. High efficiency irrigation
5. Pruning and training of fruit trees
6. Visits of global GAP registered orchards and nurseries

Recommended Texts

1. Singh, A. (2003). *Fruit Physiology and Production* (5th ed.). New Delhi: Kalyani Publishers.
2. Gardener, V.R. (2001). *The Fundamentals of Fruit Production* (5th ed.). USA: McGraw Hill Book.

Suggested Readings

1. Chottopadhyay, T.K. (2003). *A Textbook on Pomology, Vol. I: Fundamentals of Fruit Growing*. Ludhiana, New Delhi, India: Kalyani Publishers.
2. Jackson, D.I., & Looney, N.E. (1999). *Temperate and Subtropical Fruit Production* (2nd ed.). Wallingford, UK: CAB International Publishing.
3. Joseph, H.G. (2008). *Modern Fruit Production*. New York: Stratford Press.

The objective of this course is to develop understanding among the students regarding principles and physiology of vegetable production. The production practices, common problems and their solutions. At the end students will be familiar with basic principles behind successful vegetable production on a commercial scale. Students will get theoretical as well as practical knowledge regarding the vegetables growing. They will become familiar with the common vegetables being grown in the country and can compare those with the vegetable grown internationally. Students will be able to diagnose problems with vegetable plants and can suggest possible solutions to the farmers. 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, Principles of crop establishment and flower induction in vegetables
2. Role of environment on physiology, growth, development and yield
3. Recent advances in vegetable science
4. Trends in organic vegetable production
5. Soil-less culture
6. Mechanization in vegetable production and harvesting
7. Seedlessness in vegetables (watermelon, cucumber tomatoes, etc)
8. Conservation of indigenous germplasm,
9. Concepts for production, grading and quality standards according to GLOBALGAP certification and WTO regimes

Practical

1. Relevant field and laboratory studies (including biochemical analysis)
2. Surveys and assignments
3. Identification of vegetable production problems and their remedies
4. Food safety measures
5. Visit to progressive vegetable farms

Recommended Texts

1. Rana, M.K. (2008). *Scientific Cultivation of Vegetables*. Ludhiana, New Delhi, India: Kalyani Publishers.
2. Rana, M. K. (2012). *Modern Concepts of Vegetables Production*. New Delhi: Biotech. Books.

Suggested Readings

1. Singh, J., Jain, S. K., & Dashora, L.K. (2013). *Precision Farming in Horticulture*. New Delhi India: New India publishing.
2. Arunkumar, R., Vijayalatha, K.R., Kannan, K., Thirumalmurugan, V., Latha, K., & Kumar, S.N. (2008). *Innovative Horticulture*. New Delhi, India: New India publishing.
3. Sharaf, S. (2012). *Green House Management of Horticulture Crops*. New Delhi, India: Oxford Book.

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, develop writing skills, enhance time management and organizing skills. The special problem makes you do your work by prioritizing the needs and time frames completing all your tasks peacefully avoiding panic. Special problem writing work provides students a lot of scope to improve themselves.

The seminar is intended to instruct students, proper techniques for presentation of scientific material. Each student is expected to prepare and present a scientific seminar and to submit supporting/ supplemental material. A seminar is a form of academic instruction, either at an academic institution or offered by a commercial or professional organization. It is a formal academic gathering with function to brainstorming, focusing each time on some particular subject, in which everyone i.e. students as well as faculty is invited to participate. Seminars provide a chance to interact with experts from the specific field. Discussing the relevant topics of the particular subject, students tend to learn about the precise information and modern skills in a stipulated period. It also creates a sense of friendship associated with the seminar attendance, presentation, followed by question & answer session. Attending a seminar also gives the updates of latest research and development in respective fields as well as it improves communication skills of both presenter and audience.

The objective of this course is to provide knowledge of basic principles and physiology of landscape ecology. Landscape ecology is the science of studying and improving relationships between ecological processes in the environment and particular ecosystems. Students are expected to have knowledge of basic principles of ornamental crop production, and their utilization. Students will be familiarized with the ornamental flowers being grown in the country and can compare those with the flowers grown in other flowers producing countries across the world. They will be able to identify problems of commercial flowers and suggest farmers about the problems. They will learn all the basic steps involved in commercial flower growing ranging from nursery growing till the harvest and postharvest and marketing of flowers. Students will be able to identify existing gaps and trained to solve those issues.

Contents

1. Introduction, Spatial pattern and process
2. Characterization of spatial pattern
3. Detecting and characterizing landscape patterns
4. Finding the characteristic scale of spatial pattern, defining the elements of pattern, connectedness fractal geometry and percolating networks, and their interrelation in landscapes
5. Development of landscapes patterns, Agents of pattern formation
6. The physical template of environmental constraints
7. biotic processes and disturbance regimes
8. Landscape dynamics
9. Change of landscape patterns and processes through time, including techniques for detecting analyzing, or simulating landscape change
10. Modeling populations or communities in landscape mosaics (including spatially implemented meta-population models)
11. Implications of landscape pattern with focus on populations and meta-populations, communities, and ecosystem processes
12. Landscape management
13. Humans approach in managing complex landscapes to achieve management objectives
14. Conservation biology and ecosystem management

Recommended Texts

1. Wu, J., & R.J. Hobbs. (2009). *Key Topics in Landscape Ecology*. Cambridge, UK: Cambridge University Press.
2. Burel, F., & Baudry, J. (2003). *Landscape Ecology: Concepts, Methods and Applications*. Enfield, NH: Science Publishers.

Suggested Readings

1. Turner, M.G., Gardner, R.H., & O'Neill, R.V. (2001). *Landscape Ecology in Contents and Practice: Pattern and Process*. New York: Springer-Verlag.
2. Hitchmough, J. (1994). *Urban Landscape Management*. Sydney: Inkata Press.
3. Wu, J., & Hobbs, R.J. (2009). *Key Topics in Landscape Ecology*. Cambridge, UK: Cambridge University Press.

The requirement of fruits and vegetables is increasing proportionally with the increasing population in the country. Although conventional plant breeding techniques have made considerable progress in the development of improved varieties, they have not been able to keep pace with the increasing demand for vegetables and fruits in the developing countries. Therefore, an immediate need is felt to integrate biotechnology to speed up the crop improvement programs. Biotechnological tools have revolutionized the entire crop improvement programs by providing new strains of plants, supply of planting material, more efficient and selective pesticides and improved fertilizers. This course will familiarize the student with the genetic tools and their use for improvement of horticultural crops. Students would be able to understand the biotechnological aspects of horticultural crops establishment and management.

Contents

1. Definition & origin, Basic terminologies
2. Modern concept of Biotechnology
3. Multiple faces of Biotechnology
4. Biotechnology for the improvement of Horticultural crops
5. Somaclonal variation
6. Somatic hybridization, Cytoplasmic hybridization
7. Isolation of plant DNA, DNA Sequencing
8. Molecular markers and markers assisted selection of crop cultivars (MAS)
9. Genetic engineering techniques, Cell & tissue culture technology
10. Genetic transformation
11. *In vitro* mutation breeding
12. Serological and biochemical methods for plant indexing

Practical

1. Protoplast isolation and fusion
2. Isolation and quantification of DNA & RNA
3. Polymerase Chain Reaction (PCR)
4. DNA markers
5. General procedure for ELISA
6. Protein extraction, Gel Electrophoresis
7. Agro-bacterium mediated transformation
8. *In vitro* mutation breeding methods, Use of different mutagens

Recommended Texts

1. Vyas, S.P., & Kohli, D.V. (2003). *Methods in Plant Biotechnology and Bioengineering*. New Delhi, India: CBS Publishers.
2. Debnath, M. (2011). *Tools and Techniques of Biotechnology*. Jaipur, India: Pointer Publishers.

Suggested Readings

1. Keshavachandran, R., & Peter, K.V. (2008). *Plant Biotechnology: Methods in Tissue Culture and Gene Transfer*. Chennai, India: Orient Blackswan .
2. Prasad, S. (2004). *Impact of Plant Biotechnology on Horticulture* (3rd ed.). Jodhpur, India: Agrobios.
3. Purohit, S. S. (2007). *A Laboratory Manual of Plant Biotechnology* (2nd ed.). Jodhpur, India: Agrobios.

The objective of this course is to provide the basic knowledge about biotic stresses faced by the horticultural crops such as fruits, vegetables and ornamental plants. Abiotic stresses such as cold, heat, drought, flooding, salinity, nutrient deficiency, xenobiotic compounds, heavy metals, ozone, and ultraviolet radiation affect multiple physiological and biochemical mechanisms in plants, as they cope with the stress conditions. To train students about horticultural crop production under environmental stresses stressed and their mitigation. Students must have knowledge of various abiotic stresses, their phytotoxicity and alleviation techniques. Students will be able to diagnose problems with vegetable plants and can suggest possible solutions to the farmers. This course would broaden 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
2. Types of abiotic stresses and their impacts on growth and productivity, (salinity, drought, temperature, herbicide and heavy metals)
3. Potential morpho-physiological and biochemical indicators of stresses
4. Mechanism of stress tolerance
5. Role of enzymatic and non-enzymatic systems in stress tolerance
6. Strategies to mitigate stress induced phytotoxicity and augmentation in stress tolerance potential

Practical

1. Relevant field and Laboratory studies, surveys and assignments
2. Study of effects of abiotic stresses in propagation
3. physiology, growth, flower manipulation and yield of different horticultural crops

Recommended Texts

1. Shahbala, S. (2012). *Plant Stress Physiology*. USA: CABI.
2. Upadhyay, R. (2012). *Plant Stress Physiology; Physiological and Biochemical Perspectives*. Germany: Lambert Academic Publishing.

Suggested Readings

1. Venkateswarlu, B. (2012). *Crop Stress and its Management: Prospective and Strategies*. Dordrecht Heidelberg London, New York: Springer.
2. Tuteja, N. (2011). *Omics and Plant Abiotic Stress Tolerance*. USA: Bentham Books.
3. Vahdati, K., & Leslie, C. (2013). *Abiotic Stress - Plant Responses and Applications in Agriculture*. Rijeka, Croatia: Intech.

Modern agricultural production is characterized by various activities that require 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. Data in agriculture is of numerical character accompanied with variability of data. Statistics can be used as a tool for agricultural research. It can help research workers to design his experiments and to evaluate objectively the resulting numerical data. This course 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 learn some statistical software's like Minitab, R, and Design Expert 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., Hunter, 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.