

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

**MAJOR: AGRONOMY
(Four Years Program)**



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

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

MAJOR: AGRONOMY

(Four Years Program)

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

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

*Comp. = Compulsory Course

**FC = Interdisciplinary Foundation Course

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

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

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

*Supp. = Supporting Course

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

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

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

Course No.	Title of Course	Credit Hours	Type
PP - 202	Introductory Plant Pathology	3 (2-1)	FC
FST - 202	Food Processing & Preservation	3 (2-1)	FC
Ento - 202	Applied Entomology	3 (2-1)	FC
AEE - 202	Introduction to Agriculture Extension	3 (3-0)	Supp.

Eng - 202	Communication Skills & Leadership Development	3 (3-0)	Comp.
RS - 202	Rural Sociology & Development	2 (2-0)	Supp.
Agr - 202	Field Crop Production – II	2 (1-1)	FC
	Total Credit Hrs.	19	

List of additional Supporting Courses*

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

*Courses to be offered in addition/replacement of existing supporting courses in the scheme of studies.

5th Semester B.Sc. (Hons) Agriculture (Major: Agronomy)

Course No.	Course Title	Credit Hours
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Agr-301	Introduction to Weed Science	3 (2-1)
Agr-303	Irrigation Agronomy	3 (2-1)
Agr-305	Field Crop Physiology	3 (2-1)
Agr-307	Agro-Technology of Major Crops	3 (2-1)
Agr-309	Farm Record Maintenance	3 (2-1)
Agr-311	Arid and Rainfed Agriculture	3 (2-1)
Agr-313	Agro Ecology	3 (3-0)
Agr-315	Forage and Fodder Production	3 (2-1)
Agr-317	Production Technologies of Condiments and Spice	3 (2-1)

6th Semester B.Sc. (Hons) Agriculture (Major: Agronomy)

Course No.	Course Title	Credit Hours
Agr-302	Water Management in Rainfed Area	3 (2-1)
Agr-304	Plant Nutrients and Growth Regulators	3 (2-1)
Agr-306	Seed Production Technology	3 (3-0)
Agr-308	Organic Farming	3 (3-0)
Agr-310	Environment and Crop Production	3 (2-1)
Agr-312	Introduction to Crop Modeling	3 (2-1)
Agr-314	Coastal Agriculture	3 (3-0)
Agr-316	Principles of Weed Science	3 (2-1)

7th Semester B.Sc. (Hons) Agriculture (Major: Agronomy)

Course No.	Course Title	Credit Hours
Agr-401	Crop Management under Stressful Environments	3 (2-1)
Agr-403	Biological Nitrogen Fixation	3 (2-1)
Agr-405	Conservation Agronomy	3 (2-1)
Agr-407	Medicinal and Special Crops	3 (2-1)
Agr-409	Plant and Soil Analysis	2 (1-1)

Agr-411	Research and Scientific Writing	3 (2-1)
Agr-413	Principles of Weed Science	3 (2-1)
Agr-415	Forage and Fodder Production	3 (2-1)

8th Semester B.Sc. (Hons) Agriculture (Major: Agronomy)

Course No.	Course Title	Credit Hours
Agr-422	Internship / Study Project	5 (0-5)
Agr-424	Seminar	1 (1-0)

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

Agr – 101: **BASIC AGRICULTURE** **3 (2-1)**

Objective

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

Theory

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

Practical

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

Recommended Books

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

6. Qureshi, M.A. M.A. Zia and M.S. Qureshi. 2006. Pakistan Agriculture Management and Development. A-One Publisher, Urdu Bazar, Lahore.

SS-101: INTRODUCTION TO SOIL SCIENCE

3 (2-1)

Objective and Learning Outcome

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

Theory

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

Practical

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

Recommended Books

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

Hort. 101:

INTRODUCTORY HORTICULTURE

3 (2-1)

Prerequisites

F.Sc. (Pre-Medical)

Specific Objectives

To enable the students to understand the basics of Horticulture.

Learning Outcomes

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

Theory

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

Practical

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

Books recommended

1. Chadha, K.L. 2006. Handbook of Horticulture (6th Ed.). ICAR, New Delhi, India.
2. Christopher, E. P. 2012. Introductory Horticulture. Biotech books, new Dehli, India.
3. Carrol,L., J.R.Shry and H.E. Reily. 2011. Introductory Horticulture (8th Ed.) Delmar-Thomson Learning , Albany, USA
4. Hartmann, H.T., D.E. Kester, E.T. Davies and R.L. Geneve. 2009. Plant Propagation–Principles and Practices (7th Ed.). Prentice-Hall India Learning Pvt. Ltd., New Delhi, India.

5. Malik, M.N. 1994. Horticulture. National Book Foundations, Islamabad.
6. Peter, K.V. 2009. Basics of Horticulture. New India publishing Agency, New Dehli, India.
7. Reiley, H.E., C.L. Shry (Jr). 2004. Introductory Horticulture (6th Ed.). Delmar- Thomson Learning, Albany, USA.
8. Reddy, R. and Shanker J.P.A. 2008. Horticulture. Commonwealth Publishers.
9. Sharma, R.R. 2002. Propagation of Horticultural Crops: Principles and Practices. Kalyani Publishers, Ludhiana, New Delhi, India.

Eng – 101:

EXERCISE IN READING, WRITING & COMPREHENSION

3 (3-0)

Objectives

Enhance language skills and develop critical thinking.

Course Contents

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

Comprehension: Answers to questions on a given text

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

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

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

Translation skills: Urdu to English

Presentation skills: Introduction

Note: Extensive reading is required for vocabulary building

Recommended Books

a) Grammar

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

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

CS – 101: INTRODUCTION TO INFORMATION AND COMMUNICATION TECHNOLOGIES 3 (2-1)

Objectives and Learning outcome

This is an introductory course on Information and Communication Technologies. Topics include ICT terminologies, hardware and software components, the internet and world wide web, and ICT based applications.

After completing this course, a student will be able to:

- Understand different terms associated with ICT
- Identify various components of a computer system
- Identify the various categories of software and their usage
- Define the basic terms associated with communications and networking
- Understand different terms associated with the Internet and World Wide Web.
- Use various web tools including Web Browsers, E-mail clients and search utilities.
- Use text processing, spreadsheets and presentation tools
- Understand the enabling/pervasive features of ICT

Course contents

Basic Definitions & Concepts, Hardware: Computer Systems & Components, Storage Devices, Number Systems, Software: Operating Systems, Programming and Application Software, Introduction to Programming, Databases and Information Systems, Networks, Data Communication, The Internet, Browsers and Search Engines, The Internet: Email, Collaborative Computing and Social Networking, The Internet: E-Commerce, IT Security and other issues,

Text Books/Reference Books:

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

Math – 101:

ELEMENTARY MATHEMETICS

3 (3-0)

Prerequisite(s)

Mathematics at secondary level

Objective

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

Course Outline

Matrices: Introduction to matrices, types, matrix inverse, determinants, system of linear equations, Cramer's rule.

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

Sequences and Series: Arithmetic progression, geometric progression, harmonic progression.

Binomial Theorem: Introduction to mathematical induction, binomial theorem with rational and irrational indices.

Preliminaries: Real-number line, functions and their graphs, solution of equations involving absolute values, inequalities.

Limits and Continuity: Limit of a function, left-hand and right-hand limits, continuity, continuous functions.

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

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

Recommended Books:

1. Dolciani MP, Wooton W, Beckenback EF, Sharron S, *Algebra 2 and Trigonometry*, 1978, Houghton & Mifflin, Boston (suggested text)

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

IS – 101:

ISLAMIC STUDIES

2 (2-0)

Objectives

This course is aimed at:

- 1 To provide Basic information about Islamic Studies
- 2 To enhance understanding of the students regarding Islamic Civilization
- 3 To improve Students skill to perform prayers and other worships
- 4 To enhance the skill of the students for understanding of issues related to faith and religious life.

Course outlines

Introduction to Quranic Studies: Basic Concepts of Quran

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

Study of Selected Text of Holly Quran:

- 1) Verses of Surah Al-Baqra Related to Faith(Verse No-284-286)
- 2) Verses of Surah Al-Hujrat Related to Adab Al-Nabi (Verse No-1-18)
- 3) Verses of Surah Al-Mumanoon Related to Characteristics of faithful (Verse No-1-11)
- 4) Verses of Surah al-Furqan Related to Social Ethics (Verse No.63-77)
- 5) Verses of Surah Al-Inam Related to Ihkam(Verse No-152-154)

Study of Selected Text of Holly Quran

- 1) Verses of Surah Al-Ihzab Related to Adab al-Nabi (Verse No.6,21,40,56,57,58.)

- 2) Verses of Surah Al-Hashar (18,19,20) Related to thinking, Day of Judgment
- 3) Verses of Surah Al-Saf Related to Tafakar,Tadabar (Verse No-1,14)

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

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

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

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

Introduction to Sunnah

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

Selected Study from Text of Hadith

Introduction to Islamic Law & Jurisprudence

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

Islamic Culture & Civilization

- 1) Basic Concepts of Islamic Culture & Civilization
- 2) Historical Development of Islamic Culture & Civilization

- 3) Characteristics of Islamic Culture & Civilization
- 4) Islamic Culture & Civilization and Contemporary Issues

Islam & Science

- 1) Basic Concepts of Islam & Science
- 2) Contributions of Muslims in the Development of Science
- 3) Quran & Science

Islamic Economic System

- 1) Basic Concepts of Islamic Economic System
- 2) Means of Distribution of wealth in Islamic Economics
- 3) Islamic Concept of Riba
- 4) Islamic Ways of Trade & Commerce

Political System of Islam

- 1) Basic Concepts of Islamic Political System
- 2) Islamic Concept of Sovereignty
- 3) Basic Institutions of Govt. in Islam

Islamic History

- 1) Period of Khlaft-E-Rashida
- 2) Period of Ummayyads
- 3) Period of Abbasids

Social System of Islam

- 1) Basic Concepts of Social System of Islam
- 2) Elements of Family
- 3) Ethical Values of Islam

Reference Books

- 1) Hameed ullah Muhammad, “Emergence of Islam” , IRI, Islamabad
- 2) Hameed ullah Muhammad, “Muslim Conduct of State”

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

Hort. 102:

HORTICULTURAL CROP PRODUCTION

3 (2-1)

Prerequisites

Introductory Horticulture

Specific Objectives

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

Learning Outcomes

Students are expected to grow different horticultural crops of the region

Theory

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

Practical

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

Books recommended

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

AH - 102: INTRODUCTION TO ANIMAL HUSBANDRY 3 (2-1)

Pre Requisites

Students should know how to rear pet animals

Objectives

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

Theory

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

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

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

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

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

Practical

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

Demonstration of various components of livestock farming, various housing plans

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

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

Books Recommended

1. Benejee,G.C., 1998. A Textbook of Animal Husbandry. Oxford and IBH Publ, Co., New Delhi, India.
2. Card, L.,E. and M.C. Neshim, 1973. Poultry Production (11th Ed.) Bailliere Tindall, London, UK.
3. Donald, D. B. and W. D. Weaver, 2007. Commerical Chicken , Meat and Egg Production, Springer Pvt. Ltd., India.

4. Haq, A. and M. Akhtar, 2004, Poultry Farming. Higher Education Commission, H-9, Islamabad, Pakistan.
5. Henderson, H.O. and S. Reaves, 1962. Dairy Cattle Feeding and Management. John Wiley and Sons, Inc., New York, USA.
6. Khan, B.B., M. Yaqoob, M. Riaz and M. Younas, and A. Iqbal, 2004. Livestock Management Manual. Dep. Of Livestock Management, University of Agriculture Faisalabad.
7. Khan, B.B., M. Younas, M. Riaz and M. Yaqoob, 2005. Breeds of Livestock in Pakistan. Pak T.M. printers, Aminpur Bazar, Faisalabad, Pakistan.
8. Tamarin, R., 1999. Principles of Genetics (6th Ed.) McGraw Hill Co., Boston, USA.
9. Shah, S.I. (Ed.) 1994., Animal Husbandry. National Book Foundation, Islamabad.
10. McDonald, P., R.A. Edwards, J.F.D. Greenhalgh and C.A. Morgan, 2008. Animal Nutrition. (6th Ed.) Longman Scientific and Technical publishers, UK.
11. Lasley, J.F., 1963. Genetics of Livestock Improvement. Prentice Hall Inc. Englewood Cliffs, N.F. USA.

AE – 102: INTRODUCTION TO AGRICULTURAL ECONOMICS 3 (3-0)

Objectives

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

Course contents

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

Text books

1. Penson, J. B., Capps O. Rossen C. P., & Woodward, R. (2013). Introduction to Agricultural Economics. 5th Edition. New Jersey: Prentice Hall.
2. Samuelson, P. A., & Nordhaus, W. D. (2009). Economics. 19th Edition. New York: McGraw Hills.

3. McConnel, C.R; Brue, S.L and Flynn, S.M. (2011). Economics: Principles, Problems and Policies 19th Edition. New York: McGraw-Hills.

Suggested readings

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

Stat – 102:

INTRODUCTORY STATISTICS

3 (3-0)

Objectives

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

Course outlines

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

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

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

Sampling Probability and non-Probability Sampling, Simple random sampling stratified random sampling Systematic sampling error, Sampling distribution of mean and difference between two means. Interference Theory: Estimation and testing of hypothesis, Type—I and type-II error, Testing of hypothesis about mean and difference between two means using Z-test and t-test, Paired t-test, Test of association of attributes using X² (chi-square) Testing hypothesis about variance.

Recommended books

1. Introduction to Statistical Theory Part- I by Sher Muhammad and Dr. Shahid Kamal (Latest Edition)
2. Statistical Methods and Data Analysis by Dr. Faquir Muhammad

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

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

Objective

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

Theory

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

Practical

1. Identification of important forest species

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

Recommended Books

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

CP – 102:

GENERAL CROP PHYSIOLOGY

2 (1-1)

Theory

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

Practical

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

Recommended Books

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

ID – 102: IRRIGATION & DRAINAGE PRACTICES 2 (1-1)

Prerequisites

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

Aims

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

Objectives

1. To transfer the knowledge of Irrigation agronomy and Canal Irrigation System of Pakistan to the students.
2. To produce skilled persons who can contribute in the development of agriculture sector in terms of beneficially utilizing the scarce and precious water and its losses management through;
 - i. Introducing most practicable irrigation techniques

- ii. Delivering awareness to the farmers to minimize the water losses and bringing the more area under cultivation.
- iii. Properly applying the schedule of irrigation.
- iv. The use of precision land leveling.

Theory

Introduction and scope about the Course, Irrigation & Drainage Practices (ID), Definition and importance of irrigation, purpose & goal of irrigation, Benefits of irrigation, disadvantage & ill-effects of irrigation, source of irrigation water in Pakistan, system of irrigation, Indus Basin Irrigation System of Pakistan, Irrigation System Management, Warabandi, Hill Torrents etc., **Water Measurement:** Need of water flow measurement; Terminology used in water flow measurement; **Irrigation Methods:** Basin Irrigation; Border Irrigation Method; Furrow irrigation method; Sub-Surface irrigation method, High Efficiency Irrigation Methods (Drip/trickle, Sprinkler irrigation system), Consumptive use, its importance, and methods of determination, Definition, importance, components of irrigation scheduling. Well Drilling: methods of well drilling (cable tool method, rotary method), cable tool method; Rotary methods (direct rotary method, reverse rotary method), Well strainers, Development of well and pump characteristics, Pumps and their Use: definition, types of pump (reciprocating pump, jet pump, centrifugal pump, deep well turbine pump, and submersible pump), The Evaporation Pan, Introduction To Drainage, Agricultural drainage, Urban drainage; Objectives of Agricultural Drainage; Surface and Sub-surface Drainage; Occurrence of Drainage Problems; Sources of Drainage Water, Sprinkler Systems; Adverse Effects of Drainage Problems; Identification of Drainage Problems; Solution of the Drainage Problems; Pipe Drainage for Sub-Surface Drainage; Deep Surface Drains for Watertable Control, Irrigation efficiency, Surface Drains for Storm Water Drainage; Drainage Tubewells; Biological Drainage, Rainwater Harvesting/conservation Technologies/ techniques for Small Scale Rainfed Agriculture in Arid and Semi-arid Areas, Role of Remote sensing and GIS in sustainable irrigation,

Practical

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

Reference Material

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

PS – 102:

PAKISTAN STUDIES

2 (2-0)

Objectives

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

Course Outline

1. *Historical Perspective*

- a. Ideological rationale with special reference to Sir Syed Ahmed Khan, Allama Muhammad Iqbal and Quaid-i-Azam Muhammad Ali Jinnah.
- b. Factors leading to Muslim separatism
- c. People and Land
 - i. Indus Civilization
 - ii. Muslim advent
 - iii. Location and geo-physical features.

2. *Government and Politics in Pakistan*

Political and constitutional phases:

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

3. *Contemporary Pakistan*

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

e. Futuristic outlook of Pakistan

Recommended books

1. Burki, Shahid Javed. *State & Society in Pakistan*, The MacMillan Press Ltd 1980.
2. Akbar, S. Zaidi. *Issue in Pakistan's Economy*. Karachi: Oxford University Press, 2000.
3. S.M. Burke and Lawrence Ziring. *Pakistan's Foreign policy: An Historical analysis*. Karachi: Oxford University Press, 1993.
4. Mehmood, Safdar. *Pakistan Political Roots & Development*. Lahore, 1994.
5. Wilcox, Wayne. *The Emergence of Bangladesh*, Washington: American Enterprise, Institute of Public Policy Research, 1972.
6. Mehmood, Safdar. *Pakistan Kayyun Toota*, Lahore: Idara-e-Saqafat-e-Islamia, Club Road, nd.
7. Amin, Tahir. *Ethno - National Movement in Pakistan*, Islamabad: Institute of Policy Studies, Islamabad.
8. Ziring, Lawrence. *Enigma of Political Development*. Kent England: WmDawson & sons Ltd, 1980.
9. Zahid, Ansar. *History & Culture of Sindh*. Karachi: Royal Book Company, 1980.
10. Afzal, M. Rafique. *Political Parties in Pakistan*, Vol. I, II & III. Islamabad: National Institute of Historical and cultural Research, 1998.
11. Sayeed, Khalid Bin. *The Political System of Pakistan*. Boston: Houghton Mifflin, 1967.
12. Aziz, K.K. *Party, Politics in Pakistan*, Islamabad: National Commission on Historical and Cultural Research, 1976.
13. Muhammad Waseem, *Pakistan Under Martial Law*, Lahore: Vanguard, 1987.
14. Haq, Noor ul. *Making of Pakistan: The Military Perspective*. Islamabad: National Commission on Historical and Cultural Research, 1993.

PBG – 201:

ELEMENTARY GENETICS & PLANT BREEDING

3 (2-1)

Objectives

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

Theory

Definition of genetics, concepts of heredity and variation. Cell and cell, divisions. Mendelian genetics: chromosome theory of heredity, various, genotypic and phenotypic

ratios and their modifications. Differences between allelic and non-allelic interactions (epistasis), illustration of epistasis with suitable examples. Pleiotropy and multiple allelism. Multiple factor hypothesis. Linkage and crossing over. Sex determination: sex linked and sex influenced traits. Chromosomal aberrations. Nucleic acids: nature, structure and function. Classical vs modern concepts of gene. Introduction to plant breeding and its role in crop improvement. Reproductive systems in major crop plants. Genetic variation and its exploitation, creation of variation through genetic recombination, mutation and heteroploidy. Breeding self-pollinated crops: introduction, mass selection, pure line selection; hybridization, pedigree method, bulk method and backcross techniques. Breeding cross-pollinated crops: introduction, mass selection, recurrent selection, development and evaluation of inbred lines, development of hybrids, synthetic and composite populations. New trends in plant breeding.

Practical

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

Recommended Books

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

Objective

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

Theory

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

Practical

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

Recommended Books

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

Learning outcomes

The students would be able to;

1. Know about arthropods and especially insects with their morphological features
2. Identify insects of economic importance and acquire working skills for collecting, mounting, and preserving insects

Theory

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

Practical

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

Recommended books

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

11. Yousuf, M. Tayyab, M. and Shazia, Y. 2007. Manual of Introductory Entomology, University of Agriculture, Faisalabad.
12. Pedigo, L.P. and Marlin, E. R. 2009. Entomology and Pest Management, 6th Edition, Person Education Inc., Upper Saddle River, New Jersey 07458, U.S.A

MAB – 201:

AGRIBUSINESS MANAGEMENT

3 (3-0)

Objective and learning outcome

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

Course outlines

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

Text Books

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

Books Recommended

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

Objectives

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

Theory:

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

Practicals

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

Recommended Books:

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

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

Pre Requisites

Students should know the concept of health, disease and treatment

Aims

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

Objectives

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

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

Theory

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

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

Practical

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

Books Recommended

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

FMP – 201:

FARM MECHANIZATION AND PRACTICES

2 (1-1)

Pre Requisites

Some basic knowledge of Agriculture and physics.

Aims

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

Objectives

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

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

Theory

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

Practical

1. Internal combustion engine - different components and their functions, working principle of four stroke and two stroke cycle engine, comparison between diesel and petrol engine, difference between four and two stroke engine.
2. Terminology related to engine power: IHP, BHP, FHP, DBHP, compression ratio, stroke bore ratio, piston displacement, and mechanical efficiency. Numerical problems on calculation of IHP, BHP, C.R., stroke bore ratio, piston displacement volume.

3. Tractor Trouble Shooting (Maintenance Routine & its importance)
4. Calibration of Seed Drill
5. Mechanical Transplanting of Rice
6. Calibrating boom sprayers
7. Operation of Combine Harvester
8. Operation of LASER Land Leveling, Earthwork, time and cost analysis of LASER land leveling

Recommended Books / Lab Manual

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

Agr-201: FIELD CROP PRODUCTION-I 2 (1-1)

Objective

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

Theory

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

Practical

Identification and plant characteristic of crops, cultivars, and seeds; Demonstration of improved sowing methods; Raising of crop nurseries and their transplanting; Intercultural practices; Delinting of cotton seed; Burying of green manure crops; Visits to University/College research area.

Recommended Books

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

2. Ahmad, I. and A.R. Bhutta. 2005. A Text Book of Introductory Plant Pathology. Published by National Book Foundation, Islamabad, Pakistan.
3. Chaube, H.S. and R. Singh. 2002. Introductory Plant Pathology. International Book Distributing Co.
4. Hafiz, A. 1986. Plant Diseases. Pakistan Agricultural Research Council, Islamabad, Pakistan.
5. Mathew, J.D. 2003. Molecular Plant Pathology. Bios Scientific Publishers Ltd. UK.
6. Mehrotra, R.S. and A. Agarwal. 2003. Plant Pathology, 2nd Edition. TATA McGraw-Hill. Pub. Company Ltd. New Delhi.
7. Sambamurty, A.V.S.S. 2006. A Text Book of Plant Pathology. I.K. International Pvt. Ltd.

FST – 202:

FOOD PROCESSING & PRESERVATION

3 (2-1)

Objective:

To equip the students with basic techniques of food preservation

Theory:

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

Practical

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

Recommended Books:

1. Awan, J.A. 2011. Food processing and preservation. Unitech Communications, Faisalabad-Pakistan.
2. Awan, J.A. and Rehman, S.U. 2011. Food preservation manual. Unitech Communications, Faisalabad-Pakistan.
3. Bhat, R., Alias A.K. and Paliyat, G. 2012. Progress in food preservation. John Wiley and Sons Ltd., USA.

4. Brennan, JG. 2006. Food processing handbook. Wiley-VCH Verlag GmbH & Co. KGaA, Weinheim, Germany.
5. Fellow, P.J. 2005. Food processing technology. Woodhead Publishing Ltd. Cambridge, England.
6. Heldman, D. 2011. Food preservation process design. Elsevier Corporation, USA.
7. Rahman, M.S. 2007. Handbook of food preservation. CRC Press, Taylor & Francis Group, Boca Raton, Florida, USA.

Ento-202:

APPLIED ENTOMOLOGY

3 (2-1)

Learning outcomes

The students would be able to;

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

Theory

Introduction; causes of success and economic importance of insects; principles and methods of insect control i.e. cultural, biological, physical, mechanical, reproductive, legislative, chemical and bio-technological control; introduction to IPM; insecticides, their classification, formulations and application equipments; identification, life histories, mode of damage and control of important insect pests of various crops, fruits, vegetables, stored grains, household, termites and locust; introduction to entomological industries: apiculture, sericulture and lac-culture.

Practical

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

Recommended Books

1. Atwal, A.S. 2005. Agricultural Pests of Southeast Asia and their Management. Kalyani Publishers, Ludhiana.

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

AEE - 202: INTRODUCTION TO AGRICULTURE EXTENSION 3 (3-0)

Objectives

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

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

Theory

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

Books Recommended

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

Eng - 202: COMMUNICATION SKILLS AND LEADERSHIP 3 (3-0)
DEVELOPMENT

Objectives

Enable the students to meet their real life communication needs.

Course Contents

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

Essay writing: Introduction, Descriptive, narrative, discursive, argumentative

CV and job application

Translation skills: Urdu to English

Study skills: Skimming and scanning, intensive and extensive, and speed reading, summary and précis writing and comprehension

Academic skills: Letter/memo writing, minutes of meetings, use of library and internet

Presentation skills: Personality development (emphasis on content, style and pronunciation)

Note: documentaries to be shown for discussion and review

Recommended Books

a) Grammar

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

b) Writing

1. Writing. Intermediate by Marie-Christine Boutin, Suzanne Brinand and Françoise Grellet. Oxford Supplementary Skills. Fourth Impression 1993. ISBN 019 435405 7 Pages 45-53 (note taking).

2. Writing. Upper-Intermediate by Rob Nolasco. Oxford Supplementary Skills. Fourth Impression 1992. ISBN 0 19 435406 5 (particularly good for writing memos, introduction to presentations, descriptive and argumentative writing).
- c) Reading
1. Reading. Advanced. Brian Tomlinson and Rod Ellis. Oxford Supplementary Skills. Third Impression 1991. ISBN 0 19 453403 0.
 2. Reading and Study Skills by John Langan
 3. Study Skills by Riachard Yorky.

RS - 202: RURAL SOCIOLOGY AND DEVELOPMENT 2(2-0)

Objectives and Learning outcomes:

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

- Get introduced to the discipline of Social science.
- Basic introduction of the field of Sociology, rural sociology and development
- to enable students develop an analytical eye to study the social problems of the society
- To develop presentational skills through class participation and improve learning abilities of students with home assignments.

Course Outlines:

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

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

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

Culture and its concepts: Definitions, Types and examples

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

Social Organizations: Definitions, Types

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

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

Leadership: Definitions, elements of leadership, Classification

Recommended Books

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

Agr - 202:

FIELD CROP PRODUCTION-II

2(1-1)

Objective

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

Theory

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

Practical

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

Recommended Books

1. Baldev, B., S. Ramamjan and H.K. Jain. 1988. Pulse Crops. Oxford and IBH Pub. Co., New Delhi.
2. Martin, J.H. R.P. Waldren and D.L. Stamp. 2006. Principles of Field Crop Production 4th Ed. The McMillan Co., New York.
3. Nazir, M.S., E. Bashir and R. Bantel. (Eds.) 1994. Crop Production. National Book

Foundation, Islamabad.

4. Rahman, A. and M. Munir. 1984. Rapeseed, Mustard Production in Pakistan, PARC, Islamabad.
5. Reddy, S.R. 2004 Principles of Crop Production. 2nd Ed. Kalyani Publishers New Delhi.
6. Wolfe, T.K. and M.S. Kipps. 2004. Production of Field Crop: A Textbook of Agronomy. McGraw-Hill Book Co. New York.

MB - 102:

BASICS OF MOLECULAR BIOLOGY

2 (2-0)

Objectives

The students will learn about:

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

Course Outline

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

Books Recommended

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

Objective:

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

Theory

1. Aerial Photos. Sensors, Cameras, films and filters.
2. Types of photos scale of photos. Season of photography.
3. Aerial photo interpretation techniques
4. Photo-grammetry, measurement of scale, distance, heights and slope.
5. Satellite based Remote Sensing. Sensors platforms.
6. Introduction to energy sources and radiation principles.
7. Thermal Infrared and microwave Remote Sensing.
8. Introduction to GIS
9. Spatial data
10. Georeferencing and digitizing
11. Global Positioning System (GPS)

Practical

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

Recommended Books

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

Objective

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

Course Outline

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

Recommended Books

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

AE - 201: ECONOMICS OF CLIMATE CHANGE 3 (3-0)

Objective

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

Course Outlines

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

Suggested Readings

1. Andrew Dessler, (2012). Introduction to Modern Climate Change (2nd edition New York, USA, Cambridge, University Press.
2. Andrew Dessler, Edward A. Parson, (2010)The Science and Politics of Global Climate Change: A Guide to the Debate (2nd edition), UK Cambridge University Press,.
3. Erial Dinar and Robert Mendelsohn, Handbook on Climate Change and Agriculture Edward Elgar publishing Limited, (2011), Messachusetts, USA.
4. KashavLaalMaharajan and NirajParkash Joshi, Climate Change, agriculture and Rural Livelihood in Developing Countries, Springer, 2013.
5. K. Raja Reddy, H. F. Hodges, Climate Change and Global Crop Productivity New York, USA: CABI publishing,.
6. PradeepKurukulasuriya, Shane Rosenthal, Climate Change and Agriculture: A Review of Impacts and Adaptations World Bank 2003.

RS - 204: AGRICULTURE AND RURAL DEVELOPMENT 3 (3-0)

Course Contents

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

Text Books

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

Suggested Readings

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

4. Khan, S. S. (1980). Rural Development in Pakistan. Pakistan: Waqas Publishing House.

Biotech - 201: RECOMBINANT DNA TECHNIQUES 2 (2-0)

Objectives

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

Course Outlines

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

Recommended Books

1. Primrose, S.B., and Twyman, R.M. 2006. Gene Manipulation and Genomics 6th edition. Blackwell Publishing.
2. Watson, J.M., Caudy, A.A., Meyers, R.A., and Witkowski, J.A., 2007. Recombinant DNA. Gene and genomes. 3rd Edition. W.h. Freeman and Company, New York.

Biotech - 202: BIOSAFETY AND BIOETHICS 1 (1-0)

Objectives

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

Course Contents

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

Recommended Books

1. WHO. 2006. Laboratory Biosafety manual third edition. AITBS publishers and distributors, India. (Available online free of cost).
2. Lewis RJ. Sax dangerous properties of Industrial materials, 10th edition. Toronto, John Wiley and sons, 1999.
3. Lenga RE. 1988. The Sigma-Aldrich Library of chemical safety data, 2nd ed. Milwaukee, WI, Aldrich chemical company.
4. Furr AK. 2000. CRC handbook of laboratory safety 5th edition. Boca Raton, FL, CRC press.
5. United states Department Health and Human services. 1999. Biosafety in Microbiological and biomedical laboratories. 4th edition. Centers for disease control and prevention/National institutes of Health, Washington DC.
6. Biosafety in the Laboratory: Prudent Practices for Handling and Disposal of Infectious Materials Committee on Hazardous Biological Substances in the Laboratory, National Research Council ISBN: 0-309-55920-0, (1989) available from the National Academies Press at:
7. Bioethics & Biosafety in Biotechnology by V Sree Krishna.

Biotech - 204:

INTRODUCTORY BIOINFORMATICS

2 (0-2)

Objectives

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

Course Contents

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

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

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

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

Recommended Books

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

Biotech - 206:

AGRICULTURAL BIOTECHNOLOGY

3 (2-1)

Objectives

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

Theory

The concepts of Plant Molecular Markers, Historical Back ground of Tissue Culture, Requirements for in-vitro cultures, Role of Phyto-hormones in somatic embryogenesis, Types of Cultures: Tissue culture and regeneration, Cell culture, Haploid Culture, Protoplast culture. Somaclonal variations as breeding tool, Somatic Hybridization, Commercial application and Issues related to tissue culture, Plant Transformation; Gene Gun Method of Transformation, *Agrobacterium*-Mediated transformation, Chloroplast Transformation, PEG mediated transformation etc, Field Evaluation and Commercialization, Transgenic crops for Herbicide, Biotic and Abiotic stress resistance, Introduction to Biofertilizers. Biosafety Concerns and Bioethics on GM crops.

Practical:

Selection of ex-plant, Medium Preparation and Callus Induction, Culturing *Agrobacterium* and

Infection to plant callus, Selection of Transformants, Regeneration of Plantlets and acclimatization, Plant DNA extraction and PCR for Trans gene.

Recommended Books

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

SS - 202:

AGRICULTURAL CHEMISTRY

3 (2-1)

Objectives

The students will learn about:

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

Theory

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

Practical

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

Books Recommended

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

FST - 204:

PRINCIPLES OF FOOD SECURITY

2 (2-0)

Objectives

The students will learn about:

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

Course Outlines

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

Books Recommended

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

ES - 202:

GIS AND ITS APPLICATIONS

3 (2-1)

Objective

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

Theory

Introduction: what is GIS, why GIS, history of GIS, functional components of GIS, questions GIS can answer, GIS data models: vector data model, raster data model. *Spatial Data Acquisition and Management:* data acquisition techniques, data quality and assessment, accuracy, precision; map reference system, map projections, coordinate systems, properties of map projection, types of map projection, map datum. *GIS Database Management Systems:* what is database, advantages of database, components of DBMS. *Global Positioning System (GPS):* brief history, components of GPS, how GPS work, GPS errors, absolute positioning, differential

positioning, GPS applications. *Spatial Analysis*: what is spatial analysis, application areas, vector overlay analysis; buffering, map overlay, dissolve, clip, merge, select, eliminate, update, erase, and split tools; raster overlay analysis; high value vs low value, top map vs bottom map, factor combination model in raster GIS. *Remote Sensing*: why remote sensing, how remote sensing works, major component of remote sensing, remote sensing platforms and sensors, characteristics of optical sensors, earth resource remote sensing satellite, remotely sensed data characteristics: spectral, radiometric, spatial and temporal resolution, spectral signatures

Practical

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

Books Recommended

1. Chang, Kang-Tsung. 2006. Introduction to Geographic Information Systems. McGraw-Hill Higher Education, Columbus, Ohio, USA
2. Shamsi, U.M.. 2005. GIS Applications for Water, Wastewater, and Stormwater Systems CRC, Boca Raton, FL, USA
3. Bernhardsen, T., A. Viak and A. Norway. 2002. Geographic Information System: An Introduction. John Wiley & Sons Inc., New York, USA
4. Maidment, D. R. 2002. Arc Hydro: GIS for Water Resources. ESRI, Inc., USA.
5. ICIMOD. 2001. Application of GIS and RS in Planning for Mountain Agriculture and Land Use Management. International Centre for Integrated Mountain Development (ICIMOD), Nepa

ES - 204:

ECOSYSTEM AND ENVIRONMENT

3 (2-1)

Objectives

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

Theory

Concept, overall structure and components of Ecosystem, Energy flow and Biogeochemical cycling, Energy transfer (Food chain, Food webs, Food cycle, Trophic levels), Ecological pyramids, Productivity of ecosystems, Factors influencing environments and habitats, Impact of man on ecosystem, Fundamental of population ecology and community ecology, Human impacts on ecosystems, The Atmosphere (Composition, Minor and major gases, Water in atmosphere, Aerosols, Global circulation pattern), Pollution (Air, Water, Land, Thermal, Radiation and

Noise), Climate Change (Green House Effect and Global Warming), Ozone Depletion (Ozone-structure, Properties/Significances, Ozone destroying catalysts, Natural, Anthropogenic, Antarctic zone hole, Changing ozone Level, Impact on biosphere), Waste Type, Disposal and Management, Environmental Ethics.

Practicals:

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

Recommended Books

1. Davet, P. 2004. Microbial ecology of soil and plant growth. Science Publishers.
2. Nico, M., Straalen, V., and Roelofs, D., 2006. An Introduction to Ecological Genomics. Oxford University Press.
3. Aston, A., Harris, S., Lowe, A., 2004. Ecological Genetics: Planning and Application. Blackwell Science (UK).
4. Costa, L. G., and Eaton, D. L., 2006. Gene-Environment Interactions: Fundamentals of Ecogenetics. John-Wiley and Son Limited.
5. Freeland, J. R., 2005. Molecular Ecology. John-Wiley and Son Limited.
6. Light, A and Rolston III.H. 2003. Environmental Ethics. Blackwell Publishers Ltd. U.S.A.
7. Wenz, P. S., 2001. Environmental Ethics Today, Oxford University Press.
8. Louis P. and Pojman, L. P., 2004. Environmental Ethics: Readings in Theory and Application, 4th edition. Wadsworth Publishing.
9. Light, A., and Rolston, III. H., 2005. Environmental Ethics. Blacwell Publishing Incorporated.
10. Raven, P. H., and Berg, L. R., 2005. Environment, 5 Editionth. John-Wiley and Son Limited

Agr-301

INTRODUCTION TO WEED SCIENCE

3 (2-1)

Theory

Introduction, significance and history of weed science; Weeds-definition and classification; Losses caused by weed;, Noxious and invasive weeds; Weed survival mechanisms; Propagation

of weeds; Dispersal of weed seed and fruits; Critical weed crop competition period; Economic threshold level; Principles and methods of weed control.

Practical

Identification of common weeds, collection mounting and display of weed specimens; Demonstration of weed control methods under field condition; Calibration of sprayer; Field visits.

Books Recommended

1. Anderson, W.P. 2007. Weed Science: Principles and Applications. 4th Ed. Waveland Pr Inc., USA.
2. Ashiq, M., M.M. Nayyar and J. Ahmad. 2003. Weed Control Hand Book. Directorate of Agronomy, AARI, Faisalabad.
3. Jaya Kumar, R. and R. Jagannathan. 2007. Weed Science Principles. Kalyani Publishers, New Delhi.
4. Ziska, L.H. and J. S. Duke. 2011. Weed Biology and Climate Change. Willey Backward.
5. Tanveer, A. 2008. Biology and Ecology of Weed. HEC, Pakistan.
6. Walia, U.S. 2003. Weed Management. Kalyani Publishers, New Delhi – 110 002.
7. Zimdahl, R. 2013. Fundamentals of Weed Science. 4th Ed. Academic press.

Agr-302

WATER MANAGEMENT IN RAINFED AREAS

3 (2-1)

Objective

To educate students about moisture resource management in rainfed areas.

Theory

Concept of water management; Rainfed areas of Pakistan; Sources of water, soil as a water reservoir; Available water, water holding capacity, intake rates and movement; Effective rainfall; atmospheric variables affecting soil moisture; Rainfall, pattern and frequency; Appropriate cropping patterns and water budgeting; Water requirement and water use efficiency of crops; Water harvesting and run-off farming; Irrigation systems; *Rodhkohi* system.

Practical

Determination of bulk density and water holding capacity of soil; Measurement of moisture content; Calculation of water-use efficiency; Measurement of rainfall and evapo-transpiration.

Books Recommended

1. Arnon, I. 1992. Agriculture in Drylands: principles and practices. Elsevier, Amsterdam.
2. Anonymous. 1997. Irrigation Agronomy Manual. Ministry of Food Agriculture and Livestock, Islamabad.
3. Khan, S. R. A. 2001. Crop Management with focus on soil and water. Agric. Deptt. Govt. of Punjab, Lahore.
4. Kirkham, M.B. (Editor). 2004. Water Use in Crop Production. Narosa Publishing House Pvt. Ltd. New Delhi, India.
5. Misra, R.D. and M. Ahmad. 1990. Manual of Irrigation Agronomy. Oxford and IBH Publishing Co. New Delhi.
6. Prihar S.S. 2003. Intensive Cropping, Efficient use of Water, Nutrients, and Tillage. Pak Book Corp. Lahore.
7. Rashid, A. 1994. Soil Science. National Book Foundation Islamabad

Agr-303

IRRIGATION AGRONOMY

3 (2-1)

Objective

To provide knowledge about irrigation principles and management.

Theory

Concept of irrigation agronomy and water management; Sources of irrigation water and their efficient use in crop production; Irrigation scheduling and water use efficiency in field crops; Irrigation water losses and their control through on-farm water management practices; Current agro-technology for efficient use of irrigation water in crops; Irrigation water pollution and measures to minimize it.

Practical

Estimation of potential evapotranspiration by different methods; Calculation of water use efficiency in field crops; Potential soil moisture deficit and its calculation.

Books Recommended

1. Ali, M. H. 2010. Fundamentals of Irrigation and On-farm Water Management. Vol. 1, Springer, New York, USA.
2. Ali, M. H. 2011. Practice of irrigation and on-farm water management volume 2, Springer,

New York, USA.

3. Choudhary, M. R. 2009. A Text book of irrigation and Drainage Practices for Agriculture. University of Agric. Faisalabad, Pakistan.
4. Kirkham, M.B. (Editor). 2004. Water Use in Crop Production. Narosa Publishing House Pvt. Ltd. New Delhi, India.
5. Michael, M.A. 2003. Irrigation Theory and Practice. Vikas Publishing House Pvt. Ltd., New Delhi. India.
6. Sankara, R. G. H. and T. Y. Reddy. 2002. Efficient Use of Irrigation Water. Kalyani Publishers New Delhi, India

Agr-304 PLANT NUTRIENTS AND GROWTH REGULATORS 3 (2-1)

Objective

To provide know-how about mineral nutrition and growth regulators.

Theory

Mineral nutrients, classification, functions and deficiency symptoms; Criteria for essentiality of mineral nutrients; Factors affecting nutrient availability; Mechanisms of nutrient uptake and translocation in the plants; Composition and types of fertilizers; Biosynthesis, translocation and functions of growth regulators-auxins, gibberellins, cytokinins, abscisic acid and ethylene.

Practical

Raising plants in different growth media with various nutrients; Identification of deficiency symptoms; Demonstration of nutrient uptake; Demonstration of plant responses to growth regulators.

Books Recommended

1. Epstein, E. and A. J. Bloom. 2004 Mineral Nutrition of Plants: Principles and Perspectives. John Wiley and Sons Inc., USA.
2. Havlin, J.L., Tisdale, S.L., J.D. Beaton and W.L. Nelson. 2005. Soil Fertility and Fertilizers. 7th Ed. Macmillan Publishing Co., NY, USA.
3. Mengel, K., E. A. Kirkby, H. Kosegarten and T. Appel. 2001. Principles of Plant Nutrition. 5th Ed. International Potash Institute, Bern, Switzerland.
4. Rashid, A. and K.S. Memon. 2005. Soil Science. Ed. E. Bashir and R. Bantel. National Book

Foundation, Islamabad.

5. Taize, L. and E., Zeiger. 2006. Plant Physiology 4th Ed. Sinauers Associate, Inc. Sunderland, Massachusetts, USA.

Agr-305

FIELD CROP PHYSIOLOGY

3 (2-1)

Objective

To study mechanisms, processes and functions involved in plants under field conditions.

Theory

Concept and importance of crop physiology; Carbon metabolism; Factors affecting photosynthesis and respiration; Photosynthetic efficiency of different crop plants; Physiology of germination, dormancy, seedling establishment, tillering, root, stem, leaf, flower and seed development; Maturity, senescence and abscission; Source-sink relationships in crop plants; Stress physiology; Biological nitrogen fixation; Plant growth regulators, their synthesis, translocation, and mode of action; Physiological determinants of crop yield.

Practical

Equipment used in crop physiology; Preparation of solutions of various strengths; Demonstration of various types of seed germination; Respiratory losses of food reserves during seed germination; Imbibition of water by seed; Determination of water content of plant and seed; and water transpired by plants; Influence of growth regulators on plant growth; Identification of crop growth stages.

Books Recommended

1. Lambers, H., F.S. Chapin, and T.L. Pons. 2009. Plant Physiological Ecology. Springer-Verlag New York Inc.
2. Pessarakli, M. 2014. Handbook of Plant and Crop Physiology, 3rd Ed. Taylor and Francis, Boca Raton, USA.
3. Ross, C.W and F. B. Salisbury. 2011. Plant Physiology 5th Ed., Wadsworth Publ. Co., Belmont, California, USA.
4. Taize, L. and E., Zeiger. 2010. Plant Physiology 5th Ed. Sinauers Associate, Inc. Sunderland, Massachusetts, USA.

Objective

To familiarize students about fundamentals of seed technology.

Theory

Introduction, orientation, concept and perspective of seed technology; Seed production terms, their definition and types of seeds; Origin of seed industry; National and international seed centers; Origin of new varieties, variety development and plant variety production; Seed problems: Germination, stand failures, mixtures, weeds, genetics. Seed certification classes: Nucleus breeder seed, pre-basic, basic, certified and approved class. Seed analysis, sampling, processing, conditioning drying, cleaning, grading, treatment, vigor and viability: Their similarity and differences; Seed longevity and storage; Seed certification: Regulations schemes and field inspection; Seed distribution and marketing; Seed act and laws; Promotion of seed industry; biotechnology and seed development; Economic liberalization and seed trade.

Practical

Seed identification; Seed testing equipment; Study of seed structures; Sampling techniques for seed testing; Moisture testing. Purity analysis of seed; Seed viability, vigor and germination tests; Study visits to seed production farms/ processing industry.

Books Recommended

1. Ahmad, S.I. 1992. Seed Certification Manual. National Book Foundation, Islamabad.
2. Anonymous. 1992. Proceeding of International Seminar on Seed, Fauji Fertilizer Corporation. Islamabad.
3. Anonymous. 2001. A Dictionary of seed technological terms. Kalyani Publisher, India.
4. Basra, A.S. (Ed). 2006. Handbook of Seed Technology. Haworth Press New York, USA.
5. ISTA. 1996. International rules for seed testing. Proceedings of International Seed Testing Association, Zurich.
6. Khare, D. and M.S. Bhale. 2000. Seed Technology. Sci. Pub., India.
7. McDonald, M.B. 1989. Seed Science and Technology Laboratory Manual. Iowa State University Press / Ames, USA
8. Singh G. 2000. Economics of Seed Production at Farm level. Pak Book Corp. Lahore.

Objective

To comprehend crop husbandry of major field crops with special emphasis on critical production factors.

Theory

Food security (food availability, access, nutritional security), from different angles (history, policy, agronomy, food aid, agri. food chains, GMOs, organic, etc.) and different scales (global, national, household, individual); Origin, history, morphology, adaptation, distribution, economic importance and agro-technology of major field crops such as wheat, rice, maize, cotton, sugarcane and potato with special focus on regional crop;. Management of irrigation, the timing of planting and harvesting, pest management, fertilization, postharvest handling and marketing, etc.; Management, constraints and technological measures to optimize crop productivity; Modern techniques for crop improvement.

Practical

Demonstration of improved sowing methods; Raising and transplanting of rice nursery; Delinting of cotton seed by conventional and modern techniques, its impact on seed germination and seedling establishment; Techniques of maintaining optimum plant population under field conditions; Plant characteristics and phenological development of major crops; Introduction to sugar industry; Demonstration of methods used for estimating crop yields for major crops.

Books Recommended

1. Khalil I.A and A. Jan. 2002. Cropping Technology. National Book Foundation, Islamabad.
2. Khan, S. R. A. 2001. Crop Management in Pakistan with Focus on Soil and Water. Directorate of Agricultural Information, Punjab. Lahore.
3. Martin, J.H., R.P. Waldren and D.L. Stamp. 2006. Principles of Field Crop Production, 4th Ed., The Macmillan Co., New York.
4. Stoskopf, N.C. 1981. Understanding Crop Production. Reston. Pub. Co., Inc. Reston, Virginia.

Objective

To familiarize students with the concept of organic farming and its field application

Theory

Concept and brief history of organic farming; Quality of food and crop productivity under natural ecological systems; Principles of organic agriculture; Merits and demerits-organic vs inorganic farming; Components of organic farming (weed, insect, pest and fertilizer management); Maintenance of buffer zone; Preparation of organic manures-humus, sewage sludge, organic compost; Farm waste recycling, organic mulches, bio-fertilizers, etc.; Natural products for control of crop pests (weeds, insects and diseases).

Books Recommended

1. Dahama, A.K. 2002. Organic Farming for Sustainable Agriculture. 2nd Enlarged Ed. Pub. Agrobios, Jodhpur, India.
2. Eric, L. 2009. Organic Farming, Pest Control and Remediation of Soil Pollutants. Springer Dordrecht Heidelberg London New York.
3. Fossel, P.V. 2007. Organic Farming: Everything you need to know. MBI Publishing Co., USA.
4. Hari, M., S. Seshadri, K. Perumal. 2010. Biofertilizer (Phosphobacteria). Shri AMM Murugappa Chettiari Research Centre, India.
5. Niir, B. 2004. The Complete Technology Book on Bio-Fertilizer and Organic Farming. National Institute of Industrial Research, India.
6. Palaniappan, and K. Annadurani. 2006. Organic Farming Theory and Practice. Scientific Publishers. Jodhpur, India.
7. Rachel, F., S. Heather and T. Robbin. 2012. All the Dirt: Reflections on Organic Farming. TouchWood Editions, Canada.
8. William, L. 2007. Organic Farming an International History. CAB International, UK.

Objective

To impart awareness regarding principles of farm management and maintenance of farm records.

Theory

Concept of farm management and maintenance of farm records; Definition and fundamental principles of farming system and types of farming; Objective and advantages of keeping farm records; Different systems of book keeping; Principles of double entry system and their application; Objective of journal and ledger; Classification of accounts; Drawing ledger, opening, posting and closing of ledger accounts, cash book, drawing up a trial balance; Profit and loss account/income statement; Bank accounts, bank cheques, discount, interest, bad debts; Appreciation and depreciation of live and dead stock, land and buildings, plant and machinery; Preparation of trading, profit and loss account and balance sheet.

Practical

Training in maintenance of crop, livestock and dead stock registers; Preparation of a balance sheet and different types of accounts; Calculation of appreciation and depreciation of different farm articles; Working out cost of production of major crops grown in irrigated and non irrigated areas; Layout of farms and demonstration plots.

Books Recommended

1. Ghani, M. A. and E. Ahmad.2000. Principles of Accounting. Pak. Imperial Book Depot, Chowk Urdu Bazar, Lahore.
2. Moses, B. and Carson. 2009. Book Keeping and Accounts for Beginners. Custom Books, India.
3. Shresther, A.2003. Cropping System. Food products Press. An imprint of the Haworth Press Inc., USA.
4. Wood, F. and Sheila Robinson 2009. Book Keeping and Accounts. 7th Ed. Trans-Atlantic Publication Inc. India.

Objective

To familiarize students about components of environment and their relationship with crop productivity.

Theory

Environment, climate change and food security. Types and classification of environment; Dynamics of aerial and soil environment in a crop canopy at macro and micro level; Influence of different environmental factors-radiation, temperature, relative humidity, wind and CO₂ on crop growth and development; Greenhouse effect; *El Nino and La Nino* phenomenon; Crop adaptation to changing climate.

Practical

Measurement and estimation of different environmental variables; Calculations of potential evapotranspiration and different drought indices; Estimation of radiation interception and its use efficiency in field crops.

Books Recommended

1. Allaby, M. 2000. Basics of Environmental Science. Rutledge, London.
2. Dris, R., J. Mohan and I.A. Khan. 2002. Environment and Crop Production. Science Pub. Inc., New York.
3. Fitter, A.H. and P.K.M. Hay. 2002. Environmental Physiology of Plants. 3rd Ed. Academic Press Inc. London.
4. Hammer, G.L., N. Nicholls and C. Mitchell. 2000 Application of Seasonal Climate Forecasting in Agricultural and Natural Ecosystems. Kluwer Academic Publisher, London.
5. Percy, R.W., J.R. Ehleringer, H.A. Mooney and P.W. Rundal. 1989. Plant Physiological Ecology: Field Methods and Instrumentation. Chapman and Hall, London, New York.
6. Rowan Sewing, C., T.T. Richer, J.W. Jael. G.Y. Tsuji and Hi Ledyard. 1995 Climate Change Agriculture: Analysis of potential international impact ASA Special Publication, USA.
7. Hay., R.K.M. and J.R. Porter. 2006. The Physiology of Crop Yield. 2nd Ed. Blackwell publishing Ltd Oxford, UK.

Objective

To educate the students for enhancing crop production under limited moisture regimes.

Theory

Introduction, concept and causes of aridity; Climatic zones of Pakistan and their features; Climatic factors such as light, temperature, rainfall, relative humidity, wind, etc. and their effects on crop yield; Crop growth and yield responses to moisture supply in different soils; Evapotranspiration (ET), relation between crop yield and ET; Dry farming, water conservation practices, tillage, fertilizer use, sowing date and plant density; Crop rotations and cropping patterns in rainfed regions; Water harvesting and water conservation practices.

Practical

Demonstration of rainwater harvesting and conservation techniques; Determination of soil moisture; Mulching and tillage practices for moisture conservation; Field visits.

Books Recommended

1. Arnon, I. 1992. Agriculture in Drylands: principles and practices. Elsevier, Amsterdam.
2. Chandrasekaran, B. K., Annadurai and E. Somasundaram. 2010. A Textbook of Agronomy. New Age International Pub., New Delhi, India.
3. Hudson, N.W. 2004. Soil and Water Conservation in Semi-arid Areas. Scientific Publishers, India.
4. Khan, S. R. A, 2001. Crop Management in Pakistan with Focus on Soil & Water. Agr. Deptt. Govt. of Punjab. Lahore.
5. Maloo, S.R. 2002. Sustainable Crop Production under stress environments. Agro-tech Publishing Academy, Udaipur. India.
6. Panda, S.C. 2005. Agronomy. Agrobios, Jodhpur, India.

Objective

To familiarize students with the concept and application of crop modeling

Theory

History and introduction of crop growth modeling; Fundamental concepts of crop modeling, their importance and uses; Introduction to decision support system for agro-technology transfer; Components of a model, input data set for different model; Modelling and crop improvement; Modelling a tool for future predictions.

Practical

Demonstration and practice of crop growth models: CERES-wheat, DSSAT V. 4, APSIM, Measurement of different environmental variables from observatories.

Books Recommended

1. Cao, W., J.W. White and E. Wang. 2009. Crop Modeling and Decision Support. Springer, Heidelberg, Germany.
2. Singh, P. 2008. Modeling Crop Production Systems: Principles and applications. Science publishers. Enfield, New Hampshire 03784.USA
3. Sivakumar, M. V. K. and R. P. Motha. 2007. Managing Weather and Climate: Risks in Agriculture. Springer, Berlin, Heidelberg, New York.
4. Sivakumar, M. V. K. and J. Hansen. 2007. Climate Predictions and Agriculture. Springer, Berlin, Heidelberg, New York.

Agr-313

AGRO ECOLOGY

3 (3-0)

Objective

To inculcate understanding about ecological principles for sustainable cropping systems.

Theory

Ecosystem; definition and components. Ecological pyramids; process within the ecosystem; Primary production processes; measuring primary production; Estimation of primary production in ecosystems; Biogeochemical cycling process; cycling of CO₂, nitrogen, water, phosphorus and sulphur; Factors within the ecosystem; Agroecosystem; biotic structure, primary producers, consumers, decomposers; Primary productivity; Energy flow; Competition, crop yields and variability in relation to the ecological optima; responses of crop plants to biotic and abiotic factors.

Books Recommended

1. Hussain, S.S. 2003. Manual of Plant Ecology. National Book Foundation, Islamabad.

2. Kapur, P. and R.G. Sudha. 2000. Experimental Plant Ecology. CBS Publishers and Distributors, New Delhi.
3. Brown C.S. and T. Toadwine (eds.) 2007. Nature's Edge- Boundary Explorations in ecological theory and practice. State University of New York Press, Albany, USA.
4. Shukla, R. S. and P. S. Chandel, 2006. A Textbook of Plant Ecology. S. Chand & Co. Ltd. New Delhi, India.
5. Townsend, C.R., Harper, J.L. and M.E. Bego. 2000. Essentials of Ecology. Blackwell Scientific Publications, UK.

Agr-314

COASTAL AGRICULTURE

3 (2-1)

Objective

To educate students about potential of agriculture in coastal areas

Theory

Coastal agriculture and its scope; Farming trends in coastal areas of Pakistan; Saline agriculture, halophytes and their classification; Coastal land management; Agronomic techniques for use of sea water; Production and processing of coastal and biofuel crops; Post harvest techniques.

Practical

Identification of halophytes; Measurement of soil and water salinity; Plant screening for tolerance to sea water; Determination of soil texture in coastal areas; Visits to coastal areas.

Books Recommended

1. Beatley. T., D. Brower and A. Schwab. 2002. An Introduction to Coastal Zone Management. Island Press, 1718 Connecticut Avenue, N.W. Suite 300, Washington, D.C.
2. Hinrichsen, D., 1998. Coastal Waters of the World: Trends, Threats, and Strategies. Island Press, Washington, DC, USA
3. John R. Clark. 1995. Coastal Zone Management Handbook. Mote Marine Laboratory of Sarasota, Florida, USA.
4. John R. Clark. 1998. Coastal Seas: The Conservation Challenge. 989 Market Street San Francisco, CA.
5. Kay, R. and J. Alder. 2005. Coastal Planning and Development. Taylor and Francis, London.

6. Sukumar, B., 2008. Water Quality Management for Coastal Aquaculture. Daya Publishing House, India.

Agr-315

FORAGE AND FODDER PRODUCTION

3 (2-1)

Objective

To enhance skill of students for fodder production and its preservation.

Theory

Importance of forages and fodders; Terminology and taxonomy of forage and fodder crops; Forage production in Pakistan-current status and future scenario; Agro techniques for production of legume/nonlegumes forages and fodders for sustainable forage production; Rangeland status, increasing productivity of pastures and range lands; Seed production of forages, nutrient management in fodders/forages; Forage quality-its status and improvement, fodder/forage production constraints and remedies; Fodder preservation (hay and silage); Fodder research studies in Pakistan.

Practical

Identification of fodder/forage crops and seed; estimation of sprout density and plant population; silage and hay making practices; preparation of fodder calendar; determination of forage quality parameters; visits of university farms.

Books Recommended

1. Dovrat, A. 1993. Irrigated Forage Production. Elsevier Scientific Publishers, The Netherlands.
2. Khalil, I.A and A. Jan. 2006. Cropping Technology. National book foundation, Islamabad, Pakistan.
3. Mukherjee, A.K. and S.Maiti.2009. Forage Crop Production and Conservation. Kalyani publishers, New Delhi, India.
4. Martin, J.H., R.P., Waldern and D.L. Stamp.2006. Principles of Field Crop Production. 4th ed. Pearson- Prentice Hall, Ohio, USA.
5. Singh, A.K., M.A. Khan, N. Subash and K.M. Singh. 2011. Forages and Fodders. Daya Publishing House, Delhi, India.

6. Singh, J.V., B.S. Chhilar, B.D. Yadav and U.N. Joshi. 2010. Forage Legumes. Scientific Publishers, Jodhpur, India.

Agr-316

PRINCIPLES OF WEED SCIENCE

3 (2-1)

Objective

To strengthen students' understanding regarding principles of weed science and control methods.

Theory

Definition and importance of weed control; Harmful effects of weeds; Classification and biology of weeds; Weed-crop interference (competition and allelopathy); Merits and limitations of different weed control approaches; Formulation and mode of actions of herbicides; Weed control in major field crops. Integrated weed management.

Practical

Weed collection and identification; Demonstration of various hand tools & implements for weed control; Trials for testing the germination of different weeds and treatment for breaking their dormancy; Calibration and demonstration of sprayers for herbicide application; Survey into weed flora of different agro-ecological zones.

Books Recommended

1. Jaya K. R. and R. Jagannathan. 2007. Weed Science Principles. Kalyani Publishers, New Delhi.
2. Anderson, W.P. 2007. Weed Science: Principles and Applications. 4th Ed. Waveland Press Inc., USA.
3. Naylor, R.E.L. 2002. Weed Management, Principles and Practices. Blackwell Science, UK.
4. Zimdahl, R. 2013. Fundamentals of Weed Science 4th Edition. Academic Press. New York.
5. Tanveer, A. 2008. Biology and Ecology of Weed. HEC, Pakistan.
6. Walia, U.S. 2003. Weed Management. Kalyani Publishers, New Delhi, India.

Agr-317 PRODUCTION TECHNOLOGIES OF CONDIMENTS AND SPICES 3 (2-1)

Objective

To educate and familiarize students with production technology of condiments, spices and vegetables.

Theory

Concept and scope of condiments and spices; their classification and value addition; Production technology for: condiments (chillies, onion, garlic, ginger and turmeric) and spices (cumin seed, ajwain, fenugreek, fennel, kaloongi, coriander, mint and black cumin).

Practical

Identification of seeds and propagation materials of condiments and vegetables; Demonstration of sowing methods; Raising and transplanting of nursery; Demonstration and practice of harvesting, digging, picking and processing of different crops; Visits of local farms.

Books Recommended

1. Lenk, D. 2006. Commercial Spice Crops. Kalyani, Publishers New Delhi.
2. Tunio, S. D. 2004. Condiment Crops. Directorate of Agriculture Information, Hyderabad, Sindh.
3. Tunio, S. D. 2010. Vegetables and Spices of Sindh. Roshni Publication, Kandiaro.
4. Majeedano, H. I. 2012. Agro Digest. Agriculture Research Institute, Tandojam.

Agr-401 CROP MANAGEMENT UNDER STRESSFUL ENVIRONMENTS 3 (2-1)

Objective

To elaborate the concept of stress in field crops and approaches to sustain yields under such conditions.

Theory

Components of crop productivity; Crop environment and its components; Environmental optima for crop growth and development; Concept of stress and stressful environments under field conditions; Modifications in growth and developmental patterns of crop plants under biotic and abiotic stresses; Approaches for ameliorating the stress effects for crop production.

Practical

Acquaintance with the symptoms of stresses on crop,; visits to affected areas and noting the patterns of vegetative and reproductive growth of crop plants.

Books Recommended

1. Arnon, I. 1992 Agriculture in Drylands: Principles and Practices. Elsevier, Amsterdam.
2. Nosberger, J.H. H. Geiger and P.C. Struik. 2001. Crop Science Progress and Prospects. CABI Pub., Oxon, UK.
3. Pessaraskli, M. A. 2000. A. Hand Book of Stress Physiology, Marker and Deekar.
4. Taize, L., E. Zeiger. 2006. Plant Physiology. Sinauer Pub. U.S.A.

Agr-403

BIOLOGICAL NITROGEN FIXATION

3 (2-1)

Objective

To educate students about mechanism of biological nitrogen fixation and its utilization in agriculture systems.

Theory

Importance of nitrogen; Nitrogen cycle; Assimilation of nitrate and ammonium ions; Nitrogen fixation; Biological nitrogen fixation, its potentialities, perspectives and limitations; BNF in a symbiotic and nonsymbiotic association in legumes and non legumes, stages in nodulation; Nitrogenase: structure and function; Mechanism and biochemistry of BNF; Gaseous exchange in nodules; Role of leghemoglobin; Effect of environment on nitrogen fixation; Stem nodules; Prospects for making new symbiosis; Physiological limitations and genetic improvements of biological nitrogen fixation; Possibilities of engineering non- legume plants for nitrogen fixation.

Practical

Demonstration of inoculation methods; Study of nodule formation under different environmental conditions; Career material for effective inoculants; Identification of effective and non-effective nodule; Methods used to measure biologically fixed nitrogen.

Books Recommended

1. John L. H., J. D. Beaton, S. L. Tisdale, and W. L. Nelson. 2010. Soil Fertility and Fertilizers- An introduction to nutrient management, 7th edition. Pearson Prentice Hall, New Delhi, India.
2. Ross, C. W and F. B. Salisbury. 2011. Plant Physiology 5th Ed., Wadsworth Publ. Co., Belmont, California, USA.

3. Hansen, A.P. 1994. Symbiotic N₂ fixation of crop legumes. Margref verleg weikenheim, Germany.
4. Stacy, G., R.H. Burris and H.J. Evans. 1992. Biological Nitrogen Fixation. Chapman and Hall, London.
5. Taize, L. and E. Zeiger. 2002. Plant Physiology 3rd ed. Sinauers Associate, Inc. Sunderland, Massachusetts, USA.
6. Yi- Peng Wang, Min Lee, Zhe- Xian Tian, William E. Newton. Eds. 2005. Biological Nitrogen Fixation, sustainable agriculture and the environment. Proc. 14th Int. Congress Biological Nitrogen Fixation. Springer, Netherlands.

Agr-405

CONSERVATION AGRONOMY

3 (2-1)

Objective

To develop the concept of soil and water conservation for sustaining productivity.

Theory

Concept and objectives of soil and water conservation; Agronomic practices for conservation-tillage (contouring, terracing, benching, levelling, grading, deep ploughing, etc.), species selection, crop rotations, cover cropping, strip cropping, etc. Farmyard and green manuring for conservation; Stubble and crop-residue management for resource conservation; Field drainage. Watershed management under rainfed conditions.

Practical

Demonstration of soil water conservation structures; Effect of different mulches; Demonstration of tillage practices for soil and water conservation; Measurement of runoff and soil erosion; Visit to different soil and water conservation centers/institutes.

Books Recommended

1. Advances in Agronomy, All volumes. Academic Press Inc., New York.
2. Arnon, I. 1992. Agriculture in Drylands: Principles and Practices. Elsevier, London.
3. Gurmel Sing, C. Venkatarmanan, G. Sastry and B.P. Joshi. 1990. Manual of Soil and Water Conservation Practices. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
4. Hudson, N.W. 2004. Soil and water conservation in semi-arid areas. Scientific Publishers, India.

5. Kirkham, M.B. (Editor). 2004. Water Use in Crop Production. Narosa Publishing House Pvt. Ltd. New Delhi, India.
6. Maloo, S.R. 2002. Sustainable Crop Production under stress environments. Agro-tech Publishing Academy, Udaipur.
7. Chandrasekaran, B., K. Annadurai and E. Somasundaram. 2010. A Textbook of Agronomy. New Age International Publishers. New Delhi, India.
8. Rashid, A. 1994. Soil Science. National Book Foundation Islamabad.

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MEDICINAL AND SPECIAL CROPS

3 (2-1)

Objective

To introduce a production technology for medicinal and special purpose crops

Theory

Economic importance, origin, history, adaptation, distribution and production technology of medicinal and special purpose crops-tea, aloe, mint, aloe vera, chamomile, kava, red sorrel, jojoba, castor bean, jatropha, plantains, salicornia, safflower, poppy, tobacco, indigo, oil palm, fennel, *ajwain*, fenugreek, sweet basil, sesamum, *balangu*, *haloon*, *kalvanji*, *guar*, *senna*, quinoa, bitter gourd, etc.; Integrated pest management and precision farming for special purpose crops; Processing, postharvest technology, products, utilization and marketing of medicinal crops.

Practical

Identification of seed and crop plants; Demonstration of improved sowing methods. Studies on phenological development of crops. Optimization of soil types for medicinal plants; Methods for extraction of useful ingredients of medicinal plants.

Books Recommended

1. Altaf, Z. and A. Qarshi. 2013. Medicinal Plants. Qarshi Industries, Lahore.
2. Martin, J.H., R.P. Waldren and D.L. Stamp. 2006. Principles of Field Crop Production, 4th Ed., the MacMillan Co., New York.
3. Narayan, D.P., S.S. Purohit, A.K. Sharma and Tarun, K. 2003. A Handbook of Medicinal Plants. Agrobios, India.
4. Palaniappan, and K. Annadurani. 2006. Organic farming; theory and practice. Scientific Publishers, Jodhpur, India.

5. Ravindra, S. 2004. Agro-Techniques of Medicinal Plants. Daya Publishing House, New Delhi, India.
6. Reddy, S.R. 2004. Principles of Field Crop Production. 2nd Ed. Kalyani Publishers, New Delhi, India.
7. Sharma, K. 2005. Hand Book of Agriculture. Indian Council of Agricultural Research, New Delhi
8. Sharma. R. 2004. Agro-techniques of Medicinal Plants. Daya Publishing House, Delhi.

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PLANT AND SOIL ANALYSIS

2 (1-1)

Objective

To train the students about different methods of soil and plant analysis.

Theory

Types and use of different balances; Preparation of solutions of known concentrations-normal, molar, molal, ppm, etc.; Preparation of stock solutions for drawing standard curves; Soil and plant sampling techniques; Preparation of plant and soil samples for analytical work; Estimation of EC, pH, N, P, K, Na, organic matter, etc.

Practical

Demonstration of analytical methods in the laboratory, recording data, computation work and recommendations.

Books Recommended

1. Basak, R.K. 2004. Soil Testing and Recommendation. Kalyani Publisher, New Delhi.
2. Hussain, T. and A. Jabbar. 1985. Soil and Plant Analysis. Department of Soil Science, University of Agriculture, Faisalabad.
3. Ryan, J., G. Estefan and A. Rashid. 2001. Soil and Plant Analysis Laboratory Manula. 2nd Ed., ICARDA, Aleppo, Syria and NARC, Islamabad, Pakistan.
4. Tandon, H.L.S (Ed.). 2001. Methods of Analysis of Soils, Plants, Waters and Fertilizer. Development and Consultation Organization, New Delhi, India.
5. Westerman, R.L. (Ed.). 1990. Soil Testing and Plant Analysis. 3rd Ed. Soil Sci. Am. Inc., Madison, WI, USA.

6. Jones, J. Benton. 2012. Plant Nutrition and Soil Fertility Manual. 2nd Ed. CRC Press. Taylor & Francis, London. UK.

AGR-411 RESEARCH AND SCIENTIFIC WRITING 3 (2-1)

Objective

To provide guidelines for research methodology, develop and improve skills in scientific writing.

Theory

Concept of research, scientific method and experiment; Planning and execution of trials; Experimental designs and layout; Research trial observations; collection, processing and analysis of data; Measures of experimental variability; Interpretation and summarization of results; Types of scientific writing and developing a research proposal.

Practical

Writing of research proposal; Layout of field experiments; Collection, tabulation and analysis of data; Presentation of data in tables, curves, histograms, etc. Writing of scientific paper/report.

Books Recommended

1. Alan G. Clewer and David H. Scarisbrick. 2001. Practical Statistics and Experimental Design for Plant and Crop Science. John Wiley and Sons, Ltd. Chichester, England.
2. Anonymous. 1988. Publications Handbook and Style Manual. ASA-CSSA-SSSA, Madison.
3. Khalil, S K. and P. Shah, 2007. Scientific Writing and Presentation. HEC, Monograph, Islamabad.
4. Martha, D. 2005. Scientific Papers and Presentations. Academic Press, San Deigo, California, USA.
5. Mead, R. 2003. Statistical Methods in Agricultural & Experimental Biology. 3rd Ed. Pak Book Corp. Lahore
6. Youdeowei, A., P. Stapleton, and R. Obubo. (eds.). 2012. Scientific Writing for Agricultural Research Scientists-A Training Resource

Objective

To strengthen students' understanding regarding principles of weed science and control methods.

Theory

Definition and importance of weed control; Harmful effects of weeds; Classification and biology of weeds; Weed-crop interference (competition and allelopathy); Merits and limitations of different weed control approaches; Formulation and mode of actions of herbicides; Weed control in major field crops. Integrated weed management.

Practical

Weed collection and identification; Demonstration of various hand tools & implements for weed control; Trials for testing the germination of different weeds and treatment for breaking their dormancy; Calibration and demonstration of sprayers for herbicide application; Survey into weed flora of different agro-ecological zones.

Books Recommended

1. Jaya K. R. and R. Jagannathan. 2007. Weed Science Principles. Kalyani Publishers, New Delhi.
2. Anderson, W.P. 2007. Weed Science: Principles and Applications. 4th Ed. Waveland Press Inc., USA.
3. Naylor, R.E.L. 2002. Weed Management, Principles and Practices. Blackwell Science, UK.
4. Zimdahl, R. 2013. Fundamentals of Weed Science 4th Edition. Academic Press. New York.
5. Tanveer, A. 2008. Biology and Ecology of Weed. HEC, Pakistan.
6. Walia, U.S. 2003. Weed Management. Kalyani Publishers, New Delhi, India.

Objective

To enhance skill of students for fodder production and its preservation.

Theory

Importance of forages and fodders; Terminology and taxonomy of forage and fodder crops; Forage production in Pakistan-current status and future scenario; Agro techniques for production

of legume/nonlegumes forages and fodders for sustainable forage production; Rangeland status, increasing productivity of pastures and range lands; Seed production of forages, nutrient management in fodders/forages; Forage quality-its status and improvement, fodder/forage production constraints and remedies; Fodder preservation (hay and silage); Fodder research studies in Pakistan.

Practical

Identification of fodder/forage crops and seed; estimation of sprout density and plant population; silage and hay making practices; preparation of fodder calendar; determination of forage quality parameters; visits of university farms.

Books Recommended

1. Dovrat, A. 1993. Irrigated Forage Production. Elsevier Scientific Publishers, The Netherlands.
2. Khalil, I.A and A. Jan. 2006. Cropping Technology. National book foundation, Islamabad, Pakistan.
3. Mukherjee, A.K. and S.Maiti.2009. Forage Crop Production and Conservation. Kalyani publishers, New Delhi, India.
4. Martin, J.H., R.P., Waldern and D.L. Stamp.2006. Principles of Field Crop Production. 4th ed. Pearson- Prentice Hall, Ohio, USA.
5. Singh, A.K., M.A. Khan, N. Subash and K.M. Singh. 2011. Forages and Fodders. Daya Publishing House, Delhi, India.
6. Singh, J.V., B.S. Chhilar, B.D. Yadav and U.N. Joshi. 2010. Forage Legumes. Scientific Publishers, Jodhpur, India.

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INTERNSHIP/PROJECT STUDY

5 (0-5)

Practical training/work at the farms of progressive farmers and at research stations/institutes/organizations/companies; This involves report writing by the student and the student will also present report in a seminar.

Note: *The farmers/farm managers/Director will evaluate the practical work by the student. An expert committee to be appointed by the board of studies/Chairman of the department will also evaluate the student's participation at the farms and at the universities. The committee will also evaluate and grade/mark the report and seminar. The seminar/presentation delivered for internship will be mandatory.*

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SEMINAR

1 (1-0)

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