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

MAJOR: HORTICULTURE

(Four Years Program)

INSTITUTE OF AGRICULTURAL SCIENCES

UNIVERSITY OF THE PUNJAB, LAHORE

SCHEME OF STUDIES FOR B.Sc. (Hons.) AGRICULTURE
MAJOR: HORTICULTURE
(Four Years Program)

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

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: Horticulture)

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: Horticulture)

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: Horticulture)

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: Horticulture)

Course No.	Title of the Course	Credit Hours	Type
HORT-301	Principles of Fruit Production	4(3-1)	Major
HORT-303	Principles of Vegetable Production	4(3-1)	Major
HORT-305	Principles of Ornamental Crop Production	3(2-1)	Major
HORT-307	Nursery Management and Certification System	4(2-2)	Major
HORT-309	Medicinal and Aromatic Plants	3(2-1)	Major
HORT-311	Indoor Plant Culture	2(1-1)	Major
HORT-313	Organic Horticulture	2(1-1)	Major
HORT-315	Arid Horticulture	2(1-1)	Major
HORT-317	Mushroom Culture	2(1-1)	Major
HORT-319	Peri-Urban Horticulture	2(1-1)	Major
HORT-320	Introductory Plant Biotechnology	2(1-1)	Major

Note: Only 6-7 Courses comprised of 18-20 Credit Hours from above mentioned list will be offered in a semester

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

Course No.	Title of the Course	Credit Hours	Type
HORT-302	Commercial Fruit Production	4(3-1)	Major
HORT-304	Commercial Vegetable Production	4(3-1)	Major
HORT-306	Introductory Landscape Gardening	3(2-1)	Major
HORT-308	Protected Horticulture	3(2-1)	Major
HORT-310	Breeding of Horticultural Crops	3(2-1)	Major
HORT-312	Business Management in Horticulture	3(3-0)	Major
HORT-314	Tropical and Subtropical Fruits	3(2-1)	Major
HORT-316	Summer Vegetables	3(2-1)	Major
HORT-318	Landscape Horticulture	3(2-1)	Major

Note: Only 6-7 Courses comprised of 18-20 Credit Hours from above mentioned list will be offered in a semester

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

Course No.	Title of the Course	Credit Hours	Type
HORT-401	Research Methods and Techniques in Horticulture	4(2-2)	Major
HORT-403	Minor Fruits	3(2-1)	Major
HORT-405	Commercial Flower Production	3(2-1)	Major
HORT-407	Post-Harvest Horticulture	4(3-1)	Major
HORT-409	*In Vitro* Propagation	2(1-1)	Major
HORT-411	Vegetable and Flower Seed Production	3(2-1)	Major

HORT-413	Temperate Fruits	3(2-1)	Major
HORT-415	Winter Vegetables	3(2-1)	Major
HORT-417	Project Planning and Scientific Writing	2(1-1)	Major
HORT-419	Floral Designs and Arrangements	2(1-1)	Major

Note: Only 6-7 Courses comprised of 18-20 Credit Hours from above mentioned list will be offered in a semester

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

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

DETAIL OF COURSES FOR B.Sc. (Hons.) AGRICULTURE
MAJOR: HORTICULTURE
(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* (6^{th} edition), 1986, PWS-Kent Company, Boston
4. Anton H, Bevens I, Davis S, *Calculus: A New Horizon* (8^{th} edition), 2005, John Wiley, New York
5. Stewart J, *Calculus* (3^{rd} edition), 1995, Brooks/Cole (suggested text)
6. Swokowski EW, *Calculus and Analytic Geometry*, 1983, PWS-Kent Company, Boston
7. Thomas GB, Finney AR, *Calculus* (11^{th} 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. Chottopadhay, 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 ands 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, Islamabd, Pakistan.
5. Henderson,H.O. and S. Reaves, 1962. Dairy Cattle Feeding and Management. John Wiley and Sons, Inc., New York, USA.
6. Khan,B.B., M. Yaqoob, M. Riaz and M. Younas, and A. Iqbal, 2004. Livestock Management Manual. Dep. Of Livestock Management, University of Agriculture Faislabad.
7. Khan,B.B., M. Younas, M. Riaz and M. Yaqoob, 2005. Breeds of Livestock in Pakistan. Pak T.M. printers, Aminpur Bazar, Faisal Abad, Pakistan.
8. Tamarin, R., 1999. Principles of Genetics (6th Ed.) McGraw Hill Co., Boston, USA.
9. Shah, S.I. (Ed.) 1994., Animal Husbandry. National Book Foundation, Islamabad.
10. McDonald, P., R.A. Edwards, J.F.D. Greenhalf ans 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 Cangage learning Publisher.
2. Penson, J. B., Capps, O., Rossen C. P., & Woodward, R. (2013). Introduction to Agricultural Economics. 5th Edition. New Jersey: Prentice Hall.
3. Cramer, G., Jensen C. W., & Southgate, D. D. (2001). Agricultural Economics and Agribusiness. 8th Edition. Wiley Publisher.
4. Pakistan, Government of. Economic Survey of Pakistan (Various Issues), Economics Advisor Wing, Ministry of Finance, Government of Pakistan.

Stat – 102: INTRODUCTORY STATISTICS 3 (3-0)

Objectives

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

Course outlines

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

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

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

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

Recommended books

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

2. Statistical Methods and Data Analysis by Dr. Faquir Muhammad
3. A. Concise Course in A. Level Statistic with world examples by J. Crawshaw and J. Chambers (1994)
4. Basic Statistics an Inferential Approach 2nd Ed. (1986) Fran II. Dietrich-II and Thomes J. Keans
5. Introduction to Statistical Theory Part-II by Sher Muhammad and Dr. Shahid Kamal (Latest Edition)
6. Principles and Procedures of Statistics A Bio-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 theb 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. (7^{th} ed.), Pearson Education, Singapore.
3. Singh, P. 2003. Elements of Genetics. (2^{nd} ed.) Kalyani Publishers, Delhi, India.
4. Stansfield, W.D. 1988 Theory and Problems of Genetics. 4^{th} 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. (5^{th} ed.) Iowa State University Press, Ames, USA.
7. Chahal, G.S. and S.S. Gosal. 2003. Principles and Procedures of Plant Breeding. Narosa Publishing House, New Delhi, India.
8. Singh, B. D. 2003. Plant Breeding: Principles and Methods. Kalyani Publishers, New Delhi, India.
9. Singh, P. 2003. Essentials of Plant Breeding. Kalyani Publishers, New Delhi, India.
10. Khan, M.A (Editor). 1994. Plant Breeding. National Book Foundation, Islamabad.
11. Acquaah, G. 2009. Principles of Plant Genetics and Breeding. John Wiley & Sons, UK.

FST- 201: INTRODUCTION TO FOOD SCIENCE AND TECHNOLOGY 3 (2-1)

Objective

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

Theory

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

Practical

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

Recommended Books

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

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

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, 10^{th} 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. 7^{th} Ed.
10. Trigunayat, M.M. 2009. A Manual of Practical Entomology. 2^{nd} 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, 6^{th} Edition, Person Education Inc., Upper Saddle River, New Jersey 07458, U.S.A

MAB – 201: AGRIBUSINESS MANAGEMENT 3 (3-0)

Objective and learning outcome

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

Course outlines

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

Text Books

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

Books Recommended

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

FRW – 201: INTRODUCTION TO RANGELANDS AND WILDLIFE MANAGEMENT 2 (1-1)

Objectives

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

Theory:

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

Practicals

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

Recommended Books:

1. Vallentine, John, F. 2000. Grazing Management. Academic Press (Elsevier Science & Technology Books).
2. Holechek, J. et al., 1989. Range Management, Principles and Practices. Prentice Hall, Inc. Newberry. USA.

1. Quraishi, M. A. A., G.S. Khan and M. S. Yaqoob. 1993. Range Management in Pakistan, University of Agriculture, Faisalabad.
2. Mohammad, N. 1989. Rangeland Management in Pakistan. NARC Published by ICIMOD.

3. Stoddard, L.A., A.D. Smith and T.W. Box. 1975. Range Management. McGraw Hill Book Co., New York.

6. Quraishi, M.A.A., M. Ishaque, 1995. Practical Manual of Range Management, University of Agriculture, Faisalabad.

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

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 cops (cotton, jute, sun hemp, deccan-hemp), Sugar crops (sugarcane and sugar beet), Green manure crops (guara, dhancha. pigeon pea, senji, etc.).

Practical

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

Recommended Books

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

PP 202: INTRODUCTORY PLANT PATHOLOGY 3 (2-1)

Prerequisites

Biology (Higher Secondary level)

Learning Objectives

To acquaint students with basic concepts of Plant Pathology

Theory

Introduction and history of plant pathology; basic characteristics of fungi, bacteria, viruses and nematodes; concept of disease in plants; economic importance of plant diseases; nature and cause of (biotic and abiotic) diseases; components of plant disease development; diagnosis of plant diseases; principles of plant disease management; Introduction to IDM and IPM; symptoms, etiology, mode of infection, disease cycle and management of representative diseases of agricultural and horticultural crops.

Practical

Demonstration of lab equipments and reagents; collection, preservation and identification of plant diseases based on symptoms; isolation and inoculation techniques; demonstration of Koch's postulates.

Recommended Books:

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

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 DEVELOPMENT 3 (3-0)

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

c) Reading

1. Reading. Advanced. Brian Tomlinson and Rod Ellis. Oxford Supplementary Skills. Third Impression 1991. ISBN 0 19 453403 0.
2. Reading and Study Skills by John Langan
3. Study Skills by 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 Bioloigy, Genes and Proteins 3rd Ed. Jones and Bartlett, USA

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

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

Practical

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

Recommended Books

1. Paul Bolstad. 2008. GIS Fundamentals, a First Text on GIS. 3rd Edition. Eider Press.
2. Lillesand, T.M., R.W. Kiefer and J. Chipman. 2007. Remote sensing and Image Interpretation. 6th edition. Wiley and Sons.

3. P.A. Longley, M.F. Goodchild, D.G. Maguire and D.W.Rhind. 2005. GIS and Science. 2nd edition. Wiley and Sons.
4. G.N. Peterson. 2009. GIS Cartography: A guide to effective map design, CRC Press.

FRW - 204: BIODIVERSITY AND CLIMATE CHANGE 2 (2-0)

Objective

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

Course Outline

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

Recommended Books

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

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

Objective

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

Course Outlines

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

Suggested Readings

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

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

Course Contents

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

Text Books

1. Singh, K. (2009). Rural Development: Principles, Polices 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, 10nth 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. Biosaftey in Microbiological and biomedical laboratories. 4th edition. Centers for disease control and prevention/National institutes of Health, Washington DC.
6. Biosafety in the Laboratory: Prudent Practices for Handling and Disposal of Infectious Materials Committee on Hazardous Biological Substances in the Laboratory, National Research Council ISBN: 0-309-55920-0, (1989) available from the National Academies Press at: http://www.nap.edu/catalog/1197.html
7. 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, Molscript, 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 Tansformation; 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, Itlay.
5. Jones, J.M. 1992. Food Safety. AAcc. 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 Bioterrosim 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 Edition th. John-Wiley and Son Limited

HORT-301 PRINCIPLES OF FRUIT PRODUCTION 4 (3-1)

Specific Objectives:

To make students aware of principles and physiology of fruit production.

Theory:

Introduction to fruit science, Importance of fruits, Source-sink relationship, Classification of fruits, Water relations, Fruit-bud formation; initiation, development and controlling factors, Types of pollination, Pollination and fruit setting problems, Fruitfulness, Unfruitfulness, Rest and dormancy, Biennial bearing; causes and control, Fruit thinning, Parthenocarpy and seedlessness, Harvesting methods, Use of plant growth regulators (PGRs), Bud variations and mutations, Pre-harvest handling of fruits, Maturity indices, Preparation for fresh market.

Practical:

Identification of various developmental stages of buds, Fruit bearing habits, Training and pruning of important evergreen and deciduous fruit trees, Thinning of fruits, Harvesting methods, Practices to control irregular bearing, Preparation of PGR stock solutions and applications, Different methods to break seed dormancy, Visits to fruit orchards.

Books Recommended:

1. Chottopadhay, T.K. (Ed.). 2003. A Textbook on Pomology, Vol. I: Fundamentals of Fruit Growing. Kalyani Publishers, Ludhiana, New Delhi, India.
2. Chottopadhay, T.K. 2000. A Textbook on Pomology, Vol. II: Tropical Fruits. Kalyani Publishers, New Delhi.
3. Yadav, P.K. 2007. Fruit Production Technology. International Book Distributing Co. (Publishing Division), Lucknow, India.
4. Dugger, B.M.2009. Plant physiology with Special Reference to Plant Production. Biblio Bazaar, LLC.
5. Jackson, D.I., N.E. Looney (Eds.). 1999. Temperate and Subtropical
6. Fruit Production (2nd Ed.). CAB International Publishing, Wallinford, U.K.
7. Singh, A. 2003. Fruit Physiology and Production. Kalyani Publication,
8. Ludhiana, New Delhi, India.
9. Singh, N.P. 2004. Basic Concepts of Fruit Science. International Book Distribution Company (Publishing Division), Lucknow, India.
10. Gardener, V.R. 2001. The Fundamentals of Fruit Production (5th Ed.). McGraw Hill Book Company, USA.

HORT-302 COMMERCIAL FRUIT PRODUCTION 4 (3-1)

Prerequisites:

Principles of Fruit Production

Specific Objectives:

To accustom students with production technology of major fruits of Pakistan.

Theory:

Classification of fruits, Cultivation with reference to acreage, production, botany, cultivars, rootstocks, propagation, climate, soil, cultural practices (water, nutrition, weeds, diseases, disorders and pest management), Maturity, ripening, harvesting, quality assurance, Post harvest handling and marketing of major fruits of Pakistan.

Practical:

Production of fruits, Practices in fruit health management, Pollination in commercial fruits, Cost of production, Description and identification of commercial cultivars of important fruits, Visit to research institutes and commercial orchards.

Books Recommended:

1. Bali, S.S. 2003. Fruit Growing, Kalyani Publishers, New Delhi.
2. Bose, T.K. and S.K. Mitra (Eds.). 1990. Fruits: Tropical and Subtropical. Naya Prokash, Calcutta-Six.
3. Mitra, S.K., D.S. Rathore, and T.K. Bose (Eds.). 1991. Temperate Fruits. Horticulture and Allied Publishers, Calcutta.
4. Barooh, S. 1998. Modern Fruit Culture. Kalyani Publishers, Ludhiana, New Delhi, India.
5. Chottopadhay, T.K. (Ed.). 2006. A Textbook on Pomology, Vol: II. Tropical Fruits. Kalyani Publishers, Ludhiana, New Delhi, India.
6. Chottopadhay, T.K. (Ed.). 2009. A Textbook on Pomology, Vol: IV. Temperate Fruits. Kalyani Publishers, Ludhiana, New Delhi, India.
7. Yadav, P.K. 2007. Fruit Production Technology. International Book Distributing Co. (Publishing Division), Lucknow, India.
8. Jackson, D.I., N.E. Looney (Eds.). 1999. Temperate and Subtropical Fruit Production (2nd Ed.). CAB International Publishing, Wallingford, U.K.
9. Nakasone, H.Y. and R.E. Paull. 1998. Tropical Fruits. Crop Production Science in Horticulture 7. CAB International Publishing, Wallingford, U.K.
10. Salunkhe, D.K., S.S. Kadam. 1995. Handbook of Fruit Science: production, composition, storage and processing. Marcel Dekker, Inc. New York

HORT-303 PRINCIPLES OF VEGETABLE PRODUCTION 4 (3-1)

Specific Objectives:

To develop understanding among the students regarding principles and physiology of vegetable production.

Theory:

Introduction and importance, Classification of vegetables, Cropping systems; succession, relay and multiple cropping etc., Recent trends in vegetable production, Factors affecting vegetable production, Hardening, Pruning and staking, Bulb and tuber formation, Crop management and quality assurance, Parthenocarpy and seedlessness. Physiological disorders, Production problems and their management, Mulching of vegetable crops, Use of plant growth regulators, Breeding and improving vegetables.

Practical:

Identification and description of flower, fruit and seed of important cultivars of vegetables, Seed priming, Methods of sowing, Raising nursery, hardening and transplanting of seedlings, Pruning and staking practices, Visits to vegetable farms.

Books Recommended:

1. Dhaliwal, M.S. 2008. Handbook of Vegetable Crops. Kalyani Publishers, Ludhiana, New Delhi, India.
2. Fordham, R. and A.G. Biggs. 1985. Principles of Vegetable Crop Production. Collins, London.
3. Hazra, P. and M.G. Som. 2005. Vegetable Science. Kalyani Publishers, Ludhiana, New Delhi, India.
4. Bose, T.K., M.G. Som and J. Kabir. 1993. Vegetable Crops. Naya Prokash, Calcutta-Six.
5. Swaider, J.M., G.W. Ware and J.P. McCollum. 2002. Producing Vegetable Crops (5^{th} Ed.), Interstate Publishers Printers and Publishers Inc., Danville, Illinois.
6. Singh, A.P. 2003. A Textbook of Vegetable Culture. Kalyani Publishers, Ludhiana, New Delhi, India.
7. Wein, H.C. 1997. The Physiology of Vegetable Crops. CAB International Publishing, Wallingford, UK.

HORT-304 COMMERCIAL VEGETABLE PRODUCTION 4 (3-1)

Prerequisites:

Principles of Vegetable Production

Specific Objectives:

To accustom students with production technology of major vegetables of Pakistan.

Theory:

Types of vegetable farming, Cultivation of vegetables with reference to their acreage, production, botany, cultivars, climate, soil, cultural practices, maturity indices, harvesting, grading, packing, quality assurance, marketing, production problems, important weeds, insect-pests, diseases and their control, Mushroom growing.

Practical:

Practice in raising of vegetables including mushrooms, Eradication of weeds and control measures of insects and diseases, Harvesting, grading and packing of vegetables, Cost of production, Visits to vegetable farms and markets.

Books Recommended:

1. Bose, T.K., M.G. Som and J. Kabir. 1993. Vegetable Crops. Naya Prokash, Calcutta-Six, India.
2. Pandey, R,K. and S.K. Ghosh. 1996. A Handbook on Mushroom Cultivation. Emkey Publications, New Delhi.
3. Libner, N.S. 2006. Vegetable Production. Vedams Books Pvt. Ltd. New Delhi, India.
4. Rana, M.K. 2008. Scientific Cultivation of Vegetables. Kalyani Publishers, Ludhiana, New Delhi, India.
5. Decoteau, D.R. 2002. Vegetable Crops. Prentice-Hall of India, New Delhi, India.
6. Dhaliwal, M.S. 2008. Handbook of Vegetable Crops. Kalyani Publishers, Ludhiana, New Delhi, India.
7. Swaider, J.M., G.W. Ware and J.P. McCollum. 2002. Producing Vegetable Crops (5^{th} Ed.), Interstate Publishers Printers and Publishers Inc., Danville, Illinois.
8. Das, P.C. 2003. Vegetable Crops of India. Kalyani Publishers, New Delhi.
9. Singh, A.P. 2002. Vegetable Growing in India. Kalyani Publishers, New Delhi.
10. Singh, D.K. 2007. Modern Vegetable Varieties and Production Technology. International Book Distributing Co. (Publishing Division), Lucknow, India.
11. Maynard, D.N. and G.J. Hochmuth. 2007. Knott's Handbook of Vegetable Growers (5^{th} Ed.). John Willey and Sons Inc., New York.

HORT-305 PRINCIPLES OF ORNAMENTALCROP PRODUCTION 3(2-1)

Specific Objectives:

To provide knowledge of basic principles and physiology of ornamental crop production to the students of Horticulture.

Theory:

Introduction and importance; present status and future scope, Raising of important annuals, Growing of flowering perennials, foliage plants, succulents and flowering bulbs with their propagation and crop management, Seed and bulb dormancy, Pruning, training and shaping, Use of growth regulators, Manipulation of growth and flowering. Concept of Bonsai and topiary, Outdoor and indoor decoration, Flower exhibition, Flower arrangements.

Practical:

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

Books Recommended:

1. Arora, J.S. 2003. Introductory Ornamental Horticulture (4th Ed.). Kalyani Publishers, New Delhi.
2. Larson, RA. 1980. Introduction to Floriculture. Academic Press, New York.
3. Chadha, K.L and B. Choudhary. 1986. Ornamental Horticulture in India. Indian Council of Agricultural Research, New Delhi.
4. Laurie, A. and Ries V.S. 2004.Floriculture: Fundamentals and Practices. Agrobios (Inidia), Jodhpur, India.
5. Hessayon, D.G. 2007. The Flowering Shrubs Expert (3rd Ed.). Transworld Publishers,London, U.K.
6. Hessayon, D.G. 2007. The Flowering Bulbs Expert (3rd Ed.). Transworld Publishers,London, U.K
7. Bhattacharjee, S.K. 2006. Advances in ornamental Horticulture. Eastern Book Corporation, Delhi, India.
8. McDaniel, C.L. 1979. Ornamental Horticulture. Prentice-Hall International Inc., Reston, Virginia.
9. Raj, D. 2002. Floriculture and Landscaping. Kalyani Publisher, New Delhi.

HORT-306 INTRODUCTORY LANDSCAPE GARDENING 3(2-1)

Prerequisites:

Principles of Ornamental Horticulture

Specific Objectives:

To provide the students with opportunity to combine science of horticulture and their creative abilities in provision of aesthetically beautiful and functional environment.

Theory:

Classification of landscape plants, Growth habits, foliage and flowering effects, Propagation and maintenance of important landscape plants, Suitability of various plants for different purposes and locations, Principles, elements and types of landscape, Establishment and maintenance of lawn and turfs.

Practical:

Study of various soft and hard landscape designs, Aesthetic study of stem, branches, leaves, flowers and fruits, Practice in landscape designing, Visits to private and public landscape areas.

Books Recommended:

1. Arora, J.S. 2003. Introductory Ornamental Horticulture (4th Ed.). Kalyani Publishers, New Delhi.
2. Biondo, R.J., and C.B. Schroeder. 2006. Introduction to Landscaping Design, Construction and Maintenance (3rd Ed.). International Book Distributing Company (Publishing Division), Lucknow, India.
3. Bhattacharjee, S.K. 2004. Landscape Gardening and Design with Plants. Aavishkar Publishers, Distributors, Jaipur, India.
4. Raj, D. 2002. Floriculture and Landscaping. Kalyani Publishers, New Delhi.
5. Ingels, J.E. 1992. Landscaping: Principles and Practices. Delmar Publishing Inc. New York.
6. Gilmer, M. 2002. Water works. Contemporary Books McGraw Hill Companies, Sydney, Australia.
7. Hessayon, D.G. 2007. Expert Series. Transworld Publishers, London, U.K.

HORT-307 NURSERY MANAGEMENT & CERTIFICATION SYSTEM 4(2-2)

Specific Objectives:

To impart technical knowledge about nursery management and certification procedures.

Theory:

Introduction and importance, Types of horticultural nurseries, Management practices (water, nutrient, weeds, diseases, insect-pests), Protection against temperature extremities and radiation, Important nursery operations, Propagation methods and their importance, Rootstocks for horticultural plants, Raising of stock seedlings, Pre-sowing treatments of seeds; Apomixis and polyembryony, Stionic interactions, Graft compatibility and incompatibility, Use of growth regulators for propagation, Certification systems; standards, rules & regulation and procedures, Certification of planting material and nursery plants, Marketing of nursery plants.

Practical:

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

Books Recommended:

1. Adriance, G.W., and F.R. Brison. 2000. Propagation of Horticultural Plants. Biotech Books, Delhi, India.
2. Bose, T.K., S.K. Mitra and M.K. Sadhu. 1986. Propagation of Tropical and Subtropical Horticultural Crops. Naya Prokash, Calcutta-Six, India.
3. 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.
4. Sharma, R.R. 2002. Propagation of Horticultural Crops: Principles and Practices. Kalyani Publishers, Ludhiana, New Delhi, India.
5. Sharma, R.R. and M. Srivastav. 2004. Plant Propagation and Nursery management. International Book Distributing Co. (Publishing Division), Lucknow, India.
6. Sharma, V.K. 1996. Plant Nurseries: Techniques, Production and Management. Indus Publishing Company, New Delhi, India.

HORT-308 PROTECTED HORTICULTURE 3(2-1)

Specific Objectives:

To make student familiar with modern technology for production of high quality horticultural commodities round the year.

Theory:

Introduction and economic importance, Different structures and their construction, Selection of site and orientation, Environment control and maintenance, Seed and nursery raising, Crops suitable for forcing, Production technology of different crops, Soilless culture, Media, soil mixtures, containers, fertigation and irrigation systems, Pruning, training and staking, Insects, diseases, disorders and problem management.

Practical:

Structural demonstration of greenhouses, plastic tunnels and other structures, Preparation of growing media, Tools and types of containers, Raising of crops, Pollination techniques, Visits to commercial greenhouses and plastic tunnels.

Books Recommended:

1. Abbasi, N.A. and U. Habib. 2008. Protected Horticulture. Dept. of Horticulture, PMAS-Arid Agriculture University Rawalpindi, Pakistan.
2. Ashraf, M., M.S.K. Rana and M.A. Khan. 1989. Lecture Manual on Protected Vegetable Production. PARC, Islamabad.
3. Manohar, K.R. and C. Igathinathane. 2007. Greenhouse Technology and Management (2nd Ed.). BS Publications, Hyderabad, India.
4. Mastalerz, J.W. 1997. Greenhouse Environment. John Willey and Sons, New York.
5. Prasad, K. and U. Kumar. 2005. Greenhouse Management for Horticultural Crops (2nd Ed.). Agrobios (India) Jodhpur, India.
6. Resh, H.M. 1989. Hydroponic Food Production. Westbridge Press Publishing Company, Santabarbra, California, USA.

HORT-309 MEDICINAL AND AROMATIC PLANTS 3(2-1)

Specific Objectives:

To provide information about medicinal and aromatic values of different plants.

Theory:

Importance, origin and habitat, classification and botany, Climatic requirements, Cultivation and production, Chemical and pharmacological properties, Products and medicinal uses, Methods of plant collection and extraction, Processing, marketing and export potential.

Practical:

Identification, collection and description, Introduction, acclimatization and multiplication of economically important plants, Parts used and important ingredients, Processing and extraction methods, Visit to various herbal institutions, "Pansari" markets, herbal gardens.

Books Recommended:

1. Bhattacharjee, S.K. 1999. Handbook of Medicinal Plants. Pointer Publishing Co. India.
2. Joshi, S.G. 2000. Medicinal Plants. Oxford and IBH, India.
3. Farooqui, M.L.H. 2000. Medicinal Plants of Prophet Muhammad (PBUH). Sidrah Publishers, Lukhnow.
4. Grieve, M. 1992. A Modern Herbal. Tiger Book International, U.K.
5. Serdar, O. and M. Milan. 2007. Medicinal and Aromatic Crops. Haworth Food & Agric. Products.
6. Bogers, R.J., L.E. Craker and D. Lange. 2006. Medicinal and Aromatic Plants. Haworth Food & Agric. Products.
7. Raju, R.A. 2000. Wild Plants of Indian Sub-Continent and Their Economic Use. CBS Publishers and Distributors, New Delhi.

HORT-310 BREEDING OF HORTICULTURAL CROPS 3(2-1)

Specific Objectives:

To teach breeding methods for improvement of horticultural crops for quality and yields as per requirements of the growing population.

Theory:

Principles of plant breeding, Reproductive systems in horticultural crops, Self incompatibility and male sterility; centres of origin, Cytological basis of breeding, Heterosis, Theories of heterosis, Role of mutation and polyploidy in breeding, Somatic selection and chimeras, Apomixes, Breeding objective, Methods of breeding of self and cross pollinated crops, Improvement in fruit varieties, Germplasm conservation, Concept of genetic manipulation and transgenic plants.

Practical:

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

Books Recommended:

1. Eliot, E.C.1982. Plants Breeding and Cytogenetics. McGraw Hill Book Co., New York, USA.
2. Fageria, M.S., P.S. Arya and Choudhary, A.K. 2000. Vegetable Crops (Vol. 1): Breeding and Seed Production. Kalyani Publisher, Ludhiana, New Delhi, India.
3. Moore, J.N. and J. Janick, 1983. Methods in Fruit Breeding. Purdue University Press, West Lafayette, Indiana.
4. Simmonds, N.W. 1981. Principles of Crop Improvement. Longman and Co., London.
5. Bassett, M.J. 1986. Breeding Vegetable Crops. Avi Publishing Co. Inc., Westport, Connecticut.
6. Shukla, A.K., A.K. Shukla and B.B. Vashishtha. 2004. Fruit Breeding: Approaches and Achievements. International Book Distributing Company (Publishing Division), Lucknow, India.
7. Singh, A.P. 2003. Vegetable Breeding and Seed Production (1st Ed.). Kalyani Publisher, Ludhiana, New Delhi, India.
8. Ram, H.H. 2005. Vegetable Breeding, Principles and Practices. Kalyani Publisher, Ludhiana, New Delhi, India.

HORT-311 INDOOR PLANT CULTURE 2(1-1)

Specific Objectives:

To impart knowledge about interiorscaping by using foliage plants inside the building for making the environment pleasing.

Theory:

Introduction and importance, The indoor environment: light, temperature, humidity, oxygen, carbon dioxide and air pollutants, Cultural requirements, Production of flowering and foliage plants for shade and semi-shade area, Growing media; essential nutrients, watering, pests and diseases, Acclimatization, Planters, Terrarium, management practices for important indoor plants.

Practical:

Identification of indoor plants. Practices in watering and fertilization, Propagation, preparation of soil mixtures, potting and re-potting, Diagnosis of problems and solutions. Visit of nurseries and garden centres.

Books Recommended:

1. Dole, J.M. and H.F. Wilkins. 1999. Floriculture: Principles and Species. Ball Publishing, USA.
2. Hessayon, D.G. 2007. House Plant Expert. Transworld Publishers, London, U.K.
3. Hessayon, D.G. 2007. Indoor Plant Spotter. Transworld Publishers, London, U.K.
4. Davidson, W. 1991. House Plants. Tiger Books International, London.
5. Manaker, G.H. 1981. Interior Plant Scape Installation: Maintenance and Management. Prentice-Hall Inc., New Jersey.
6. Pyenson, L.L.P. 1981. Plant Health Handbook. A Guide to Better Gardening: Indoors and Outdoors. Avi Publications, Westport, Connecticut.
7. Rice, L.W. and R.P. Rice. 1986. Practical Horticulture–A Guide to Growing Indoor and Outdoor Plants. Prentice-Hall, New Jersey.
8. Schjenk, G. 1984. The Complete Shade Gardeners. Houghton Miffin and Co., Boston.

HORT-312 BUSINESS MANAGEMENT IN HORTICULTURE 3(3-0)

Specific Objectives:

To promote entrepreneurship and business management capabilities of horticulture graduates.

Theory:

Introduction and importance of horticultural enterprise, management for fruits, vegetables and ornamental crops, in Pakistan, Market demand and quality control, International standards and product handling for export, and marketing of value added commodities, Pricing, regulations, Global trade and Pakistan, W.T.O., Classified business Marketing channels Export prospects, Processing industry policy and market Opportunities and challenges.

Book Recommended:

1. Meena, R.K. and J. Yadev. 2001. Horticulture Marketing and Post-harvest Management. Pointer Publisher, Jaipur, Rajisthan.

HORT-313 ORGANIC HORTICULTURE 2(1-1)

Specific Objectives:

To impart training to the students for producing safe and other chemicals-free horticultural produce.

Theory:

Introduction and importance of organic farming, Principles of organic horticulture, Selection and use of materials and resources, Managing physical and chemical properties of growing substrate, Organic Manure production, Sustainability and environmental impact, Integrated farming system, Organic crop production of selected fruits, vegetables and flowering crops, Certification of organic produce.

Practical:

Identification and production of organic fertilizers, Developing organic fertilizer application programme for different horticultural crops, Integrated weed and pest management, Organic crop production techniques in greenhouse and field, Permaculture and organic lawn care, Vists to organic and non-organic progressive gardens.

Books Recommended:

1. Davies, F. and L. Margi. 2006. Organic Vegetable Production: A Complete Guide. Henry Doubleday Research Association Publications, U.K.

2. Gehlot, D. 2005. Organic Farming Standards, Accreditation, Certification and Inspection. Agrobios (India), Agro House, Jodhpur, India.

3. Gillman, J. 2008. The Truth about Organic Gardening: Benefits, Drawbacks and the Bottom Line. Timber Press.

4. Lind, G., K. Lafer, K. Scholfer and G. Innerhofer. 2003. Organic Fruit Growing. CAB International Publishing, Wallingford, U.K.
5. Lampkin, N. 2002. Organic Farming. Old Pond Publishing 104 Valley Road Ipswich, IPI 4 PA UK.
6. Reddy, P. 2008. Organic Farming for Sustainable Horticulture. Jodhpur, Scientific

HORT-314 TROPICAL AND SUB-TROPICAL FRUITS 3(2-1)

Prerequisites

Principles of Fruit Production

Specific Objectives

To accustom students with production technology of major tropical and sub-tropical fruits of Pakistan.

Theory

Classification of tropical and sub-tropical fruits, Cultivation with reference to acreage, production, botany, cultivars, rootstocks, propagation, climate, soil, cultural practices (water, nutrition, weeds, diseases, disorders and pest management), Maturity, ripening, harvesting, quality assurance and marketing of major tropical and sub-tropical fruits of Pakistan.

Practical

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

Learning Outcomes

Student must be able to produce important tropical and sub-tropical fruits.

Books recommended

• Alebrigo, L.G., L.W.Timmer and M.E. Rogers. 2014. Vol:II. Citrus (Crop Production Science in Horticulture). CABI

• Bali, S.S. 2003. Fruit Growing, Kalyani Publishers, New Delhi.

• Bose, T.K. and S.K. Mitra (Eds.). 1990. Fruits: Tropical and Subtropical. Naya Prokash, Calcutta-Six.

• Durate, O. and R.E. Paull, 2012. Tropical Fruits: Vol.II. Crop Production Science in Horticulture 24. CAB International Publishing.

• Chottopadhay, T.K. (Ed.). 2006. A Textbook on Pomology, Vol: II. Tropical Fruits. Kalyani Publishers, Ludhiana, New Delhi, India.

• Yadav, P.K. 2007. Fruit Production Technology. International Book Distributing Co. (Publishing Division), Lucknow, India.

• Jackson, D., N. E. Looney, **Bunker and G. Thiele. 2011. Temperate and Subtropical -M. Morley .ing, Wallingford, UKFruit Production. CAB International Publish**

• Nakasone, H.Y. and R.E. Paull. 1998. Tropical Fruits. Crop Production Science in Horticulture 7. CAB International Publishing, Wallingford, U.K.

• Salunkhe, D.K., S.S. Kadam. 1995. Handbook of Fruit Science: production, composition, storage and processing. Marcel Dekker, Inc. New York

• Radha, T. and L. Mathew. 2007. Fruit Crops. New India Publishing Agency, New Delhi, India. (429 Pages).

Journals/Periodicals

Worldwide Web

HORT-315 ARID HORTICULTURE 2(1-1)

Prerequisites

Specific Objectives

To impart knowledge to the students for utilization of arid areas for sustainable production of horticultural crops.

Theory

Introduction, Economic aspects of arid zone horticulture, Formulation of rainfall distribution models for arid zone, Arid ecology, Problems associated with arid zone horticulture, Rainfall analysis and crop planning, Soil and moisture conservation, Agro-techniques for horticultural crops, Physiology of drought and salinity tolerance in horticultural crops. Suitable crops for arid areas and their production technologies. Dry climate landscape (Xeroscape).

Practical

Orchard management in arid fruits, evaluation of moisture conservation techniques like organic and inorganic mulches, studies of critical stages of irrigation in various arid horticultural crops, studies of irrigation systems (drip and sprinkler) and their impact on productivity of arid fruits and vegetables, water harvesting techniques, control of water loss through evapotranspiration, integrated nutrient management in arid horticultural crops.

Learning Outcomes

Students must be able to grow and manage horticultural crops in dry-land areas.

Books Recommended

- Saroj, P.L., B. Vashishtha and D.G. Dhandar. 2004. Advances in Arid Horticulture. Vol I: Present Status. International Book Distribution Co. Lucknow, India.
- Saroj, P.L., B. Vashishtha and D.G. Dhandar. 2004. Advances in Arid Horticulture. Vol II: Present Status. International Book Distribution Co. Lucknow, India
- Chandra, A., A. Chandra and I.C. Gupta. 1994. Arid Fruit Research. New Delhi, India.
- Chundawat, B.S. 1990. Arid Fruit Culture. Pub. Oxford and IBH Co. Ltd. New Delhi, India.

Journals/Periodicals

Worldwide Web

HORT-316 SUMMER VEGETABLES 3(2-1)

Prerequisites

Principles of Vegetable Production

Specific Objectives

To accustom students with production technology of major summer vegetables of Pakistan.

Theory

Introduction, importance and issues, Types of vegetable farming, Cultivation of summer vegetables with reference to their acreage, production, botany, cultivars, climate, soil, cultural practices, maturity indices, harvesting, grading, packing, quality assurance, marketing, production problems, important weeds, insect-pests, Diseases and their control.

Practical

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

Learning Outcomes

Students must be skilled in growing summer vegetables of the region.

Books recommended:

• Bose, T.K., M.G. Som and J. Kabir. 1993. Vegetable Crops. Naya Prokash, Calcutta-Six, India.

• Biswas, S., **M. Datta and S.V. Ngachan. 2011. Mushrooms: A Manual for Cultivation. PHI learning private Ltd., New**Delhi, India.Libner, N.S. 2006. Vegetable Production. Vedams Books Pvt. Ltd. New Delhi, India.

• Das, P.C. 2003. Vegetable Crops of India. Kalyani Publishers, New Delhi.

• Decoteau, D.R. 2002. Vegetable Crops. Prentice-Hall of India, New Delhi, India.

• Dhaliwal, M.S. 2008. Handbook of Vegetable Crops. Kalyani Publishers, Ludhiana, New Delhi, India.

• Maynard, D.N. and G.J. Hochmuth. 2007. Knott's Handbook of Vegetable Growers (5th Ed.). John Willey and Sons Inc., New York.

• Rana, M.K. 2008. Scientific Cultivation of Vegetables. Kalyani Publishers, Ludhiana, New Delhi, India.

• Swaider, J.M., G.W. Ware and J.P. McCollum. 2002. Producing Vegetable Crops (5th Ed.), Interstate Publishers Printers and Publishers Inc., Danville, Illinois.

• Singh, A.P. 2002. Vegetable Growing in India. Kalyani Publishers, New Delhi.

• Singh, D.K. 2007. Modern Vegetable Varieties and Production Technology. International Book Distributing Co. (Publishing Division), Lucknow, India.

HORT-317 MUSHROOM CULTURE 2(1-1)

Prerequisites

Introductory Horticulture and Horticultural Crop Production

Specific Objectives

To acquaint the students to understand the basics of mushroom cultivation

Theory

Introduction, nutritional and medicinal value, general biology, spawn production, growing structures and systems, different substrates and their preparation, fruiting body formation, environmental requirements, production technology of the important mushroom species, Postharvest handling and packing.

Practical

Identification of different edible species, Media and substrate preparation, isolation of pure culture for spawn, compost preparation, practices in growing methods of different cultivated mushrooms, visits of mushroom houses.

Learning Outcomes

Students must be trained in identifying and growing different mushroom species.

Book recommended

- Biswas, S., M. Datta and S.V. Ngachan. 2011. Mushrooms: A Manual For Cultivation. PHI .learning private Ltd., New Delhi, India
- Chang, S. and P.G. Miles. 2004. Mushrooms: cultivation, nutritional value, medicinal effect, and environmental impact. CRC Press. USA.

- Miles, P.G. and S. Chang. 1997. Mushroom Biology: Concise basics and current developments. World Scientific Publishing Co. Pte. Ltd. Singapore.
- Bahl, N. 1984. Handbook of Mushrooms. Oxford and IBH publishing Co. New Delhi.

HORT-318 LANDSCAPE HORTICULTURE 3(2-1)

Prerequisites

Principles of Ornamental Horticulture

Specific Objectives

To provide the students with opportunity to combine science of horticulture and their creative abilities in provision of aesthetically beautiful and functional environment.

Theory

Classification of landscape plants, Growth habits, foliage and flowering effects, Propagation and maintenance of important landscape plants and turf grasses Introduction to landscape design, hardscape and softscape, Principles, elements and types of landscape, Suitability of various plants for different purposes and locations, Irrigation systems for different landscapes, Landscape planning, installation, maintenance, and budget estimation.

Practical

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

Learning Outcomes

Students must be able to prepare designs, and manage landscape of various premises.

Books recommended

• Arora, J.S. 2003. Introductory Ornamental Horticulture (4th Ed.). Kalyani Publishers, New Delhi.

• Biondo, R.J., and C.B. Schroeder. 2006. Introduction to Landscaping Design, Construction and Maintenance (3rd Ed.). International Book Distributing Company (Publishing Division), Lucknow, India.

• Bhattacharjee, S.K. 2004. Landscape Gardening and Design with Plants. Aavishkar Publishers, Distributors, Jaipur, India.

• Gilmer, M. 2002. Water works. Contemporary Books McGraw Hill Companies, Sydney, Australia.

• Hessayon, D.G. 2007. Expert Series (Garden Expert, DIY Expert, The Easy Care Gardening Expert, The Rock and Water Garden Expert). Transworld Publishers, London, U.K.

• Ingels, J.E. 1992. Landscaping: Principles and Practices. Delmar Publishing Inc. New York.

• Raj, D. 2002. Floriculture and Landscaping. Kalyani Publishers, New Delhi.

Journals/Periodicals

Worldwide Web

HORT-319 PERI-URBAN HORTICULTURE 2(1-1)

Prerequisites

Specific Objectives

To provide information about horticulture within and immediate surroundings of cities.

Theory

Introduction and historical background, Present status of peri-urban horticulture in the world and Pakistan, Recent trends in peri-urban horticulture, Need for changing the scenario, Crop production (vegetables, flowers, fruits) on small scale, Safe use of waste water, Soil and water management, Organic farming, Health and food safety, Marketing strategies for peri-urban horticulture.

Practical

Visits of peri-urban horticulture farms and waste recycling projects, Practice in layout of peri-urban farms, Waste water treatments, Use of solid waste as growing media, Practice in nursery raising and transplanting, Management of cultural practices.

Learning Outcomes:

Students must be familiar with the techniques of peri-urban production and management of horticultural crops.

Books recommended

- Baud, I.S.A., J. Post and C. Furedy. 2004. Solid Waste Management and Recycling. Kluwer Academic Publishers, Netherland.
- Duncan, M., D. Simon and D. Thompson. 2005. The Peri-Urban Interface. Approaches to Sustainable Natural and Human Resource Use. Royal Holloway, University of London, London, UK.

- Fall, S. Toure and Y. Akinbamijo. 2000. Integrated Peri-Urban Systems: Horticulture and Livestock in West African Cities. International Trypanotolerance Center Annual Technical Report Year II, June 1999 - June. (Centre File 03934-97-0021-01).
- McGregor, D. and Urban Interface: Approaches to Sustainable -D. Simon. 2012. The Peri .Natural and Human Resource Use. Earthscan, New York, USA
- Mukherjee, N. and M. Jayaswal. 2006. Chained by Food: Marginalized Voices from Peri-Urban India : Poor Households as Food Producers and Consumers in Peri-Urban India.Vedams eBooks (P) Ltd. Pitampura, New Delhi, India.
- Smit, J., A. Ratta, and J. Nasr. 1996. Urban agriculture: Food, Jobs and Sustainable Cities. UNDP, Urban Development Unit, New York, U.S.A.

Journals/Periodicals

Worldwide Web

HORT-320 INTRODUCTORY PLANT BIOTECHNOLOGY 2(1-1)

Specific Objectives:

To enable students to understand:

- Basic concept and techniques in Plant Biotechnology.
- Application of Genetic Engineering in Horticultural plant Research.

Theory:

Introduction to genetic engineering and plant biotechnology. In vitro culture techniques : callus culture, cell suspension culture, protoplast culture, embryo rescue, soma clonal variations. Basics of molecular biology, DNA amplification, Polymerase Chain Reaction, DNA fingerprinting, molecular markers and marker assisted selection in plant breeding. Biotechnological approaches to drought tolerance, salt tolerance and protein quality in various field crops. Scope of transgenic plants in plant breeding.

Practical:

Safety measures in the biotech laboratory. Introduction to aseptic techniques, autoclaving, sterilization, use of laminar flow and fume hoods. Storage and weighing of chemicals, preparation of stock-solutions, adjusting pH, making dilutions. Media preparation. Callus formation and regeneration from plant material. Isolation, handling and quantification of DNA.

Books recommended:

1. Loodish, H. 2004. Molecular Cell Biology. 5th Ed., John Wiley and Sons, New York, USA.

2. Paul, C and K. Harry. 2004. Handbook of Plant Biotechnology. John Willy and Sons, New York, USA.

3. Muglani, G. S. 2003. Advanced Genetics. Narosa Publishing House, New Delhi, India.

4. Razdan, M. K. (Ed) 2003. Introduction to Plant Tissue Culture. 2nd Ed., Intercept, New York, USA.

5. Brown, T. A. 2000. Essential Molecular Biology: A Practical Approach. Oxford University Press, New York, USA.

HORT-401 RESEARCH METHODS AND TECHNIQUES IN HORTICULTURE 4(2-2)

Specific Objectives:

To develop ability in the students to identify and address the researchable problems in different areas of Horticulture.

Theory:

Areas of research in Horticulture, Planning of field and lab experiment, Product oriented research methods, New innovation in research methodology, Hypothesis and experimentation, Research parameters (molecular, morphological, physiological, biochemical, growth and yield characteristics), Survey, sampling and data collection, Data processing, tabulation, analysis and interpretation of result, Computer application, word processing, graphics and data analysis packages., Application of biotechnology and bioinformatics in horticulture research.

Practical:

Practices in field layout of experimental design, Sampling and data collection of plant, Laboratory practices in physico-chemical analyses of plant and soil , Use of computer (DNA star, MEGA5.0, word processing, data processing and graphics) in horticultural research, Preparation of research proposal.

Books Recommended:

1. Ben Dewey, 2012. Getting started with Windows 8 Apps: A Guide to the Windows Runtime O Rally Media Inc 1005 Gravensten Highway North Sebsatopol CA95472.
2. Pearce, S.C., 1976. Field Experimentation with Fruit and other Perennial Plants.
3. Hartmann, H.T., D.E. Kester, E.T. Davies and R.L. Geneve, 2009. Plant Propagation: Principles and Practices (7^{th} Ed.) Prentice-Hall India Learning Pvt. Ltd., New Delhi, India.
4. Tech. Communication No.23. Commonwealth Bureau of Horticulture and Plantation Crops. East Malling, Kent.

5. Petersen, R.G. 1994. Agricultural Field Experiments–Design and Analysis. Marcel Dekker, Inc., New York.
6. Little, T.M. and F.J. Hills. 1978. Agricultural Experimentation–Design & Analysis. John Wiley and Sons, New York.
7. Srivastav, M. and R.S. Yadav. 2007. Principles of Laboratory Techniques and Methods. International Book Distributing Company (Publishing Division), Ludhiana, India.

HORT-403 MINOR FRUITS **3(2-1)**

Specific Objectives:

To create know how among the students about different fruits grown in different areas of Pakistan at small scale.

Theory:

Introduction and importance, Acreage, production, botany, composition and uses, climate, soil, propagation, rootstocks, cultural practices, cultivars, important insect-pests and diseases, harvesting, post-harvest handling and marketing of fruits such as bael, ber, berries, chiku, currants, custard apple, fig, falsa, jaman, jack fruit, kiwi fruit, kronda, loquat, mulberry, olive, papaya, pecan and quince.

Practical:

Identification of minor fruit plants and their fruits, seeds, layout systems, propagation methods, pollination, pruning, thinning, harvesting, handling and marketing techniques.

Books Recommended:

1. Alford, D.V. 2007. Pests of Fruit Crops. Manson Publishing Delhi, India.
2. Das, D.C. and S.N. Das. 2006. Cultivation of Minor Fruits. Kalyani Publishers, Ludhiana, New Delhi, India.
3. Philip, S. 2002. Fruit Crops. Kalyani Publishers, Ludhiana, New Delhi, India.
4. Singh, S.P. 2005. Commercial Fruits. Kalyani Publishers, Ludhiana, New Delhi, India.
5. Steferud, A. 2005. Diseases of Fruits and Nuts. Publisher Biotech Books, Delhi,India.

HORT-405 COMMERCIAL FLOWER PRODUCTION 3(2-1)

Specific Objectives:

To accustom students with production technology of economically important flowers.

Theory:

Introduction, Environmental simulation, Climate and soils, propagation, crop management practices, harvesting, post harvest handling and marketing of important floral crops such as carnation, chrysanthemum, roses, snapdragon, marigold, jasmine (motia), gypsophylla, calendula, orchids, gerbera, nemesia, statice, stock, geranium, sweet pea, zinnia, dahlia, amaryllis, anemone, freezia, gladiolus, crocus, iris, lilium, daffodil (narcissus), tulip, tuberose.

Practical:

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

Books Recommended:

1. Armitage, A.M. and J.M. Laushman. 2003. Specialty Cut Flowers (2nd Ed.). Timber Press, Windsor, Australia.
2. Bose, T.K., L.P. Yadav, P. Pal, V.A. Parthasarathy and P. Das. 2003. Commercial Flowers (2nd Ed.). Naya Udyog, Calcutta, India.
3. Banerjee, U. 2001. Commercial Flower Production. Mangal Deep Publications, Jaipur, India.
4. Larson, RA. 1980. Introduction to Floriculture. Academic Press, New York, USA.
5. Prasad, S. and U. Kumar. 2005. Commercial Floriculture. Agrobios (India), Jodhpur, India.
6. Rees, A.R. 1992. Ornamental Bulbs, Corms and Tubers. Crop Production Science in Horticulture 1. CAB International, Wallingford, U.K.
7. Dole, J.M. and H.F. Wilkins. 1999. Floriculture: Principles and Species. Ball Publishing, USA.
8. Yadav, I.S. and M.L. Choudhry. 1997. Progressive Floriculture– Production Technologies of Important Commercial Flower Crops. The House of Sarpan, Banglore.
9. Laurie, A. 2004. Floriculture: Fundamentals and Practices. McGraw Hill Book Company, New York.

HORT-407 POST-HARVEST HORTICULTURE 4 (3-1)

Specific Objectives:

To equip students with the techniques to prolong shelf-life of perishable horticultural produce.

Theory:

Introduction and importance, Pre- and post-harvest factors affecting quality, Climacteric and non-climacteric commodities, Indices of crop maturity / ripening, harvesting and pre-cooling, Curing and artificial ripening of horticultural commodities, Packing house operations; culling, grading, washing, cleaning, colouring, waxing and packaging of important horticultural commodities, Packing materials and containers, Storage; principles and types, storage life and factors determining it, International standards and quality assurance, Shipment for local and foreign markets.

Practical:

Machinery and equipment used for various operations, Demonstration of harvest indices, Practices in harvesting, curing, packing and preparation of different fruits, vegetables and cut flowers for marketing, Visits to the fruit, vegetable and floral markets, packing houses and cold storages etc.

Books Recommended:

1. Kader, A.A. 2002. Postharvest Technology of Horticultural Crops. University of California Press, California, USA.
2. Kays, S.J. 1998. Postharvest Physiology of Perishable Plant Products. CBS Publishers & Distributors, New Delhi, India.
3. Mitra, S.K. 1997. Post-Harvest Physiology and Storage of Tropical and Sub-tropical Fruits. CAB International Publishing, Wallingford, U.K.
4. Shewfelt, R.L. and S.E. Prussia (Eds.). 1993. Postharvest Handling: A Systems Approach. Academic Press, California, USA.
5. Thompson, A.K. 1996. Post-Harvest Technology of Fruits and Vegetables. Blackwell Science Ltd., Oxford.
6. Pandry, P.H. 2002. Principles and Practices of Postharvest Technology. Kalyani Publishers, New Delhi, India.
7. Wills, R.B.H., W.B. McGlasson, D. Graham, D.C. Joyce. 2007. Postharvest (5^{th} Ed.). Printer Everbest China.

HORT-409 IN VITRO PROPAGATION 2(1-1)

Specific Objectives:

To acquaint the students with modern techniques of plant multiplication.

Theory:

Introduction and importance; Basic terminology, application and constraints of plant tissue culture, Preparation of synthetic seed; Nutritional components of culture media (nutrients, carbohydrates, vitamins, growth regulators, amino acids and antibiotics), their types & functions; aseptic techniques; Initiation and maintenance of cultures; Physical factors for growth; transplanting and acclimatization; concepts of plant biotechnology and its role in improvement of horticultural crops.

Practical:

Laboratory safety precautions, sanitation, equipment; Calculations (preparation of molar, percent, normal, ppm etc solutions); Preparation of stock solutions & media, disinfestation, inoculation and culture of explants, Acclimatization & transplanting.

Books Recommended:

1. Trigiano, R.N. and J.G. Dennis. 2000. Plant Tissue Culture Concepts and Laboratory Exercises. CRC Press LLC, USA.
2. Defergh, P.C. and R.H. Zimmerman. 1991.
3. Hartmann, H.T., D.E. Kester, E.T. Davies and R.L. Geneve. 2009. Plant Propagation: Principles and Practices (7^{th} Ed.). Prentice-Hall India Learning Pvt. Ltd., New Delhi, India.
4. Lindsey, K. (Ed). 2007. Plant Tissue Culture Mannual. Springer-Kluwer Academic Publishers New Delhi, India.
5. George, E.F., M.A. Hall and G.J. De Klerk. 2008. Plant Propagation by Tissue Culture. 3rd Ed. Springer, Dordrecht, Netherlands.
6. Kumar, U. 2002. Methods in Plant Tissue Culture. 2nd Ed. Agrobios. (India) Agro House, Chopasani Road, Jodhpur 342 oo2.
7. Razdan, M.K. 2003. Introduction to Plant Tissue Culture. Science Publishers Inc. (ISBN: 1-57808-237-4).
8. Margit, L. and W. Rucker. 2004. Plant Tissue Culture: Plant Tissue Culture – 100 years since Gottlieb Haberlandt. CPL Scientific Publishers, (ISBN: 3211838392).
9. Chandra, R. and M. Mishra (Eds). 2005. Comprehensive Micropropagation of Horticultural Crops International Book Distributing Co. (Publishing Division), Lucknow, India.

HORT-411 VEGETABLE AND FLOWER SEED PRODUCTION 3(2-1)

Specific Objectives:

To provide technical knowledge about pure and hybrid seed production of annual horticultural crops.

Theory:

Introduction and Importance, Principles of seed production, Seed classes, Pre-basic, basic, registered and certified seed, Reproductive systems, modes of pollination and seed production, Pure and hybrid seed production, Methods and procedures for seed production of important vegetables and flowers, Seed handling technology, Seed testing and storage, Seed certification and registration.

Practical:

Pollination techniques, Maintenance of self and cross pollinated lines, Methods of seed collection; Seed desiccation for storage, Seed treatments for storage, Seed testing techniques.

Books Recommended:

1. Desai, B.B., P.M. Kotecha and D.K. Salunkhe. 1997. Seeds Handbook – Biology, Production, Processing and Storage. Marcel Dekker Inc., New York.
2. McDonald, M.B. and L.O. Copeland. 1998. Seed Production – Principles and Practices. CBS Publishers and Distributors, New Delhi.
3. Salunkhe, D.K., B.B. Desai and N.R. Bhat. 1987. Vegetable and Flower Seed Production. Agricole Publishing Academy, New Delhi.
4. Singh, A.P. 1999. Vegetable Seed Production Principles (1st Ed.). Kalyani Publisher, Ludhiana, New Delhi, India.
5. Khare, D., M.S. Bhale. 2005. Seed Technology. Scientific Publishers, New Delhi, India.
6. Singh, P. and B.S. Asati. 2008. Seed Production Technology of Vegetables. Daya Publishing Home, Delhi, India.
7. Singh, N., D.K. Singh, Y.K. Singh and V. Kumar. 2006. Vegetable Seed Production Technology. International Book Distributing Company (Publishing Division), Lucknow, India.
8. Singh, P.K., S.K. Dasgupta and S.K. Tripathi. 2005. Hybrid Vegetable Development, CRC Press Boca Raton, USA.

HORT-413 TEMPERATE FRUITS

3(2-1)

Prerequisites

Principles of Fruit Production

Specific Objectives

To accustom students with production technology of major temperate fruits of Pakistan.

Theory

Classification of temperate fruits, Cultivation with reference to acreage, production, botany, cultivars, rootstocks, propagation, climate, soil, cultural practices (water, nutrition, weeds, diseases, disorders and pest management), Maturity, ripening, harvesting, quality assurance and marketing of major temperate fruits of Pakistan.

Practical

Practices in fruit health management, Pollination in commercial fruits, Cost of production, Description and identification of commercial cultivars of important temperate fruits, Visit to research institutes and commercial orchards.

Learning Outcomes

Student must be able to produce important temperate fruits.

Books recommended

• Bali, S.S. 2003. Fruit Growing, Kalyani Publishers, New Delhi.

• Bose, T.K. and S.K. Mitra (Eds.). 1990. Fruits: Tropical and Subtropical. Naya Prokash, Calcutta-Six.

• Mitra, S.K., D.S. Rathore, and T.K. Bose (Eds.). 1991. Temperate Fruits. Horticulture and Allied Publishers, Calcutta.

• Barooh, S. 1998. Modern Fruit Culture. Kalyani Publishers, Ludhiana, New Delhi, India.

• Chottopadhay, T.K. (Ed.). 2009. A Textbook on Pomology, Vol: IV. Temperate Fruits. Kalyani Publishers, Ludhiana, New Delhi, India.

• Yadav, P.K. 2007. Fruit Production Technology. International Book Distributing Co. (Publishing Division), Lucknow, India.

• Jackson, D.I., N. Looney, M. Morley-Bonker and G. Thiele. 2011. Temperate and Subtripical Fruit Production. CAB International Publishing, Wallingford, UK.

• Salunkhe, D.K., S.S. Kadam. 1995. Handbook of Fruit Science: production, composition, storage and processing. Marcel Dekker, Inc. New York

Journals/Periodicals

Worldwide Web

Hort. 415 WINTER VEGETABLES 3(2-1)

Prerequisites

Principles of Vegetable Production

Specific Objectives

To accustom students with production technology of major winter vegetables of Pakistan.

Theory

Introduction, importance and issues, Types of vegetable farming, Cultivation of winter vegetables with reference to their acreage, production, botany, cultivars, climate, soil, cultural practices, maturity indices, harvesting, grading, packing, quality assurance, marketing, production problems, important weeds, insect-pests, Diseases and their control.

Practical

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

Learning Outcomes:

Students must be skilled in growing winter vegetables of the region.

Books recommended

• Bose, T.K., M.G. Som and J. Kabir. 1993. Vegetable Crops. Naya Prokash, Calcutta-Six, India.

• Biswas, S., **M. Datta and S.V. Ngachan. 2011. Mushrooms: A Manual For Cultivation. PHI .ing private Ltd., New Delhi, Indialearn**

• Libner, N.S. 2006. Vegetable Production. Vedams Books Pvt. Ltd. New Delhi, India.

• Rana, M.K. 2008. Scientific Cultivation of Vegetables. Kalyani Publishers, Ludhiana, New Delhi, India.

• Decoteau, D.R. 2002. Vegetable Crops. Prentice-Hall of India, New Delhi, India.

• Dhaliwal, M.S. 2008. Handbook of Vegetable Crops. Kalyani Publishers, Ludhiana, New Delhi, India.

• Maynard, D.N. and G.J. Hochmuth. 2007. Knott's Handbook of Vegetable Growers (5th Ed.). John Willey and Sons Inc., New York.

• Swaider, J.M., G.W. Ware and J.P. McCollum. 2002. Producing Vegetable Crops (5th Ed.), Interstate Publishers Printers and Publishers Inc., Danville, Illinois.

• Das, P.C. 2003. Vegetable Crops of India. Kalyani Publishers, New Delhi.

• Singh, A.P. 2002. Vegetable Growing in India. Kalyani Publishers, New Delhi.

• Singh, D.K. 2007. Modern Vegetable Varieties and Production Technology. International Book Distributing Co. (Publishing Division), Lucknow, India.

• Maynard, D.N. and G.J. Hochmuth. 2007. Knott's Handbook of Vegetable Growers (5th Ed.). John Willey and Sons Inc., New York.

Journals/Periodicals

Worldwide Web

HORT-417 PROJECT PLANNING AND SCIENTIFIC WRITING 2(1-1)

Specific Objectives:

To develop ability in the students to identify and plan research projects in different areas of Horticulture and write their reports.

Theory:

Concept of research, Scientific method and experiment, Steps in experimentation, Writing of research proposal, Layout of field experiments, Observation of field trials, Measurement of crop growth and yield, Collection, tabulation and analysis of data, Measures of experimental variability, Interpretation of data, Writing and summarizing of scientific paper.

Practical:

Preparation of research proposal, Layout of field experiments, Collection and tabulation of data, Analysis of data, Presentation of data in tables, curves, histograms etc, Writing of scientific paper.

Books Recommended:

1. Anderson, J., B.H. Durston and M. Poole. 1992. Thesis and Assignment Writing. Wiley Eastern Ltd. New Delhi, India.
2. Awan, J.A. 2003. Scientific Presentation. Uni-tech Communication, Faisalabad, Pakistan.
3. Hashmi, N. 1989. Style Mannual of Technical Writing, 2nd Edition. Pakistan Economic Analysis Network Project, Govt. of Pakistan, Ministry of Food and Agriculture, Islamabad, Pakistan.
4. Mathews, J.R., J.M. Brown and R.W. Mathews. 2000. Successful Scientific Writing: A Step-by-Step Guide for Bio-Medical Scientists, 2nd Edition. Cambridge University Press, Cambridge, U.K.
5. Redmond, W.A. 1992. Getting Started with Microsoft Windows. Version 3.1, One Microsoft Way 98052-6399 (1991-92), Microsoft Corporation, Washington.
6. Petersen, R.G. 1994. Agricultural Field Experiments–Design and Analysis. Marcel Dekker, Inc., New York.

HORT-419 FLORAL DESIGNS AND ARRANGMENTS 2(1-1)

Prerequisites

Ornamental Horticulture

Specific Objectives

To develop ability of the students to make different floral arrangements and designs for different occasions.

Theory

Introduction; Principles and elements of floral designs and arrangements; Basic techniques and styles; Cut flowers and foliage, European and Asian floral designs; Contemporary and thematic designs, Dried arrangements; Speciality floral designs; Business practices.

Practical

Identification of cut flowers and foliage, Design tools and materials; Basic floral design and using proper techniques; Care and handling of flowers and foliage; Seasonal, holiday and special occasion designs; Marketing techniques, florist shops visit.

Learning Outcomes

Students must be trained in making bouquet of different styles and other floral designs and arrangements for different occasions.

Books recommended

- Webb, I. 1988. The Complete Guide to Flower & Foliage Arrangement. Ebury Press, London.
- Armitage, A.M. and J.M. Laushman 2008. Specialty Cut Flowers. Varsity/ Timber Press, Portland.
- Hunter, N.T. 1999. The Art of Floral Design. Delmar Thomson Learning.
- Perry, L.P. 1998. Herbaceous Perennial Production: A Guide from Propagation to Marketing. NRAES, Cornell, Ithaca, NY.
- Pryke, P. 2004. The Complete Book of Floral Design. Kevin summers, Rizzoli International Publications, New York.
- Stevens, A. 1997. Field Grown Cut Flowers. Avatar's World, 106 E, Hurd Road, Edgerton, WI 53534.
- De, L. C. 2011. Value Addition in Flowers and Orchids. New india publishing agency. New Dehli India.
- McHoy, P. 2002. The Ultimate Rose Book. Anness Publishing Inc. New York, USA.
- Aruna, P., T.L. Preethi, V. Ponnuswami, V. Swamiminathan and R. Shankaranarayanan. 2011. Post-Harvest Techniques and Management for Dry Flowers. New India Publishing Agency New Delhi, India

Journals/Periodicals

Worldwide Web

HORT-422 ` INTERNSHIP 5 (0-5)

Specific Objectives:

To strengthen the practical knowledge of students and their involvement in various horticultural projects.

Practical:

Placement of students at various public and private organizations. Study, discussion and their practical involvement in ongoing programs/projects. Performance of practical managerial duties or practical demonstration of important operations in the concerned gardens, Submission of report and oral presentation at the end of the semester.

Hort - 424 SEMINAR 1 (1-0)

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