



# COURSE OUTLINE BRIEFS

DEPARTMENT OF  
**AGRICULTURAL  
ECONOMICS**



**SARGODHA UNIVERSITY**  
*Pathway to Progress*

FACULTY OF  
**AGRICULTURE**



## OVERVIEW

Agricultural Extension is about extending research based knowledge of Agricultural Sciences at grass root level to its clients in the fields for adoption and for better agricultural production. It is the most unique knowledge transfer approach that has been prevailed for thousands of years since the first basic profession adopted by humans on this planet was agriculture. Agricultural technology transfer, advisory services for respondents, human resource development in agriculture through educational and awareness programs and facilitation for empowerment are major prevailing schools of thought in Agricultural Extension educational system.

The Department of Agricultural Extension was officially established in 2012 to bring the fresh wave of change in the national economy of the country and to spread the research based agricultural knowledge in the closing vicinities of Sargodha district.

The Department offers BSc (Hons), MSc (Hons) and PhD programs and is planning to start new post-graduate degree program in Rural Development. It has always been in the front line to organize workshops, seminars, festivals and conferences during the academic year.

The Department's faculty is a blend of highly qualified agriculture scientists. The faculty includes four PhD and one MSc qualified members. In perspective of the growing trends of value-addition and knowledge-based economy, the faculty members of the Department conducts outreach program for local farming community in the area for the last 10 years.

## Academic Programs Offered

### BSc (Hons) Agriculture (Major in Agricultural Economics)

#### 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/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**

AEXT-6408	Communication Skills in Agricultural Extension	3(2+1)
AGEC-6503	Microeconomics – I	3(3+0)
AGEC-6504	Macroeconomics – I	3(3+0)
AGEC-6505	Mathematics for Economists	3(3+0)
AGEC-6506	Food and Agricultural Marketing	3(3+0)
AGEC-6507	Economics of Agro-based Industries	3(3+0)

#### **Semester-VI**

AGEC-6508	Microeconomics –II	3(3+0)
AGEC-6509	Macroeconomics – II	3(3+0)
AGEC-6510	Development Economics	3(3+0)
AGEC-6511	Mathematical Economics	2(2-0)
AGEC-6512	Agribusiness Management	3(3+0)
AGEC-6513	Statistical Methods for Economists	2(1-1)

#### **Semester-VII**

AGEC-6514	Econometrics – I	3(2-1)
AGEC-6515	Natural Resource Economics	2(2-0)
AGEC-6516	Agricultural Finance	3(3+0)
AGEC-6517	Agricultural Production Economics	3(3+0)
AGEC-6518	Research Methods in Social Sciences	3(2-1)
AGEC-6519	International Economics	2(2-0)

#### **Semester-VIII**

AGEC-6520	Econometrics – II	3(2-1)
AGEC-6521	Agricultural issues and Policies of Pakistan	3(3+0)
AGEC-6522	Economics of Livestock Production	3(3+0)
AGEC-6523	Agribusiness, Marketing and Trade	3(3+0)
AGEC-6524	Research Project/Internship	4(0-4)



**BSc**  
**(Hons)**  
**AGRICULTURE**  
**AGRICULTURAL**  
**ECONOMICS**

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.

3. Das, D.K. (2011). *Introductory Soil Science* (3rd ed.). New Delhi: Kalyani Publications.

**ZOOL-6141**

**Introduction to Biology I**

**3(3+0)**

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 (rapeseeds, 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  $\chi^2$  (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 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 course discusses the terminology, concepts, contents, methodology and limitations of current microeconomic analysis. The course provides students with a theoretical structure to analyze and understand economics as it relates to individuals and businesses. In addition, it seeks to provide students with an understanding of how political, social and market forces determine and affect the economy. This introductory course explores the principles of production and consumption – and the exchange of goods and services – in a market economy. In particular, it compliments other courses of agricultural economics by highlighting the various market mechanisms that influence managerial decision-making in agricultural business. After completing the course, students will be able to understand economic issues pertaining to households and firms.

#### *Contents*

1. Scope of Economics
2. Contents of Consumer's Behavior – Approaches to Utility analysis
3. Laws of Demand and Supply
4. Various dimensions of Elasticity of Demand and Supply
5. Contents of Production
6. Cost concepts in the short run and long run
7. Market equilibrium analysis

#### *Recommended Texts*

1. Parkin, M. (2010). *Economics* (10th ed.). Boston: Addison Wesley Publishing Company.
2. Nicholson, W., & Snyder C. M. (2009). *Intermediate Microeconomics and its application* (11th ed.). Mason: South-Western Cengage learning Publisher.

#### *Suggested Readings*

1. Varian, H.R. (2009). *Intermediate Microeconomic* (8th ed.). New York: W.W. Norton Company.
2. Pindyck, R., & Daniel, R. (2012). *Microeconomics* (8th ed.). New Jersey: Prentice Hall publisher.

The purpose of this course is to provide students with an introduction to the basic macroeconomic principles; to enable students to appreciate the workings of real (labor and goods) and asset/money markets and the nature of equilibrium in each market; to emphasize the role of macroeconomic policies that affect internal and external deficits, inflation and growth of per capita income. Throughout the course, focus will be on ‘critical thinking’ to analyze macroeconomic problems. The major areas of focus will be the inputs market, goods market, money/asset market, and economic growth. Business cycles will also be discussed and linked to macroeconomic policy debate issues of ‘active’ versus ‘passive’ and ‘rules’ versus discretion. The equilibrium IS-LM, ADAS models will be covered with some basic applications, providing a smooth transition to Intermediate macroeconomics. After completing the course, students are supposed to have fundamental knowledge of economic issues at aggregate level.

#### *Contents*

1. An introduction to Macroeconomics and the economy
2. Microeconomics versus macroeconomics
3. The Roots of macroeconomics
4. Structure of economy and circular flow of income
5. Measuring domestic output and national income
6. Product, expenditure and income approaches
7. Other national income accounts
8. Price indices, Nominal and real GDP
9. Economic growth and instability
10. The business cycles
11. Unemployment and its types
12. Inflation and its types
13. The income consumption and income saving relationships
14. The real interest rate and investment relationship
15. The multiplier, accelerator and super-multiplier effect
16. The aggregate expenditure models.

#### *Recommended Texts*

1. McConnel, C.R., Brue, S.L., & Flynn, S.M. (2011). *Economics: Principles, Problems and Policies* (19th ed.). New York: McGraw-Hills.

#### *Suggested Readings*

1. Dornbusch, R., Fischer, S., & Startz, R. (2013). *Macroeconomics* (12th ed.). New York: McGraw Hill.
2. Shapiro E. (2003). *Macroeconomic Analysis* (5th ed.). California: HARCOURT BRACE publisher.
3. Abel, B. A., & Bernanke, B. S. (2005). *Macroeconomics* (6th ed.). New York: McGraw Hill.

The course is intended for students without sufficient mathematics who wish to obtain knowledge of mathematical techniques suitable for economic analysis. It assumes very little prerequisite knowledge. The approach is informal and aims to show students how to do and apply the mathematics they require for a successful study of economics. Economic applications are considered, although this course aims to teach the mathematics not the economics. Topics covered include basic algebra, simple calculus and matrix algebra. After completing the course, students will have the basic understanding about the use of mathematics in economics.

#### *Contents*

1. The nature of mathematical economics
2. Mathematical versus non-mathematical economics and econometrics
3. Economic models and equilibrium analysis
4. Matrix algebra
5. Applications of derivatives
6. Comparative static analysis in economics and economic models
7. Derivatives of implicit functions
8. Optimization Problems, General Constrained Optimization, Dynamic optimization & Integration
9. Convexity and Optimization—Multivariate Optimization
10. Mathematical Programming
11. The concepts of Linear and Non-Linear Programming

#### *Recommended Texts*

1. Chiang, A. C. (2005). *Fundamentals Methods of Mathematical Economics* (3rd ed.). New York: McGraw Hill publications.

#### *Suggested Readings*

1. Goshaw, M. (2008). *Concepts of calculus with applications* (1st ed.). Singapore: Pearson Publisher.
2. Shannon, J. (1995). *Mathematics for Business Economics and Finance*. Australia: John Willey & Sons.

The primary purpose of this course is to help students develop analytical tools of thinking about agricultural marketing. The course covers the principles of agricultural marketing including consumers demand and supply. The course will also provide an overview of the role of agriculture in Pakistan and some world economies. Students in this course may complete a market analysis to show that they understand how managers, firms, wholesalers, retailers, transporters, packagers and storage, etc. function in the agricultural marketing system. At the end of this course, students will be able to define agricultural marketing, identify the problems of agricultural marketing, find ways to solve the problems, explain the principles of demand & supply while understanding the relationship in the agricultural marketing system. Students will complete a market analysis to understand the functions of all of the actors within a marketing food distribution channel.

#### *Contents*

1. Basic concepts and principles of food and fiber marketing system and its role in development
2. Marketing structure, marketing approaches and problems
3. Marketing functions: standardization, grading, packing coding, packaging, storage, transportation, information, legislation and management
4. Marketing margins and profitability
5. Market functionaries, marketing channels, price variation and stabilization
6. Concept of supply chain management
7. Review of agricultural marketing systems in Pakistan

#### *Recommended Texts*

1. Crawford, I.M. (1997). *Agriculture and food marketing management*. Africa: FAO publishers.
2. Kohls, R.L., & Uhl, J. N. (2002). *Marketing of Agricultural Products* (9th ed.). New York: MacMillan.

#### *Suggested Readings*

1. Clarkson, K.W., & Miller, R. L. (1997). *Industrial Organization, Contents, Evidence and Public Policy*. New York: McGraw-Hill.
2. Scarborough, V., & Kydd, J. (1992). *Economic Analysis of Agricultural Markets: A Manual*. Chatham, UK: Natural Resources Institute.
3. Shepherd, G. F. (2004). *Marketing Farm Products- Economic Analysis* (4th ed.). Islamabad: National Book Foundation.

The purpose of this course is to provide students with an overview of the agricultural and agro-industrial sectors as part of a system within which production and service components are linked, recognizing that a system's sustainability relies on striking a balance between its economic, social and environmental aspects, as well as designing and implementing policy instruments conducive to sustainability. The objectives of the course are to understand how the agricultural and agro-industrial sectors operate, as part of an integrated system in which they are linked and interact with other actors within political, institutional and environmental context. The course also introduce students with basic functioning of agro-based industries, and agricultural policies of Pakistan and their subsequent impacts on industrialization and prosperity of society.

#### *Contents*

1. Role of Industries for economic development
2. Policies and growth of Agro-based industries
3. Performance of small- & large-scale industries, i.e. ginning and textile, sugar, vegetable ghee/edible oil, tobacco, fruits and vegetables processing, beverages, wheat flour and rice mills, feed mills, etc.
4. Efficiency, productivity and capacity utilization
5. Overview of Pakistan industrial policies
6. Quantitative & Qualitative restrictions, tariff, protection; tax concessions and export subsidies
7. Role of public and private sectors in rural industrialization
8. Problems of agro-based industries
9. Green supply chain

#### *Recommended Texts*

1. Khawaja, A. S. (2014). *Economy of Pakistan* (3rd ed.). Lahore: Ilmi Kitab Ghar.
2. Shahida W. (2003). *Industrial Productivity*. Pakistan: Oxford University Press.

#### *Suggested Readings*

1. Aslam, M. (2004). *Perspective on Development planning in Pakistan*. Lahore: Allied Books.
2. Khan, M. Z. (2001). *Kick starting Pakistan's Economy*. Lahore: Vanguard Books.
3. Rafi, R. (2001). *Pakistan in Perspective 1947-97*. Pakistan : Oxford University Press.

Decision-making by consumers, producers, and governments lies at the heart of economic analyses. The first half of this course is devoted to the study of rational decision-making and the modelling of associated market behavior. In addition, we will study how individual economic decisions interact in markets with varying degrees of competition, paying substantial attention to the comparative welfare outcomes produced by different market forms. Additional topics include welfare economics and its applications, and market imperfections like oligopoly and externalities. There is substantial emphasis on the use of analytical and mathematical tools. These tools and the subject material underpin much of the current research in microeconomics. The course intends to provide further insight about price and output determination under various market scenarios.

### *Contents*

1. Characteristics and output/price determination under pure competition, monopoly, monopolistic competition and oligopoly
2. profit maximization under different market structures in both short run and long run perspectives
3. Price discrimination
4. Regulation of monopoly
5. Game Contents
6. Resource Market structure
7. Demand and supply pattern in resource market (wage rent, interest and profit determination)
8. General equilibrium model
9. Welfare Economics, public
10. Goods and externalities
11. Microeconomics of Government

### *Recommended Texts*

1. Parkin, M. (2010). *Economics* (10th ed.). Boston: Addison Wesley Publishing Company.
2. Nicholson, W., & Snyder C. M. (2009). *Intermediate Microeconomics and its application* (11th ed.). Mason: South-Western Cengage learning Publisher.

### *Suggested Readings*

1. Varian, H.R. (2009). *Intermediate Microeconomic* (8th ed.). New York: W.W. Norton Company.
2. Pindyck, R., & Daniel, R. (2012). *Microeconomics* (8th ed.). New Jersey: Prentice Hall publisher.



The macro-economy of a country is a complex network consisting of millions of interacting pieces such as consumers, firms, banks, and government institutions. This course introduces students to some of the key models, economists employ to understand how these pieces interact to generate economic growth, the business cycle, and inflation. The course covers models of aggregate income determination in open economies; theories of aggregate economic behavior with respect to consumption, investment expenditures, and financial transactions; balance of payments and exchange rate analysis; theories of inflation and unemployment; introductory dynamic analysis; and theories of growth and business cycles. The models will be applied to the data and used to analyze the observed growth patterns across the world. Macroeconomics - II develops the tools, skills and knowledge base, necessary to operate as a practicing macroeconomist. The course leads on from the first-year macroeconomics course and provides a smooth transition for those intending to pursue macroeconomics in later years. After completing the course, students will have understandings of major macroeconomic models.

### *Contents*

1. Aggregate demand and Aggregate Supply patterns
2. Changes in AD and AS, equilibrium and dynamics of equilibrium in short run and long run
3. Money and Banking: functions of money, the components of money supply, Money definitions M1, M2, M3
4. Banking system, historical background and functions of different banks, commercial banks, and central bank.
5. The IS-LM Model, equilibrium in the labor market, goods market and money market
6. Factors affecting IS and LM curves
7. General equilibrium in the complete model
8. The phenomenon of Phillips curve
9. The Okun's law
10. Introduction to macroeconomic policies, Monetary and fiscal policies
11. Labor and wage policies
12. International policy
13. International trade, balance of payments and causes of disequilibrium

### *Recommended Texts*

1. McConnel, C.R., Brue, S.L., & Flynn, S.M. (2011). *Economics: Principles, Problems and Policies* (19th ed.). New York: McGraw-Hills.

### *Suggested Readings*

1. Dornbusch, R., Fischer, S., & Startz, R. (2013). *Macroeconomics* (12th ed.). New York: McGraw Hill.
2. Shapiro E. (2003). *Macroeconomic Analysis* (5th ed.). San Diego: HARCOURT BRACE publisher.
3. Andrew, A. B., & Ben S. Bernanke, B. S. (2005). *Macroeconomics* (6th ed). New York: McGraw Hill.

Poverty and underdevelopment in many countries are among the main contemporary challenges for humanity. This course provides an in-depth discussion of different economic explanations of underdevelopment, and modern strategies for fostering development. We will investigate the role of institutions, institutional change, and markets as they relate to economic development, and discuss related domestic and international economic policy questions. Special emphasis is put on the interplay and synergy between economic contents (attempting to explain underdevelopment) and empirical data (providing both motivating facts and specific test grounds for contents). At the end of this course, students will be able to design innovative ways to assess whether a proposed development intervention is likely to successfully improve the welfare of its target population. After completing the course, students will have the knowledge about the development issues in general and developing countries in particular.

#### *Contents*

1. The concepts of economic development and Economic growth
2. Characteristics of developing economies
3. Importance and challenges of the development process
4. Theories of economic growth and development
5. Education, technological change and Economic development
6. Growth, Poverty and Income distribution
7. Economics of population and development
8. Importance of trade for development
9. Globalization and its implications for development
10. Debt burden of developing countries
11. Governance and developmental experiences in Pakistan
12. NGOs and Development

#### *Recommended Texts*

1. Todaro, M. P., & Smith, S. C. (2008). *Economic Development* (8<sup>th</sup> ed.). Singapore: Pearson Education Publisher.

#### *Suggested Readings*

1. Jhingan, M.C. (2005). *Economics of Development and Planning*. New Delhi: Konark Publishers.
2. Meier, G.M. (2005). *Leading Issues in Economic Development*. New York: Oxford University Press.
3. Zaidi, A.S. (2008). *Issues in Pakistan's Economy*. Karachi: Oxford University Press.

The principal aim of this course is to extend student's facility with those methods of mathematics needed to pursue economic analysis at a more advanced level. By the end of the course, students will have extended their knowledge to include the technique of optimization under inequality constraints, the analysis of dynamic economic models, in particular differential and difference equations and dynamic optimization (optimal control contents), as well as correspondences and fixed point theorems used in general equilibrium analysis. After completing the course, students will be in a position to apply the knowledge of mathematical tools for formulation of economic models and analyses.

### *Contents*

1. The nature of mathematical economics
2. Mathematical versus non-mathematical economics
3. Mathematical economics versus econometrics
4. Economic models
5. Review of Matrix Algebra and its application to Business and Economics
6. Review of Differentiation, Rules of differentiation, maxima/minima of functions, partial/total derivatives and their applications in Business and Economics
7. Integration: Integrals and their applications in Business and Economics
8. Optimization Problems

### *Recommended Texts*

1. Chiang, A. C., & Wainwright, K. (2004). *Fundamental Methods of Mathematical Economics* (4th ed.). New York: McGraw-Hill, Irwin.
2. Silberberg, E., & Suen, W. (2001). *The Structure of Economics: A Mathematical Analysis*, (3rd ed.). New York: McGraw-Hill/ Irwin.

### *Suggested Readings*

1. Sydsaeter, K., & Hammond, P. (2012). *Essential Mathematics for Economic Analysis* (3rd ed.). New Jersey: Prentice Hall Publisher.

Agribusiness management, applies business theories and practices to the agricultural industry to lower costs, boost profits and ensure that farm or food products are grown and distributed effectively. This course provides a perspective and understanding of the key components of agricultural business management, with a focus on the management tools used to measure business performance. There will be an emphasis on evaluating farm businesses incorporating financial, marketing, production and human resource management tools, decision making techniques, technology adoption and management of risk. After completing the course, students will have developed some understanding of concepts, principles and issues in business management.

### *Contents*

1. Scope of Agribusiness Management
2. Functions of management
3. Forms of business organizations
4. Principles and Techniques of farm planning, operation and management
5. Enterprise budgeting
6. Resource constraints
7. Optimum combinations and alternate business plans.
8. Balance Sheet, income statement and their analysis
9. Benefit Cost Analysis
10. Uncertainty and Risk in Farm Business
11. Risk Management Strategies
12. Supply chain management and Relevant Case studies
13. Role of Government in Agribusiness management

### *Recommended Texts*

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

### *Suggested Readings*

1. Kinsey, B. H. (2002). *Agri. Business and Rural Enterprise*. London: Croom Helm Ltd.
2. Goldberg, R. A., Wilson, L. M., & Austin, J. E. (1974). *Agribusiness Management for Developing Countries*. Cambridge, MA: Ballinger Publishing Company.
3. Buckett, M. (1981). *An Introduction to Farm Organization and Management*. USA: Elsevier Science & Technology Books.
4. Kay, R., Edwards, W., & Duffy, P. (2007). *Farm Management (7th ed.)*. EU: McGraw Hill Education.

This course helps students develop the understanding that they will need to make informed decisions using data, and to communicate the results effectively. The course is an introduction to the essential concepts, tools and methods of statistics for students in business, economics and similar disciplines. The focus is on concepts, reasoning, interpretation and thinking rather than computation, formula and contents. After completing the course, students will be able to apply the statistical tools and techniques in the field of agricultural economics.

#### *Contents*

1. Index numbers
2. The concept of Index Numbers
3. Different types of indices and their uses
4. Random Variables and their distribution, probability and Density function
5. Estimation of Parameters
6. Properties of Estimators
7. Confidence interval of means and proportions
8. Variance of normal distribution
9. Variance and Covariance
10. Hypothesis testing
11. Chi Square Test, Analysis of Variance (ANOVA)
12. Correlation, Introduction to Regression Analysis
13. Application of software to various estimation techniques

#### *Recommended Texts*

1. Wonnacott, T.H., & Wonnacott, R.J. (1990). *Introductory Statistics* (5th ed.). New York: John Wiley Publishers.
2. Floyd, J.E. (2010). *Statistics for economists: a beginning*. Toronto: University of Toronto.

#### *Suggested Readings*

1. Aczel, A. D. (1995). *Statistics, Concepts and Applications*. USA: Richard D. Irwin Inc.
2. Newbold, P., Carlson, W., & Thorne, B. (2010). *Statistics for Business & Economics*, (8th ed.). USA: Pearson Hall Publisher.

Econometrics-I introduce students the regression methods for analyzing data in economics. This course emphasizes both the theoretical and the practical aspects of statistical analysis, focusing on techniques for estimating econometric models of various kinds and for conducting tests of hypotheses of interest to economists. The goal is to help students develop a solid theoretical background in introductory level econometrics, the ability to implement the techniques and to critique empirical studies in economics. After completing the course, students will be in a position to apply the econometric tools and techniques in the field of Agricultural Economics.

#### *Contents*

1. Definition, scope and importance of econometrics
2. Basic concepts
3. Properties of statistical estimators
4. Inferences and hypothesis testing
5. Regression analysis
6. OLS estimation of simple and multiple Regression
7. Dummy variables
8. Specification bias and tests
9. Concepts of Multicollinearity
10. Heteroscedasticity
11. Autocorrelation

#### *Recommended Texts*

1. Gujarati, D.N. (2009). *Essentials of Econometrics* (4th ed.). London: McGraw-Hill.
2. Wooldridge J.M. (2012). *Introductory Econometrics: A Modern Approach* (5th ed.). USA: Cengage Learning Publisher.

#### *Suggested Readings*

1. Mirar, T.W. (1990). *Economic Statistics and Econometrics*. New York: McMillan Publishing.
2. Ramanathan R. (2001). *Introductory Econometrics with Applications* (5th ed.). Ohio: South-Western College Publisher.



The course provides the students theoretical knowledge regarding natural resource management and economic concepts associated with its management. This course will help students in preparation of sustainable approaches for the proper utilization of natural resources and pricing regarding economic and optimal use of resources available. The key outcomes of this course are to introduces the students with basic concept of natural resources and their proper handling and to aware the students about concept of socially optimal resource-use and their evaluation.

#### *Contents*

1. Concepts of natural resources
2. Optimal use of renewable and nonrenewable resources
3. Issues related to natural resources (soil, water, forest, fisheries and environment)
4. Resource scarcity, prices, demand and supply of natural resources
5. Market equilibrium
6. Economic efficiency
7. Inter-temporal efficiency
8. Property rights
9. The economics of pollution
10. Natural resource exploitation
11. Economic approaches to conservation of natural resources
12. Benefit cost analysis

#### *Recommended Texts*

1. Bergstrom, J.C., & Randall, A. (2010). *Resource Economics- An Economic Approach to Natural Resource and Environmental Policy*. New York: Edward Elgar Publishing.
2. Tietenberg, T., & Lewis, L. (2013). *Environmental and natural resource economics*. (9th ed.). New Jersey: Prentice Hall Publisher.

#### *Suggested Readings*

1. Ashfaq, M., Griffith, G., & Hussain, I. (2009). *Economics of Water Resources in Pakistan*. Pakistan: Pak TM Publishers.
2. Common, M., Perman, D. R., Ma, D. Y., Maddison, D. D., & Mcgilvray, D. J. (2011). *Natural Resource and Environmental Economics*. (4th ed.). Boston: Longman/Addison Wesley.

The course is designed to provide students a general overview of the fundamentals of finance and its application in agriculture and agribusiness. Consequently, it will cover a broad range of finance topics and applications. In addition to a broad overview of finance, it will also cover in some detail several fundamental concepts of finance, including the nature of financial markets, financial instruments and techniques that are critical in financial decision-making. The objectives of the course may be summarized as *firstly* to introduce students to agricultural finance and highlight the importance of finance in real-world decision-making and the uniqueness of finance related to agriculture and *secondly* to introduce the fundamental concepts and techniques that are at the heart of financial decision-making. This course will cover various topics including the time value of money, financial statement analysis, capital budgeting and structure, investment decisions, farmland valuations, credit, banking, agricultural lending, risk management and financial markets.

#### *Contents*

1. Nature and scope of agricultural finance
2. Sources and types of financial instruments and intermediaries in Pakistan's perspective
3. Credit assessment and decision criteria
4. Agricultural credit markets
5. Agricultural credit policies and their problems
6. Role of central bank and other financial institutions in agricultural financing
7. Classification of loans
8. Insurance in agricultural sector
9. Micro-credit and role of NGO's in agricultural lending and development
10. Nature and scope of financial management
11. Time value of money
12. Capital budgeting
13. Capital and its cost
14. Financial analyses
15. Capital structure
16. Liquidity and lender-borrower relationship and credit evaluation
17. Risk management
18. Financial markets

#### *Recommended Texts*

1. Reddy, S. S., & Ram, P. R. (1996). *Agricultural Finance and Management*. New Delhi: Oxford & IBH publisher.

#### *Suggested Readings*

1. Barry, P. J., Ellinger, P. N., Hopkin, J.A., & Baker, C. B. (2000). *Financial Management in Agriculture* (6th ed.). New Jersey: Prentice Hall.
2. Downey, W.D., & Enieson, S.P. (2002). *Agribusiness Management*. Singapore: McGraw Hill.

Agricultural production economics is concerned with the productivity of farm inputs. As such it deals with resource allocation, resource combinations, resource use efficiency, resource management and resource administration. After completing the course, students will be able to understand the theoretical core of production economics. The course is focused on economic analysis of production agriculture. The influential role of plant and animal biological growth processes sets this field of study apart from industrial production processes, where much greater levels of control are available to the producer and input and output relationships are measured with more completeness and precision. The course will cover the basic contents and analytical tools required to conduct analysis of optimal management decisions subject to the biological production technology.

#### *Contents*

1. Definition and scope of agricultural production economics
2. Assumptions of static and dynamic production economics
3. Production relationships, i.e. factor-product relationships, factor-factor relationship and product-product relationships
4. Economic decision making under various production relationships
5. Costs of production
6. Returns to scale
7. Technological change
8. Resource allocation

#### *Recommended Texts*

1. Debertin, D.L. (2012). *Agricultural Production Economics* (2nd ed.). New York: McMillan Publishing.
2. Beatie, B. R., Taylor, C. R., & Myles, W.J. (2009). *The Economics of Production*. New York: Krieger Publishing.

#### *Suggested Readings*

1. Doll, J.P., & Orazem, F. (1992). *Production Economics: Contents with Applications* (2nd ed.). New York: Krieger Publishing.

This course is designed for students who wish to gain an understanding of the limits and potentials of social science research, and for those who intend to research social phenomena scientifically. This course is intended to facilitate student's awareness of the research process and their ability to conduct research in an ethical and thorough manner using appropriate research strategies. This course has technical and critical components. This means understanding the course requires a good grasp of many technical concepts and processes and applying these concepts to the study of social phenomena. After completing the course, students will be in a position to understand the methods of conducting research in the field of social sciences.

#### *Contents*

1. Foundation of Empirical Research
2. The scientific approach
3. The Conceptual foundation of Research
4. Research Ethics
5. Review of literature and plagiarism
6. Research proposal and its contents
7. Sampling and Sample Design
8. Survey methods
9. Observation methods
10. Data Types
11. Questionnaire construction process
12. Data collection: Data coding, entry and analysis
13. Univariate, bivariate and multivariate analyses
14. Citation methods
15. Presentation and dissemination of research results

#### *Recommended Texts*

1. Nachmias, C. F., & Nachmias, D. (2007). *Research Methods in the Social Sciences*, (7th ed.). London: Worth Publisher.
2. Ethridge, D. E. (2004). *Research Methodology in Applied Economics* (2nd ed.). New Jersey: Wiley-Blackwell.

#### *Suggested Readings*

1. Baker, T. L. (1998). *Doing Social Research* (3rd ed.). London: McGraw-Hill Social Science Series.
2. Vaus, D.A. (1993). *Surveys in Social Research*. Australia: Allen & Unwin Pvt. Ltd.
3. Goode, W.J., & Hatt, P.K. (1999). *Methods in Social Research*. US: McGraw Hill Inc.

This course provides a critical overview of theoretical, empirical and policy issues relating to international economics. The first part of the course introduces the main theories of international trade, including standard neoclassical free trade approaches and recent theories addressing imperfect competition, economies of scale, national competitiveness issues, and managed trade. It also discusses topics in international trade such as the effects of trade on income distribution and poverty, the debate about import substitution and trade protection, and alternative approaches to trade policy. It also covers topics in international macroeconomics and finance, including inter alia, the balance of payments, exchange rate policy, globalization and international capital flows, financial crises and regionalism. After qualifying the course, the students will be able to understand the theories and dimensions of international economics.

### *Contents*

1. Concept of International economics and trade
2. Market integration and challenges
3. Trade Theories
4. Free trade versus protectionism
5. Tariff and non-tariff trade barriers
6. Approaches to the measurement of protection
7. Distortion and comparative advantage
8. The effects of exchange rates on the agricultural and food sectors
9. Commodity and price instability and terms of trade
10. International commodity agreements
11. Balance of payment in Pakistan's perspective
12. International migration and remittances

### *Recommended Texts*

1. Salvatore, D. (2007). *International economics* (9th ed.). New Jersey: Wiley Publisher.
2. Krugman, P.R., & Obstfeld, M. (1998). *International Economy: Contents and Policy*. New York: Addison-Wesley Longman.

### *Suggested Readings*

1. Appleyard, R.D., Field, A. J. & Cobb, S. (2009). *International Economics* (7th ed.). New York: Irwin/McGraw-Hill Publisher.
2. Appleyard, R.D. (2006). *International Economics, Trade, Contents and Policy* (3rd ed.). Illinois: Richard D. Irwin.

Econometrics -II provides the basic tools of applied econometric analysis. The course is based on regression analysis (covered in Econometrics 1) and gives a thorough introduction to the problem of endogeneity with possible treatments, time series regressions, linear panel models, and nonlinear probability and censored outcomes models. Successful completion of the course enables students: To understand how econometric methods are used to estimate causal relationships from observational data; possess a critical understanding of identification and estimation problems in economics and other social sciences; formulate simple research questions and carry out independent analyses in order to answer those and argue for and against endogeneity of right-hand side variables; prove consistency and asymptotic bias of estimators; understand the logic of sampling variance and distribution of estimators and understand the properties of time-series.

#### *Contents*

1. Overview of issues of multicollinearity
2. Heteroscedasticity and Autocorrelation
3. Causes, effects, tests and remedial measures
4. Model specification issues
5. Limited dependent variables (LPM, Tobit, Logit and Probit Models)
6. Auto regressive and distributed lag models
7. Time series analysis
8. Simultaneous equation models and their estimation approaches
9. Panel Data Analysis

#### *Recommended Texts*

1. Gujarati, D.N. (2009). *Essentials of Econometrics* (4th ed.). London: McGraw-Hill.
2. Wooldridge J.M. (2012). *Introductory Econometrics: A Modern Approach* (5th ed.). USA: Cengage Learning Publisher.

#### *Suggested Readings*

1. Mirar, T.W. (1990). *Economic Statistics and Econometrics*. New York: McMillan Publishing Co.
2. Ramanathan R. (2001). *Introductory Econometrics with Applications* (5th ed.). Ohio: South-Western College Publisher.



The objective of this course is to provide students with an understanding of the motivations for government policies related to food and agriculture, and the policy instruments that are used to pursue policy. The first part of the course introduces motivations for agricultural policies and describes some tools that can be used to meet policy goals. The second part provides details on specific policies, with emphasis on Pakistani food and agricultural policies and programs, however it is important to note that the primary goal of this course is not to memorize the details of specific government policies. Government policies change every few years, so knowledge of a specific program is useful only for limited period of time. This course is intended to provide students with the tools to understand and analyse both current and future agricultural policies. After completing the course, students will be able to understand the economic thought behind agricultural issues & policies from Pakistan's perspective.

### Contents

1. Overview of Pakistan's economy and role of Agriculture
2. Major issues and problems in agriculture development of Pakistan
3. Agricultural Policy, policy goals, policy instruments
4. Policy formulation, tradeoffs between goals
5. Land Reforms and land tenure system
6. Agricultural pricing policies, input-Output pricing policies
7. Policy of Agricultural Marketing
8. Agro-based industries
9. Agri-Taxation and subsidies
10. Agri. Credit and finance policies
11. Trade policies for agricultural commodities
12. Farm mechanization
13. Agri. extension, research and educational policies
14. Irrigation policies of Pakistan
15. Institutional reforms
16. Rural development policies
17. Past policies and their evaluation

### Recommended Texts

1. Eckert, J. (1990). *Agricultural policy manual: A discussion of agricultural policies for development*. Islamabad, Pakistan: Directorate of Agricultural Policy and Chemonics International Consulting Division for the EAN/Economic Analysis Network Project in collaboration with the Ministry of Food, Agriculture and Cooperatives, Govt. of Pakistan and United States Agency for International Development.
2. Ellise, F. (1992). *Agricultural Policies in Developing Countries*. Cambridge: Cambridge University Press.

### Suggested Readings

1. Govt. of Pakistan. (1988). *Report of the National Commission on Agriculture*. Islamabad: Ministry of Food and Agriculture.
2. Knutson, R.D., Penn, J.B. & Bocam, W.T. (2002). *Agricultural and Food Policy*. New Jersey, USA: Prentice Hall.
3. Naqvi, H.M., & Harold, J. (1998). *National Conference on Agriculture Policies & Farmers in Pakistan May 19-21, 1992*. Peshawar: Proceedings, Academy of Rural Development.

This course is about animal production and management economics. The objectives of the course are to provide students with an advanced understanding of the economics of animal feeds and feeding, to provide a good understanding of principles of aggregate demand and supply in livestock trade and to provide students with an understanding of marketing margins for dairy products, integration and management of livestock enterprises, integration of livestock and crop enterprises.

#### *Contents*

1. Importance of livestock in the economy of Pakistan
2. Comparative economics of livestock and crop enterprises
3. Economics of livestock and poultry
4. Economic analysis of livestock products
5. Cost and profitability estimations procedures
6. Labor-input estimate
7. Capital input estimate
8. Economics of milk, beef and hides and skins
9. Economics of green fodder
10. Dry fodder and concentrates
11. The livestock industry structure and problems
12. Economic losses due to various factors
13. Techniques of estimation of losses
14. Economic analysis of budgeting with different techniques
15. Economics of genetic engineering in livestock
16. Measures of economic efficiency
17. Uncertainty and risk
18. Trend and future of livestock and poultry

#### *Recommended Texts*

1. Ahmed, B., Ahmed, M., & Chaudhry, M. A. (1996). *Economics of Livestock Production*. Faisalabad: University of Agriculture, Faculty of Agri. Economics and Rural Sociology.
2. Ruhela, A. (2010). *Livestock Economics*. Jaipur: Oxford Book Company.

#### *Suggested Readings*

1. Bernad, C.S., & Nix, J.S. (1979). *Farm Planning and Control* (2nd ed.). Cambridge: University Press.
2. Kay, R. D., Edwards, W., & Duffy, P. (2007). *Farm Management: Planning, Control and Implementation* (6th ed.). London, McGraw Hills.

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

#### *Contents*

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

#### *Recommended Texts*

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

#### *Suggested Readings*

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.

The students will be attached individually or in groups with the field staff of the Economics & Marketing, Department of Agricultural, Nation Building Departments (NBDs), Non-Governmental Organizations (NGOs), etc. In addition, the students will pay study visits to various agricultural research stations and economics projects in the province/country with special reference to the following:

1. Field crop production and protection
2. Livestock and poultry management
3. Seed farms
4. Fruits and vegetable production, preservation, processing (packages industry & cold storage) and protection
5. Manures/chemical fertilizers
6. Water management/irrigation department
7. Maintenance of official records
8. Agriculture credit, business and marketing cooperatives
9. Rural Support Programs/NGO's
10. Institutes of Economic Research and Rural Development

#### *Research Project/Internship*

Every student will write a comprehensive report based on his/her field experiences, according to the following guidelines and present individually in the class

1. Introduction
2. Objectives of apprenticeship training program
3. Daily activity report
4. Activities undertaken during training
5. Future plans for work in different areas of Agricultural Economics
6. Problems faced by field staff (host institutes/department), farmers and internee
7. Relationship of Agricultural Economics with other nation building departments, agencies and stakeholders
8. Suggestions for improvement of internship program
9. Suggestions for the improvement of Agricultural Economics and Marketing

#### *Recommended Texts*

1. FAO. (2010). *Manuals of Agriculture*. Washington, DC: USAID.

#### *Suggested Readings*

1. Mickhel, B. (2000). *Integrating Quantitative and Qualitative Research in Development Project*. Washington, DC: USAID.
2. Keith, H., Jhon, P., & Jhon, S. (2002). *The Management of Student to Research Project*. (3rd ed.). Burlington: Grower publishing.