

CURRICULUM

OF

AGRONOMY

BS/BSc (Hons)

MS/MSc (Hons)

Ph.D.

(Revised 2010)



**HIGHER EDUCATION COMMISSION
ISLAMABAD**

CURRICULUM DIVISION, HEC

Dr. Syed Sohail H. Naqvi	Executive Director
Prof. Dr. Altaf Ali G. Shaikh	Member (Acad)
Mr. Muhammad Javed Khan	Adviser (Acad)
Ms. Ghayyur Fatima	Director (Curri)
Dr. M. Tahir Ali Shah	Deputy Director (Curri)

Composed by: Ms. Pakeeza Yousuf, HEC, Islamabad

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PREFACE

The curriculum of subject is described as a throbbing pulse of a nation. By viewing curriculum one can judge the stage of development and its pace of socio-economic development of a nation. With the advent of new technology, the world has turned into a global village. In view of tremendous research taking place world over new ideas and information pours in like of a stream of fresh water, making it imperative to update the curricula after regular intervals, for introducing latest development and innovation in the relevant field of knowledge.

In exercise of the powers conferred under Section 3 Sub-Section 2 (ii) of Act of Parliament No. X of 1976 titled “**Supervision of Curricula and Textbooks and Maintenance of Standard of Education**” the erstwhile University Grants Commission was designated as competent authority to develop review and revise curricula beyond Class-XII. With the repeal of UGC Act, the same function was assigned to the Higher Education Commission under its Ordinance of 2002 Section 10 Sub-Section 1 (v).

In compliance with the above provisions, the HEC undertakes revamping and refurbishing of curricula after regular intervals in a democratic manner involving universities/DAIs, research and development institutions and local Chamber of Commerce and Industry. The intellectual inputs by expatriate Pakistanis working in universities and R&D institutions of technically advanced countries are also invited to contribute and their views are incorporated where considered appropriate by the National Curriculum Revision Committee (NCRC).

To bring international compatibility to qualifications held from Pakistani universities/DAIs for promotion of students mobility and job seekers around the globe, a Committee comprising of Conveners of the National Curriculum Revision Committee of HEC met in 2009 and developed a unified template for standardized 4-years/8-semesters BS degree programmes. This unified template was aimed to inculcate broader base of knowledge in the subjects like English, Sociology, Philosophy, Economics etc in addition to major discipline of study. The Bachelor (BS) degree course requires to be completed in 4-years/8-semesters, and shall require qualifying of 130-140 credit hours of which 77% of the curriculum will constitute discipline specific and remaining 23% will comprise compulsory and general courses.

In line with above, NCRC comprising senior university faculty and experts from various stakeholders and the respective accreditation councils has finalized the curriculum for BS and MS (Agronomy). The same is being recommended for adoption by the universities/DAIs channelizing through relevant statutory bodies of the universities.

PROF. DR. ALTAF ALI G. SHAIKH
Member Academics

March 2010

CURRICULUM DEVELOPMENT

Rationale of Degree Programs in Agronomy

Achieving sustainability in food grain production and food security, in its totality, continues to be a challenge in the developing world including Pakistan. The produce of green revolution, we are harvesting now, seems to be saturated in terms of genetic potential. Over the past two decades, global food production has trebled, largely because of advances in agronomy.

The major challenges to sustainable food grain production in Pakistan include availability of quality seed, declining soil health, fragile cropping systems, looming water crisis, environmental degradation owing to indiscriminate use of farm chemicals, post-harvest losses, minimal value addition and product differentiation, inadequate food storage and preservation, and poor marketing system. The imperative need, therefore, is to address these issues more forcefully in order to tap the considerable productivity potential of the agriculture sector through resource conservation.

The objective of the education and training in Agronomy is to generate, integrate, and apply knowledge about crop plants that are grown for food, feed, fiber and the general benefit of people. Education and training programs in agronomy (at under graduate, post graduate and Ph.D level) aim at developing trained human resource base who conduct basic and applied research in various aspects of crop production and soil management under varying agro-ecological and socio-economic conditions of the farming community. The graduates majoring in agronomy help find and disseminate answers to problems, and discover opportunities concerning efficiency and sustainability of production systems by developing safe and environmentally-sound practices. Manpower so trained serves in different capacity providing advisory services to farmers, NGOs and the relevant agro-based industry, impart short term training to farmers and in-service agri-personnel pertaining to latest developments in this field for better resource management and sustaining crop yields under changing environmental scenario.

INTRODUCTION

A meeting of the National Curriculum Revision Committee to finalize the draft curriculum of Agronomy was held at HEC, Regional Centre, Lahore, on April 26 – 28, 2010. The following experts attended the meeting:-

Prof. Dr. Zahid Ata Cheema, Chairman Department of Agronomy, University of Agriculture, Faisalabad.	Convener
Prof. Dr. Inayatullah Awan Chairman, Department of Agronomy, Faculty of Agriculture, Gomal University, D.I.Khan.	Member
Prof. Dr. Rana Muhammad Iqbal Department of Agronomy, University College of Agriculture & Environmental Sciences, Islamia University, Bahawalpur.	Member
Prof. Dr. Muhammad Bismillah Khan Head, Department of Agronomy & Soil Science B.Z. University Multan.	Member
Prof. Dr. Fayyaz-ul-Hassan Sahi Department of Agronomy, (Nominee NAEAC) PMAS Arid Agriculture University, Rawalpindi.	Member
Prof. Dr. Muhammad Hussain Professor, Department of Agronomy Faculty of Agriculture, Rawalakot Azad Jammu & Kashmir.	Member
Prof. Muhammad Akmal Professor, Department of Agronomy Agriculture University, Peshawar	Member
Prof. Dr. Hayatullah Khan Faculty of Agriculture Sciences, Hazara University, Haripur Campus Haripur,	Member

<p>Prof. Dr. R.B. Mirbahar Dean, Faculty of Crop & Plant Sciences Lasbela University (LUAMWS), Balochistan</p>	Member
<p>Dr. Zammarud Iqbal Ahmed, Associate Professor, Department of Agronomy, Arid Agriculture University, Rawalpindi.</p>	Member
<p>Dr. Samsuddin Tunio, Professor, Department of Agronomy, Sindh Agriculture University, Tandojam.</p>	Member
<p>Dr. Fateh Chand Oad, Associate Professor/ Chairman, Department of Agronomy, Sindh Sindh Agriculture University, Tandojam.</p>	Member
<p>Dr. Abdul Khaliq Associate Professor, Department of Agronomy University of Agriculture, Faisalabad.</p>	Member
<p>Dr. Riaz Ahmed Mann PSO, Crop Science Institute, National Agriculture Research Centre, Park Road, P.O NIH, Islamabad.</p>	Member
<p>Dr. Muhammad Naeem Ch. Assistant Professor, Department of Agronomy, University College of Agriculture & Environmental Sciences, Islamia University, Bahawalpur.</p>	Member
<p>Dr. Ejaz Ahmad Khan, Associate Professor, Department of Agronomy, Faculty of Agriculture, Gomal University, D.I.Khan</p>	Member

Dr. Hakoomat Ali
Associate Professor, Department of
Agronomy, University College Agriculture,
B.Z. University Multan. Member

Dr. Shahan Shah,
Department of Agronomy,
Agriculture University,
Peshawar. Member

Mr. Abdul Razzaq Reki
Head, Department of Agronomy,
Baluchistan Agriculture College,
Chaman Road Beleli,
Quetta. Member

Mr. Muhammad Ehsan Safdar
Assistant Professor,
Department of Agronomy,
University of Sargodha,
Sargodha. Member

Mr. Riaz Ahmed Ghuman
Technical Services Manager
Fauji Fertilizer Company Ltd,
11-shahrah-e-Awan-e-Tijarat
Lahore. Member

Mr. Saulat Hussain
General Manager (HR), Fauji Fertilizer
Company,
93-Harley Street, Rawalpindi. Member

Prof. Dr. Mushtaq Hussain Kazmi
Chairman, Department of Agronomy
Faculty of Agriculture, Rawalakot
Azad Jammu & Kashmir. Secretary/Member

Meeting started with recitation from the Holy Quran by Ch. Bashir Ahmad, Director, HEC, Regional Centre, Lahore. Dr. Muhammad Tahir Ali Shah, Deputy Director, Curriculum Division, HEC, Islamabad welcomed the participants and briefed about the obligations of the Commission for review, revision and development of curricula. He explained the procedure for curriculum revision. The committee critically evaluated the of BS/B.Sc.(Hons) Agri., MS (Hons) Agronomy and Ph.D.

curriculum. Modifications/improvements were made according to the current national requirements. The committee offered *Fatihah* for late Professors Dr. Shahbaz Ahmed Warriach and Dr. Shamshad Hussain Shah (previous NCRC members). The Committee agreed to recommend the Agronomy courses for BS/B.Sc. (Hons), MS (Hons.) and Ph.D. as detailed below:

Standardized Template for 4-Year BS/B.Sc (Hons) Agriculture

1. Compulsory Courses	Credit Hours
Mathematics / Biology (2 courses)	6 (3-0) (2-1)
Statistics 1 & 2	6 (3-0) (3-0)
Computers /IT	3(2-1)
Pak Studies	2(2-0)
Islamic Studies	2(2-0)
Communication Skills	3(3-0)
English	3(3-0)
Basic Agriculture	3(2-1)
Sub-Total	28
2. Interdisciplinary Foundation Courses	
Agronomy	3(2-1)
Plant Breeding & Genetics	3(2-1)
Entomology	3(2-1)
Plant Pathology	3(2-1)
Food Technology	3(2-1)
Horticulture	3(2-1)
Soil Sciences	3(2-1)
Agriculture Economics	3(2-1)
Sub-Total	24
Agriculture Extension	3(2-1)
Forestry & Range Management	3(2-1)
Animal Science	3(2-1)
Marketing & Agri Business	3(2-1)
Rural Development	3(2-1)
Human Nutrition	3(2-1)
Agriculture Chemistry	3(2-1)
Agriculture Engineering	3(2-1)
Water Management	3(2-1)
Any other discipline recommended by the University/Faculty/College	
Sub-Total	18-24
Sub-Total during the first four semesters	70-76
Semester 5, 6, 7 & 8	56-60
Project / Internship	04
Grand Total	130-140

**SCHEME OF STUDIES
For
BS/BSC. (HONS) IN AGRONOMY**

Course No.	Title	Credit Hours
AGR-001	Basic Agriculture	3(2-1)
AGR-002	Field Crop Production-I*	3(2-1)
AGR-003	Field Crop Production-II*	3(2-1)
AGR-004	General Crop Production**	3(2-1)
AGR-005	Arid Zone Agriculture	3(2-1)
AGR-006	Farm Record Maintenance	3(2-1)
AGR-007	Agro-technology of Major Crops	3(2-1)
AGR-008	Principles of Weed Science	3(2-1)
AGR-009	Field Crop Physiology	3(2-1)
AGR-010	Plant Nutrients and Growth Regulators	3(2-1)
AGR-011	Water Management in Rainfed Area	3(2-1)
AGR-012	Biological Nitrogen Fixation	3(2-1)
AGR-013	Seed Production Technology	3(2-1)
AGR-014	Research and Scientific Writing	3(2-1)
AGR-015	Conservation Agronomy	3(2-1)
AGR-016	Agro Ecology	3(3-0)
AGR-017	Irrigation Agronomy	3(2-1)
AGR-018	Environment and Crop Production	3(2-1)
AGR-019	Forage and Fodder Production	3(2-1)
AGR-020	Organic Farming	3(3-0)
AGR-021	Coastal Agriculture	3(2-1)
AGR-022	Introduction to Weed Science	3(2-1)
AGR-023	Crop Growth Modeling and its Application	3(2-1)
AGR-024	Crop Management under Stressful Environments	3(2-1)
AGR-025	Medicinal and Special Crops	3(2-1)
AGR-026	Plant and Soil Analysis	3(2-1)
AGR-027	Project Studies	4(0-4)
AGR-028	Internship***	4(0-4)

Note:

Universities/Faculties/Colleges may adopt their own system for course numbers and credit hours for different courses.

* Winter /Summer Crops

** Alternate course for Field Crop Production – I & II

*** Internship can be performed 5th semester onward

DETAIL OF COURSES FOR BS/BSC (HONS.) IN AGRONOMY

AGR-001 BASIC AGRICULTURE 3(2-1)

Objective

- To provide the basic knowledge about Pakistan's Agriculture.

Theory

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

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.

Books Recommended

1. Abbas, M. A. 2006. General Agriculture. Emporium Urdu Bazar, Lahore
2. Balasubramaniyan. 2004. Principles and Practices of Agronomy. Agrobios, Jodhpur, India.
3. Bashir, E. and R. Bantel. 1996. Soil Science. National Book Foundation, Islamabad.
4. Cheema, Z.A. and M. Farooq. 2007. Agriculture in Pakistan. Allied Book Centre, Urdu Bazar, Lahore.
5. Khalil, I.A and A. Jan. 2002. Cropping Technology. National Book Foundation, Islamabad.
6. Khan S.R.A. 2001. Crop Management in Pakistan with Focus on Soil and Water. Directorate of Agricultural Information, Punjab, Lahore.
7. Nazir, M.S. 1994. Crop Production. National Book Foundation, Islamabad.
8. Qureshi, M.A. M.A. Zia and M.S. Qureshi. 2006. Pakistan Agriculture Management and Development. A-One Publisher, Urdu Bazar, Lahore.

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 pattern. Mono versus multiple cropping. Production technology of cereals-crops (Wheat, Barley, Oats, Rice, Maize, Sorghum and Millets), Fibre Crops (Cotton, Jute, Sunhemp, Deccan-hemp, Sugar crops (Sugarcane and Sugarbeet), 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, their transplanting and inter-cultural practices. Burying of green manure crops. Visit to University/College research areas.

Books Recommended

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. 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, NY
7. Wolfe, T.K. and M.S. Kipps. 2004. Production of Field Crops: A Textbook of Agronomy. McGraw Hill Book Co. NewYork.

AGR-003 FIELD CROP PRODUCTION-II 3(2-1)

Objective

- To familiarize the students with production technology of oil seed, grain legume, forage and miscellaneous crops.

Theory

Production technology of oilseed-crops (Toria, Raya, Sarsoon, Canola, Taramira, Castor bean, Sunflower, Safflower, Sesame, Linseed, Groundnut, Soybean), grain legume crops (Chickpea, Lentil, Mungbean, Mashbean, Cowpea, Pigeonpea), forage crops (Berseem, Shaftal, Lucerne, Oats, Maize, Sorghum, Millets, Mottgrass), and 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 and their seeds. 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.

Books Recommended

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. 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. NewYork.

AGR-004 GENERAL CROP PRODUCTION 3(2-1)

Objective

- To acquaint the students with field crops production technology.

Theory

Concept of crop production. Classification of field crops. Cropping scheme, Cropping patterns, Cropping systems, Cropping intensity. Production technology of major field crops: cereals (wheat, rice, maize, barley), sugar crops (sugarcane, sugar beet), fiber crops (cotton, jute) oil seed crops (*i-Traditional*: rapeseed and mustards, groundnut, linseed, sesame, castorbean; *ii-Non-traditional*: sunflower, soybean, safflower), grain legumes, (chickpea, lentil, green gram, black gram) fodders (berseem, lucern, oats, sorghums, millets, mott grass, cowpea), special crops (tobacco). Green manure crops (Guara, Dhancha. Pigeon pea, Senji etc.).

Practicals

Identification of crops and their seeds. Demonstration of improved sowing methods of crops. Delinting of cotton seed. Raising of crop nurseries and transplanting. Intercultural practices. Seed Inoculation. Seed treatment with fungicides. Demonstration of harvesting and threshing operations. Field visits.

Books Recommended

1. Byerlee, D. and T. Hussain, 1992. Farming Systems of Pakistan. Vanguard Books, Lahore.
2. Martin, J.H., R.P. Waldren and D.L. Stamp. 2006. Principles of Field Crop Production, 4th Ed., The MacMillan Co., New York.
3. Nazir, M.S. 1994. Crop Production. Ed. E. Bashir and R. Bantel. National Book Foundation, Islamabad.
4. Reddy, S.R. 2004. Agronomy of Field Crops. Kalyani Publishers, India.
5. Shrestha, A. 2003 Cropping System. Food Products Press. Haworth Press, Inc. Binghamton, NY
6. Stoskopf, N.C. 1981. Understanding Crop Production. Reston Pub. Co., Inc. Reston, Virginia.
7. Wolfe, T.K. and M.S. Kipps. 2004. Production of Field Crops: A Textbook of Agronomy. McGraw Hill Book Co. NewYork.

AGR 005

ARID ZONE AGRICULTURE

3(2-1)

Objective

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

Theory

Introduction, concept and causes of aridity, features of arid zone. Climatic factors and their effects on crop yield. Dryland tracts of Pakistan, their location, extent and traditional land use, desertification and its control; physico-biological and socio-economic problems of dryland agriculture in Pakistan. Integrated crop and livestock systems. Crop growth and yield responses to moisture supply in different soils. Water harvesting and water conservation practices.

Practical

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

Books Recommended

1. Arnon, I. 1992. Agriculture in Dry Lands: Principles and Practices. Elsevier, London.
2. Govindan. K. and V. Thirumurugan. 2003. Principle and Practices of Dry Land Agriculture. Kalyani Publishers New Delhi.
3. Karthikeyan, C. K. 2007. Dry Land Agriculture Traditional Wisdom. Kalyani Pub. New Delhi, India.
4. Panda, S. C. 2004. Dry Land Agriculture. Kalyani Pub. New Delhi, India
5. Saxena. N.P.S 2003. Management of Agricultural Drought. Oxford & IBH Publishing Co. New Delhi.

AGR-006 FARM RECORD MAINTENANCE 3(2-1)

Objective

- To impart awareness regarding principles of farm management.

Theory

Principles of farm layout and design. Concept of farm management and maintenance of farm records. Objectives and advantages of keeping farm records. Different systems of book keeping. Profit and loss account/income statement. Bank accounts, bank cheques, discount, interest, bad debts. Appreciation and depreciation of live and dead stocks, land and buildings, plant and machinery. Preparation of trading, profit and loss account and balance sheet.

Practical

Layout of farm, training in maintenance of crop, livestock and dead stock registers. Preparation of a balance sheet and different types of accounts.

Calculation of appreciation and depreciation of different farm articles, crop yield estimation. Working out cost of production of major crops grown in irrigated and rainfed areas.

Books Recommended

1. Byerlee, D. and T. Hussain, 1992. Farming Systems of Pakistan. Vanguard Books, Lahore.
2. Ghani M.A. 1992. Principles of Counting. Pak Imperial Book Depot Chowk Urdu Bazar, Lahore.
3. Shresther, A. 2003. Cropping System. Food Products Press. An imprint of the Haworth Press, Inc.
4. Vendermeer, J. 1989. The Ecology of Intercropping. Cambridge University Press.

AGR-007 AGRO-TECHNOLOGY OF MAJOR CROPS 3(2-1)

Objective

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

Theory

Origin, history, morphology, adaptation, distribution and agro technology of wheat, rice, maize, cotton, sugarcane with special emphasis on regional crops. Management, constraints and measures to optimize crop productivity. Modern techniques for crop improvement.

Practical

Demonstration of improved sowing methods. Raising and transplanting of rice nursery. Delinting of cotton seed by conventional and modern techniques, its impact on seed germination and seedling establishment. Techniques of maintaining optimum plant population under field conditions. Plant characteristics and phenological development of major crops.

Books Recommended

1. Khalil I.A and A. Jan. 2002. Cropping Technology. National Book Foundation, Islamabad.
2. Khan, S. R. A. 2001. Crop Management in Pakistan with Focus on Soil and Water. Directorate of Agricultural Information, Punjab. Lahore.
3. Martin, J.H., R.P. Waldren and D.L. Stamp. 2006. Principles of Field Crop Production, 4th Ed., The Macmillan Co., New York.
4. Nazir, M.S. (Ed.) 1994. Crop Production. National Book Foundation, Islamabad.

5. Stoskopf, N.C. 1981. Understanding Crop Production. Reston. Pub. Co., Inc. Reston, Virginia.

AGR-008 PRINCIPLES OF WEED SCIENCE 3(2-1)

Objective

- To nurture students regarding principles of weed science and control methods.

Theory

Definition and importance of weeds. Yield losses and harmful effects of weeds. Classification and biology of weeds. Weed-crop interference, Competition and allelopathic interactions. Methods of weed management; preventive, cultural, mechanical, biological and chemical. Weed control in major field crops. Integrated weed management. Herbicide resistance and tolerance against weeds and crops. Technical information regarding current herbicides. Mulching and soil solarization.

Practical

Weed collection and identification. Demonstration of various hand tools & implements for weed control. Computation of herbicide doses. Demonstration of the use of sprayers for herbicide application.

Books Recommended:

1. Ashiq M., M.M Nayyar and J. Ahmad. 2003. Weed Control Handbook Directorate of Agronomy. Ayub Agri. Res. Inst. Faisalabad.
2. Gupta, O.P. 1998. Modern Weed Management. Agro Botanica, Bikaner, India.
3. Kumar, J. R. and Jagannathen. 2003. Weed Science: Principles. Kalyani Publishers New Delhi.
4. Nayyar, M. M. Ashiq and J. Ahmad. 2001 Manual on Punjab Weeds: Part I and II. Directorate of Agronomy. Ayub Agri. Res. Inst. Faisalabad.
5. Rao, V.S. 2002. Principles of Weed Science 2nd edition, Sci. Pub. Inc. USA.
6. Zimdhal, R. L. 2007. Fundamental of Weed Science 3rd Ed. Elsevier, Academic Press, USA.

AGR-009 FIELD CROP PHYSIOLOGY 3(2-1)

Objective

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

Theory

Concept and importance of crop physiology. Carbon metabolism, Factors affecting photosynthesis, respiration and transpiration. Photosynthetic efficiency of different crop plants. Growth and development, Photomorphogenesis, Physiology of germination, dormancy, seedling establishment, tillering, root, stem, leaf, flower and seed development. Maturity, senescence and abscission. Source-sink relationships in crop plants. Photoperiodism, vernalization and tropism. Physiological determinants of crop yield.

Practical

Equipments used in crop physiology. Leaf area measurement. Growth analysis. Determination of source-sink relationship. Identification of crop growth stages. Demonstration of various types of seed germination. Measurement of water potential and its components.

Books Recommended:

1. Bonner, J. 1995. Principles of Plant Physiology. W.H. Freeman, NBF, San Francisco.
2. Hans, M. and P. Schopfer. 1995. Plant Physiology. Springer Verlag Berlin.
3. Hopkins, G.H. 1999. Introduction to Plant Physiology. John Wiley & Sons, N.Y.
4. Mengel, K., E. A. Kirkby, H. Kosegarten and T. Appel. 2001. Principles of Plant Nutrition. 5th Ed. International Potash Institute, Bern, Switzerland.
5. Salisbury F.B. and Ross C.B. 1992. Plant Physiology. 5th Ed. Wadsworth Publishing Co. Belmont, CA.
6. Taiz, L. and E., Zeiger. 2006. Plant Physiology 4th Ed. Sinauers Associate, Inc. Sunderland Massachusetts, USA.

AGR-010 PLANT NUTRIENTS AND GROWTH REGULATORS 3(2-1)

Objective

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

Theory

Mineral nutrients, classification, functions and deficiency symptoms. Criteria for essentiality of mineral nutrients. Factors affecting nutrient availability. Mechanisms of nutrient uptake and translocation within the plants. Composition and types of fertilizers. Biosynthesis, translocation

and functions of growth regulators-Auxins, gibberellins, cytokinins, abscisic acid and ethylene.

Practical

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

Books Recommended:

1. Epstein, E. and A. J. Bloom. 2004 Mineral Nutrition of Plants: Principles and Perspectives. John Wiley and Sons Inc., USA.
2. Havlin, J.L., Tisdale, S.L., J.D. Beaton and W.L. Nelson. 2005. Soil fertility and fertilizers. 7th Ed. Macmillan Publishing Co., NY, USA.
3. Mengel, K., E. A. Kirkby, H. Kosegarten and T. Appel. 2001. Principles of Plant Nutrition. 5th Ed. International Potash Institute, Bern, Switzerland.
4. Rashid, A. and K.S. Memon. 2005. Soil Science. Ed. E. Bashir and R. Bantel. National Book Foundation, Islamabad.
5. Taize, L. and E., Zeiger. 2006. Plant Physiology 4th Ed. Sinauers Associate, Inc. Sunderland Massachusetts, USA.

AGR-011 WATER MANAGEMENT IN RAINFED AREA 3(2-1)

Objective

- To educate students about moisture resource management in rainfed areas.

Theory

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

Practical

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

Books Recommended:

1. G.O.P. 1997. Irrigation Agronomy Manual. Ministry of Food Agriculture and Livestock, Islamabad.
2. Khan, S. R. A. 2001. Crop Management with focus on soil and water. Agric. Deptt. Govt. of Pb., Lahore.
3. Kirkham. M.B. 1999. Water Use in Crop Production. Food Products Press, Binghamton, New York
4. Misra, R.D. and M. Ahmad. 1990. Manual of Irrigation Agronomy. Oxford and IBH Publishing Co. New Delhi.
5. Prihar S.S. 2003. Intensive Cropping, Efficient use of Water, Nutrients, and Tillage. Pak Book Corp. Lahore.
6. Rashid, A. 1994. Soil Science. National Book Foundation Islamabad

AGR-012 BIOLOGICAL NITROGEN FIXATION 3(2-1)

Objective

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

Theory

Perspective, scope, process and mechanism of biological nitrogen fixation. Nitrogen fixation by legumes. Nodule development. Factors affecting nodulation. Nitrogen fixation by non legumes. Nitrogen fixation by free living organisms. Biological nitrogen fixation associated with rice production. The influence of environment and management practices on legume-rhizobium symbiosis. Role of mycorrhizae in nutrient absorption. Bioenergetics in biological nitrogen fixation.

Practical

Preparation of quality inoculum. Legume inoculant and inoculation techniques. Soil and seed inoculation methods. Methods of measuring nitrogen fixation. Study of different types of nodules.

Books Recommended:

1. Hansen, A. P. 1994. Symbiotic N₂ Fixation of Crop Legumes. Margref Verlag Weikenheim, Germany.
2. Loomis, R.S. and D. J. Connor. 1993. Crop Ecology. Productivity and Management in Agricultural Systems. Cambridge University Press, New York.
3. Sprent, J.I. and P. Sprent. 1990. Nitrogen Fixing Organisms: Pure and applied aspects. Chapman and Hall, London.
4. Stacy, G., R.H. Burris and H.J. Evans. 1992. Biological Nitrogen Fixation. Chapman and Hall, London.

5. Taize, L. and E., Zeiger. 2002. Plant Physiology 3rd Ed. Sinauers Associate, Inc. Sunderland Massachusetts, USA.
6. Yi-Ping Wang, Min Lin, Zhe-Xian Tian, William E. Newton. Eds. 2005. Biological Nitrogen Fixation, Sustainable Agriculture and the Environment. Proc. 14th Int. Congress Biological Nitrogen Fixation. Springer, Netherlands.

AGR-013 SEED PRODUCTION TECHNOLOGY 3(2-1)

Objectives

- To familiarize students about fundamentals of seed technology.

Theory

Concept of seed technology. Definition and types of seed. Morphology of seed. Production and multiplication of quality seed. Seed sampling. Seed processing; drying, cleaning, grading, treatment. Seed quality, purity, vigor and viability. Seed longevity and storage. Seed certification. Seed distribution. Seed act and laws.

Practical

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

Books Recommended:

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

AGR-014 RESEARCH AND SCIENTIFIC WRITING 3(2-1)

Objective

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

Theory

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

Practical

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

Books Recommended:

1. Alan G. Clewer and David H. Scarisbrick. 2001. Practical Statistics and Experimental Design for Plant and Crop Science. John Wiley and Sons, Ltd. Chichester, England.
2. Anonymous. 1988. Publications Handbook and Style Manual. ASA-CSSA-SSSA, Madison.
3. Hashmi, N. 1989. Style Manual of Technical Writing, 2nd Ed. Pakistan Economic Analysis Network Project. Ministry of Food and Agric., Islamabad.
4. Khalil, S K. and P. Shah, 2007. Scientific Writing and Presentation. HEC, Manaograph, Islamabad.
5. Mead, R. 2003. Statistical Methods in Agricultural & Experimental Biology. 3rd Ed. Pak Book Corp. Lahore

AGR-015 CONSERVATION AGRONOMY 3(2-1)

Objective

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

Theory

Concept, importance and objectives of conservation. Agronomic practices for resource conservation. Tillage practices such as contouring, terracing, benching, leveling, grading, *watbandi*, Zero tillage and minimum tillage, chiseling, deep ploughing and planking, Species and

cultivars, selection. Crop rotation and weed management. Cover cropping. Strip cropping. Fertilizers and green manuring. Mulching and crop residue management. Field drainage. Micro water-shed management under rainfed conditions.

Practical

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

Books Recommended:

1. Arnon, I. 1992. Agriculture in Dry Lands. Principles and Practices. Elsevier, London.
2. Gurmel Sing, C. Venkatarmanan, G. Sastry and B.P. Joshi. 1990. Manual of Soil and Water Conservation Practices. Oxford and IBH Pub. Co., New Delhi.
3. Hudson, N.W. 2004. Soil and water conservation in semi-arid areas. Scientific Publishers, India.
4. Kirkham, M.B. 2004. Water use in crop production. Internal Book Distributing Co. (Publishing Division).
5. Maloo, S.R. 2002. Sustainable Crop Production under stress environments. Agro-tech Publishing Academy, Udaipur, India.

AGR-016

AGRO ECOLOGY

3(3-0)

Objective

- To inculcate understanding about ecological principles for sustainable cropping systems.

Theory

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

Books Recommended:

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

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

AGR-017 IRRIGATION AGRONOMY 3(2-1)

Objective

- To provide knowledge about irrigation principles and management.

Theory

Concept of irrigation agronomy and water management. Sources of irrigation water. Introduction to different irrigation methods, their feasibility in various regions. Water requirement of different crops. Irrigation scheduling and water use efficiency in field crops. Current agrotechnology for efficient use of irrigation water in crops. Irrigation water pollution and measures to minimize it.

Practical

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

Books Recommended:

1. Ahmad, N. and G.R. Chaudhry. 1988. Irrigated Agriculture of Pakistan. Publisher, Shahzad Nazir, Lahore.
2. Allen R.G. L.S. Pereira, D. Raes, and M. Smith. 1998. Crop evapotranspiration: Guidelines for computing crop water requirements. FAO. Irrigation and Drainage paper No. 56. Rome.
3. Choudhary, M, R. 2009. A Text Book of Irrigation and Drainage Practices for Agriculture. University of Agric. Faisalabad, Pakistan.
4. Kirkham, M.B. 2004. Water use in crop production. Internal Book Distributing Co. (Publishing Division).
5. Micheal, M. A. 2003. Irrigation Theory and Practices. Vikas Pub. House, New Delhi, India
6. Sankara, R. G. H. and T. Y. Reddy. 2002. Efficient Use of Irrigation Water. Kalyani Publishers New Delhi, India.

AGR-018 ENVIRONMENT AND CROP PRODUCTION 3(2-1)

Objective

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

Theory

Environment, climate change and food security. The aerial and soil environments. Macro and micro environments. Influence of different environmental factors; radiation, temperature, water, wind, CO₂ and vapour pressure on crop growth processes such as photosynthesis, respiration and transpiration. Effect of drought on growth. Greenhouse effect on crop production, *El Nino and La Nino* phenomenon. Crop adaptation to changing climate.

Practical

Measurements and estimation of different environmental variables. Calculations of potential evapotranspiration and different drought indices. Measurement of solar radiation in crops.

Books Recommended:

1. Allaby, M. 2000. Basics of Environmental Science. Rutledge, London & New York.
2. Dris, R., J. Mohan and I.A. Khan. 2002. Environment and Crop Production. Science Pub. Inc., New York.
3. Fitter, A.H. and P.K.M. Hay. 1987. Environmental Physiology of Plants. 2nd Ed. Academic Press Inc. London.
4. Hammer, G.L., N. Nicholls and C. Mitchell. 2000 Application of Seasonal Climate Forecasting in Agricultural and Natural Ecosystems. Kluwer Academic Publisher, London.
5. Pearcy, R.W., J.R. Ehleringer, H.A. Mooney and P.W. Rundal. 1989. Plant Physiological Ecology: Field Methods and Instrumentation. Chapman and Hall, London, New York.
6. Rowan Sewing, C., T.T. Richer, J.W. Jael. G.Y. Tsuji and Hi Ledyard. 1995 Climate Change Agriculture: Analysis of Potential international impact ASA Special Publication, USA.

AGR-019 FORAGE AND FODDER PRODUCTION 3(2-1)

Objective

- To educate students about enhancement skills and conservation of fodder

Theory

Importance and characteristics of forages and fodders. Critical period of fodder scarcity. Factors influencing productivity and quality. Methods of increasing biomass production. Factors affecting chemical composition and nutritive value of forages. Preservation of fodders and forages (silage and hay making). Toxicity due to chemicals and poisonous plants. Establishment of grasses and legumes in range lands. Constraints in fodder production and remedies.

Practical

Identification of forage, fodder crops and poisonous plants. Estimation of sprout density and carrying capacity. Preparation of fodder calendar. Measurement of cover frequency. Preparation of silage and hay.

Books Recommended:

1. Balasubramaniyan, P.O. and S.P. Polanippan. 2001. Principles and Practices of Agronomy. Agrobios, India,
2. Anonymous. 1996. Fodder Production in Pakistan. Proc. National Conf. Improvement, Production and Utilization of Fodder Crops in Pakistan, NARC. March 25-27, 1996, Islamabad.
3. Khalil, I.A. and A. Jan. 2006. Cropping Technology. National Book Foundation, Islamabad.
4. Reddy, D.V. 2006. Fodder Production and Grassland Management for Veterinarians. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
5. Singh, S.S. 2004. Crop Management. Kalyani Publishers, New Delhi.
6. Stuart, P. 2002. The Forage Book. 2nd Ed. Pacific Seeds Pty Ltd., Toowoomba, Australia.

AGR-020 ORGANIC FARMING 3(3-0)

Objective

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

Theory

Concept and brief history of organic farming. Principles of organic agriculture. Soil and crop management. Preparation of organic matter, humus, sewage sludge, organic compost. Conversion of conventional to organic farming. Maintenance of buffer zone. Components of organic farming. Hazards of inorganic farming. Farm waste recycling, organic mulches, nature safe products for control of weeds and diseases

management. Quality of food and crop productivity under natural ecological systems

Books Recommended:

1. Dahama, A.K. 2002. Organic Farming for Sustainable Agriculture. 2nd Enlarged Ed. Pub. Agrobios, Jodhpur, India.
2. Fossil, P.V. 2007. Organic Farming: Every thing you need to know. MBI Publishing Co., USA.
3. Francis, C.A., C.B. Flora, and L.D. King. 1990. Sustainable Agriculture and Temperate Zones. Wiley, New York, USA.
4. Hatfield, J.L. and D.L. Karlen. 1994. Sustainable Agriculture Systems. Lewis Pub. Boca Rapon, FL, USA.
5. Palaniappan, and K. Annadurani. 2006. Organic farming theory and practice. Scientific Publishers. Jodhpur, India.

AGR-021 COASTAL AGRICULTURE 3(2-1)

Objective

- To educate students about potential of agriculture in coastal areas

Theory

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

Practical

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

Books Recommended:

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

5. Kay, R. and J. Alder. 2005. Coastal Planning and Development. Taylor and Francis, London.
6. Sukumar, B., 2008. Water Quality Management for Coastal Aquaculture. Daya Publishing House, India.

AGR-022 INTRODUCTION TO WEED SCIENCE 3(2-1)

Objective

- To impart basic information regarding weeds in field crops and their control.

Theory

Weed science: introduction, significance and history, Definition of weeds, Losses caused by weeds, Classification of weeds, Newly introduced foreign weeds, weed problems in Pakistan, Survival mechanism of weeds, Dispersal of weed seeds and fruits and their mode of propagation, Weed/Crop interference: Competition and allelopathy, Principles of weed control, preventive weed control, mechanical weed control, cultural weed control, biological weed control, chemical weed control. Integrated weed control. Application of biotechnology in weed science.

Practical

Weed identification (rabi and kharif weeds), Collection and mounting of weeds, Weed seed identification, Demonstration of weed control methods: manual, mechanical, chemical and organic weed control; Spraying equipment, sprayer calibration; Herbicide dosage calculation, field observation and visits regarding weed surveys and identification; Survey into weed flora of different agro-ecological zones.

Recommended Books:

1. Anderson, W.P. 2007. Weed Science: Principles and Applications. 4th edition. Waveland Pr Inc
2. Monaco, T. J., S.C. Weller and F.M. Ashton. 2004. Weed Science - Principles and Practices, 4th Edition. John Wiley & Sons.
3. Ross, M. A. and C.A. Lembi. 2009. Applied Weed Science: Including the Ecology and Management of Invasive Plants. 3rd Edition. Prentice Hall, USA
4. Walia, U.S. 2010. Weed Management. Kalyani Publishers, B-I/292, Rajinder Nagar, Ludhiana-141008.
5. Zimdahl, R. 2008. Fundamentals of Weed Science. Third edition. Academic Press, USA.

Objective

- To familiarize students with the concept and application of crop modeling.

Theory

History and introduction of crop growth modeling, importance and uses, introduction to decision support system for agro-technology transfer, components of a model, input data set for different models, modeling and crop improvement, modeling: a tool for future predictions.

Practical

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

Books Recommended:

1. Mavi, H.S. and G.J. Tupper. 2005. Agrometeorology Principles and Application of Climate Studies in Agriculture. International Book Distribution Co., Lucknow, India.
2. Sivakumar, M.V.K. and J. Hansen. 2007. Climate Predictions and Agriculture. Springer, Berlin, Heidelberg, New York.
3. Sivakumar, M.V.K. and R.P. Motha. 2005. Increasing Climate Variability and Change: Reducing the vulnerability of agriculture and forestry. Springer, Dordrecht, The Netherland.
4. Sivakumar, M.V.K. and R.P. Motha. 2007. Managing Weather and Climate: Risks in Agriculture. Springer, Berlin, Heidelberg, New York.
5. Allen R. O. and R.V. Scholtz III. 2002. Mathematical Models of Crop Growth and Yield. CRC Press, USA.
6. Floor M. B. and M. van Ittersum. 2010. Environmental and Agricultural Modeling: Integrated Approaches for Policy Impact Assessment, Springer, Heidelberg, Germany
7. John H. M. Thornley and Ian R. Johnson. 2000. Plant and Crop Modeling: A Mathematical Approach to Plant and Crop Physiology. The Blackburn Press, Caldwell, New Jersey, USA.
8. Weixing, C., Jeffrey, W. W. and E. Wang (Ed). 2009. Crop Modeling and Decision Support. Springer, Heidelberg, Germany.

AGR-024 CROP MANAGEMENT UNDER STRESSFUL ENVIRONMENTS 3(2-1)

Objective

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

Theory

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

Practical

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

Books Recommended:

1. Arnon, I. 1992 Agriculture in Dry Lands: Principles and Practices. Elsevier Amsterdam.
2. Nosberger, J.H. H.Geiger and P.C. Struik. 2001. Crop Science Progress and Prospects. CABI Pub., Oxon, UK.
3. Pessaraskli, M. A. 2000. A. Hand Book of Stress Physiology, Marker and Deekar.
4. Taize, L., E. Zeiger. 2006. Plant Physiology. Sinauer Pub. U.S.A.
5. Turner, N.C. and P.J. Kramer. 1980. Adaptation of plants to water and high temperature stress.

AGR-025 MEDICINAL AND SPECIAL CROPS 3(2-1)

Objective

- To introduce a production technology for medicinal and special purpose crops

Theory

Importance, origin, adaptation, distribution and production technology of medicinal and special purpose crops – tea, aloe, mint, chamomile, red sorrel, jojoba, castor bean, jatropha, plantains, salicornia, safflower, poppy, tobacco, indigo, oil palm, fennel, *ajwain*, fenugreek, sweet basil, sesamum, *balangu*, *haloon*, *kalvanji*, *guar*, *senna*, etc,

Practicals

Identification of seed and crop plants. Demonstration of improved sowing methods. Studies on phenological development of crops.

Books Recommended:

1. Martin, J.H., R.P. Waldren and D.L. Stamp. 2006. Principles of Field Crop Production, 4th Ed., the MacMillan Co., New York.
2. Narayan, D.P., S.S. Purohit, A.K. Sharma and Tarun, K. 2003. A Handbook of Medicinal Plants. Agrobios, India.
3. Palaniappan, and K. Annadurani. 2006. Organic farming; theory and practice. Scientific Publishers, Jodhpur, India.
4. Ravindra, S. 2004. Agro-Techniques of Medicinal Plants. Daya Publishing House, New Delhi, India.
5. Reddy, S.R. 2004. Principles of Field Crop Production. 2nd Ed. Kalyani Publishers, New Delhi, India.
6. Sharma, K. 2005. Hand Book of Agriculture. Indian Council of Agricultural Research, New Delhi
7. Sharma. R. 2004. Agro-techniques of Medicinal Plants. Daya Publishing House, Delhi.

AGR-026 PLANT AND SOIL ANALYSIS 3(2-1)

Objective

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

Theory

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

Practical

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

Books Recommended:

1. Basak, R.K. 2004. Soil testing and recommendation. Kalyani Publisher, New Delhi.
2. Hussain, T. and A. Jabbar. 1985. Soil and Plant Analysis. Department of Soil Science, University of Agriculture, Faisalabad.

3. Ryan, J., G. Estefan and A. Rashid. 2001. Soil and Plant Analysis Laboratory Manual. 2nd Ed., ICARDA, Aleppo, Syria and NARC, Islamabad, Pakistan.
4. Tandon, H.L.S (Ed.). 2001. Methods of Analysis of Soils, Plants, Waters and Fertilizer Development and Consultation Organization, New Delhi, India.
5. Westerman, R.L. (Ed.). 1990. Soil Testing and Plant Analysis. 3rd Ed. Soil Sci. Am. Inc., Madison, WI, USA.

AGR-027 PROJECT STUDIES 4(0-4)

The students will be assigned projects in different areas of agronomy. They will deliver a seminar which will be evaluated by a committee constituted by the department. In addition, they will write a comprehensive report at the completion of the project which will be evaluated by external and internal examiners.

AGR-028 INTERNSHIP 4(0-4)

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

Note: *The farmers/farm managers/Director will evaluate the practical work by the student. An expert committee to be appointed by the board of studies/Chairman of the department will also evaluate the student's participation at the farms and at the universities. The committee will also evaluate and grade/mark the report and seminar. The seminar/presentation delivered for internship will be mandatory but not be considered extra credit.*

**Scheme of Studies for
MS/MSc. (Hons.) and Ph.D Agronomy**

AGR-701	Advanced Agronomy	3(2-1)
AGR-702	Applied Crop Ecology	3(3-0)
AGR-703	Advanced Irrigation Agronomy	3(2-1)
AGR-704	Agro-Environment Conservation	3(3-0)
AGR-705	Agro-meteorology	3(3-0)
AGR-706	Allelopathy in Crop Production	3(2-1)
AGR-707	Applied Conservation Agronomy	3(3-0)
AGR-708	Arid Zone Agronomy	3(3-0)
AGR-709	Biological Crop Potential	3(3-0)
AGR-710	Crop Environment	3(3-0)
AGR-711	Crop Management on Problem Soils	4(3-1)
AGR-712	Crop Modeling	3(2-1)
AGR-713	Crop Nutrition Management	3(2-1)
AGR-714	Crop Production and Herbicides	4(3-1)
AGR-715	Farming and Cropping Systems	3(3-0)
AGR-716	Field Crop Experimentation	4(3-1)
AGR-717	Herbicides in Plant and Soil Systems	3(2-1)
AGR-718	Integrated Agriculture	3(3-0)
AGR-719	Modern Concepts of Crop Production	3(2-1)
AGR-720	Recent Advances in Agronomy	3(3-0)
AGR-721	Seed Physiology	3(2-1)
AGR-722	Seed Science and Technology	3(2-1)
AGR-723	Stress Agronomy	4(3-1)
AGR-724	Sustainable Agriculture	3(3-0)
AGR-725	Water Relations in Plant	3(2-1)
AGR-726	Weed Management	3(2-1)
AGR-727	Climate Change and Agriculture	3(3-0)
AGR-728	Special Problem	1(0-1)
AGR-729	Seminar	1(0-1)
AGR-730	Thesis M.Sc. (Hons.) Agronomy	6(0-6)
AGR-731	Thesis Ph.D. Agronomy	12(0-12)

Note: *Universities/Faculties/Colleges may adopt their own system for course numbers and credit hours for different courses*

Courses selected/qualified for M.Sc. (Hons) Agronomy will not be permitted to take again in Ph.D.

DETAILS OF COURSES FOR MS/MSC. (HONS) AND PH.D IN AGRONOMY

GR-701 ADVANCED AGRONOMY

3(2-1)

Objective

- To deepen understanding about advanced concepts of crop growth and development.

Theory

Phenological development of crop plants. Determinants of crop growth. Factors affecting development of crop canopy, photosynthesis and respiration. Photosynthetic efficiency and respiration in relation to crop productivity. Crop management for improving photosynthetic efficiency and harvest index. Potential for increasing dry matter accumulation in crop plants, dry matter partitioning. Crop growth analysis, its objectives and agronomic uses. Growth analysis of individual plants and crops, Classical and functional growth analysis. Biological relevance of different growth functions and curve fittings in crop growth studies.

Practical

Phenological development stages of crop plants. Use of classical growth formulae for determining various crop growth indices. Estimation of crop growth rates derived from different fitted growth functions. Demonstration and calculation of radiation interception and use efficiency.

Books Recommended:

1. Causton, D.R. and J.C. Venus. 1981. The Biometry of Plant Growth. Edward Arnold, London.
2. Coombs, J., D.O. Hall, S.P. Long and J.M.O. Scurlock. 1987. Techniques in Bioproductivity and Photosynthesis, 2nd Ed. Pergamon Press, Oxford.
3. France, J. and J. M.M. Thornley, 1984. Mathematical Models in Agriculture. Butter-worths, London.
4. Gupta, U.S. 1992. Crop Improvement. Vol-I. Physiological Attributes. Oxford and IBH Pub. Co. Pvt. Ltd., New Delhi.
5. Hay, R.K.M. and A.J. Walker. 1989. An Introduction to the Physiology of Crop Yield. Longman Scientific and Technical Group, U.K. Ltd. Essex.
6. Hunt, R. 1978. Plant Growth Analysis. Edward Arnold, London.
7. Hunt, R. 1982. Plant Growth Curves: An Introduction to the Functional Approach to Plant Growth Analysis. Edward Arnold, London.

8. Johnson, C.B. 1981. Physiological Processes Limiting Plant Productivity. Butterworths, London.
9. Tsuji, G.Y., G. Hoogenboom, and P.K. Thornton. 1998. Understanding Options for Agricultural Production. Kluwer Academic Publishers, Dordrecht, Boston, London.

AGR-702 APPLIED CROP ECOLOGY 3(3-0)

Objective

- To impart better understanding of ecological optima and its relevance to crop production.

Theory

Concept of ecosystem and population dynamics. Dynamics of agro-ecosystems, carbon utilization and dry matter production. Analysis of ecological factors. Crop-plant domestication. Evaluation of different farming systems. Ecological characteristics of intensive agriculture with special reference to environmental pollution. Crop productivity and ecological optima. Root growth, distribution and foraging activities.

Books Recommended:

1. Allaby, M. 2000. Basics of Environmental Science. Rutledge, London & New York.
2. Fitter, A.H. and R.K.M. Hay. 1987. Environmental Physiology of Plants. Academic Press, Inc., London.
3. Gurevitch, J. M.Schiner and A.F. Gordon. The Ecology of Plant. 2nd Ed. 2006. State University of New York.
4. Kapur, P. and R.G. Sudha. 2000, Experimental Plant Ecology. CBS Publishers and Distributors, New Delh.
5. Kroon, H. and E. J. W. Visser. 2003. Root Ecology. Springer Verlag. Berlin.
6. Kumar, H.D. 1994. Modern Concepts of Ecology. 7th Ed. Vikas Pub. House New Delhi.
7. Larcher, W. 1995. Physiological Plant Ecology. Ecophysiology and Stress Physiology of Functional Groups. Springer Verlag, Berlin.
8. Raven, P.H. Berg, L.R. and G.B. Johnson. 1993. Environment. International Ed. Saunders College Publishing, New York.
9. Schulze, E. Beck & K. Muller-Hohenstein. 2005. Plant Ecology. State University of New York.
10. Tivy, J. 1990. Agricultural Ecology. Longman Group U.K. Ltd. Essex.

Objective

- To educate about estimation/measurement of environmental variables used in irrigation scheduling.

Theory

Concept and aims of irrigation. Methods of irrigation scheduling. Moisture sensitive periods. Indices of drought: stress degree days, canopy temperature variability, crop water stress index, maximum allowed depletion, etc. Response of yield to irrigation: Penman's irrigation-yield response analysis, concept of maximum potential soil moisture deficit and limiting deficit. Crop response to total water received and drought, criteria for drought resistance. Concepts of lost time for growth and crop yield. Water use efficiency and factors affecting it.

Practical

Measurements of plant and soil moisture contents. Demonstration of Irrigation scheduling for different crops. Water flow measurements with different techniques. Visits to controlled irrigation systems.

Books Recommended:

1. Allen R.G. L.S. Pereira, D. Raes, and M. Smith. 1998. Crop evapotranspiration: Guidelines for computing crop water requirements. FAO. Irrigation and Drainage paper No. 56. Rome.
2. Brouwer, C., K. Prins and M. Heibloem, 1989. Irrigation Scheduling: Irrigation Water Management Training Manual No.4. FAO Land and water Development Division, Rome.
3. Choudhary, M, R. 2009. A Text Book of Irrigation and Drainage Practices for Agriculture. University of Agric. Faisalabad, Pakistan.
4. Doorenbos, T. and A.H. Kassam, 1979. Yield response to Water. FAO Irrigation and Drainage Paper 23: United Nations, Rome.
5. Kirkham, M.B. 2004. Water use in crop production. Internal Book Distributing Co. (Publishing Division).
6. Micheal, M. A. 2003. Irrigation Theory and Practices. Vikas Pub. House, New Delhi, India
7. Sankara, R. G. H. and T. Y. Reddy. 2002. Efficient Use of Irrigation Water. Kalyani Publishers New Delhi, India.

AGR-704 AGRO- ENVIRONMENT CONSERVATION 3(3-0)

Objective

- To enhance the understanding of agro-environment conservation for sustainable productivity.

Theory

Agro-chemicals: use, abuse, uptake, persistence, degradation and residual effects. Management and recycling of agro-industrial wastes: solid waste, farm waste, sewage sludge etc. Role of agriculture in environmental conservation. Integrated approaches to reduce the use of agro-chemicals in agriculture.

Books Recommended:

1. Allaby, M. 2000. Basics of Environmental Science. Rutledge, London.
2. Hudson, N.W. 2004. Soil and water conservation in semi-arid areas. Scientific Publishers, India.
3. Kirkham, M.B. 2004. Water use in crop production. Internal Book Distributing Co. (Publishing Division).
4. Maloo, S.R. 2002. Sustainable Crop Production under stress environments. Agro-tech Publishing Academy, Udaipur, India.
5. Raven, P.H. Berg, L.R. and G.B. Johnson. 1993. Environment. International Ed. Saunders College Publishing, New York.

AGR-705 AGRO-METEOROLOGY 3(3-0)

Objective

- To impart knowledge about meteorological optima and its relevance to crop production.

Theory

Scope of agricultural meteorology. Climate and weather of different zones of Pakistan. Crop adaption and distribution in relation to climate. Diurnal and seasonal variation in photoperiod and light integral. Quantitative analysis of crop-weather relationship and crop yield. Atmospheric pollution and plant productivity. Remote sensing, Geographical Information System (GIS) and their application in agriculture. Crop monitoring and forecasting.

Books Recommended:

1. Murthy, V. 2002. Basic Principles of Agricultural Meteorology. Pak Book Corp. Lahore.

2. Prasada, G.S. L. H. 2008. Agricultural Meteorology. Printice Hall of India, NewDelhi.
3. Ahrens, C. D. 2008. Meteorology Today. Brooks/Cole Cengage Learning, Belmont, USA.
4. Brunt, D. 2007. Meteorology. OxfordUniversity Press. UK.
5. Shamshad, K.M. 1988. The Meteorology of Pakistan. Royal Book Co., Karachi.

AGR-706 ALLELOPATHY AND CROP PRODUCTION 3(2-1)

Objective

- To educate students about allelopathic phenomena and its utilization in agro-ecosystem.

Theory

Concept of allelopathy, history. Allelopathic plants, types of allelochemicals, mechanism of allelochemicals' action. Factors influencing production and effectiveness of allelochemicals. Production, release, absorption and translocation of allelochemicals. Role of allelopathy in agro-eco system. Interactions among cropping systems. Utilization of allelopathy for pest management. Enhancing crop productivity by utilizing allelopathy. Recent research trends in allelopathy.

Practical

Preparation of allelopathic plant water extracts. Comparison of crop cultivars for their allelopathic effects. Demonstration of allelopathic effects of crop extracts/residues on seed germination and seedling growth of crops/weeds. Identification of allelopathic chemicals.

Books Recommended:

1. Gliessman, S. R. 2007. Field and laboratory investigations in Agroecology (2nd Edn). Taylor and Francis, USA.
2. Kohli, K.R., H.P. Singh and D. R. Batish. 2004. Allelopathy in agroecosystems. IDBC Lucknow, India.
3. Macias, F.A., C.G. Galindo and J.M. G. Molinillo. 2003. Allelopathy: Chemistry and mode of action of allelochemicals. CRC Press, New York, USA.
4. Reigosa, M. J., N. Petrol and L. Gonzalez. 2006. Allelopathy: A physiological process with ecological implications. Springer, Heidelberg, Germany.
5. Rice, E.L. 1997. Allelopathy. (4th Ed.). Academic Press, Inc. Orlando, Florida, USA.

- Zeng, R.S, A.U. Mallik and S.M. Luo. 2008. Allelopathy in sustainable agriculture and forestry. Springer, USA.

AGR-707 APPLIED CONSERVATION AGRONOMY 3(3-0)

Objective

- To develop understanding about resource conservation with special emphasis on soil and water.

Theory

Objectives and types of conservation. Current problems of conservation agronomy. Biological conservation by crop management. Farming systems and cultural practices with focus on integrated natural resource conservation; conservation structures, water harvesting in rainfed regions. Developments in soil conservation and crop productivity.

Books Recommended:

- Arnon, I. 1992. Agriculture in Dry Lands: Principles and Practices. Elsevier, London.
- Govindan, K. and V.Thirumurugan. 2003. Principles and Practices of Dry Land Agriculture. Kalyani Publishers, New Delhi, India.
- Gurmel, S., C. Venkataraman, G. Sastry and B.P. Joshi. 1990. Manual of Soil and Water Conservation Practices. Oxford and IBH Pub. Co., New Delhi.
- Philips, W.L. Nelson and J.D. Beaton. (Ed.) 1984. Tillage Agriculture: Principles and Practices. Van Norstand Rheinhold Co., New York.
- Redders, I.K. 1992. Conservation Tillage Systems and Management: Crop Residue Management with no-fill, ride till and mulch till. MWPS – 45. Midwest Plan Service, Agriculture and Bio System Engineering Department, Iowa State University, Ames Iowa, USA .

AGR-708 ARID ZONE AGRONOMY 3(3-0)

Objective

- To broaden the understanding of problems, limitations and potentials in arid areas.

Theory

Classification of dry areas. Aridity: causes and implications. Climatic factors affecting crop production. Vegetation of the arid zones. Water resources, their conservation and development in irrigated and

non-irrigated regions. Crop water relations. Plant adaptation to water stress. Sustainable agriculture in dry regions. Soil fertility and irrigation management. Modern tillage methods in arid soils. Plant population, planting geometries, cropping patterns and crop sequences in arid and semi arid regions.

Books Recommended:

1. Arnon, I. 1992. Agriculture in Dry Lands: Principles and Practices. Elsevier, Amsterdam.
2. Gupta, U.S. 1975. Physiological aspects of Dryland Farming. Oxford and IBH Pub. Co., New Delhi.
3. Shaw, T. 2010. Dryland Farming. Nabu Press, USA.
4. Unger, P.W., T.V. Sneed, W.R. Jordan and R. Jensen. 1988. Challenges in Dryland Agriculture: A. Global Perspective. Proc. Int. Conf. Dryland Agriculture. Texas, USA.

AGR -709 BIOLOGICAL CROP POTENTIAL 3(3-0)

Objective

- To elaborate the concept of biological potential and exploitation in crops.

Theory

Biological crop potential, actual, attainable, record and potential yield. Agro-physiological factors limiting yield potential of arable crops. Factors limiting crop growth and yield. Components of plant leaf area expansion. Optimum and critical leaf area indices. Crop canopy development, canopy architecture and interception of solar radiation. Potential for increasing photosynthetic gains and decreasing respiratory losses. Dry matter partitioning.

Books Recommended:

1. Charles-Edwards, D.A. 1982. Physiological Determinants of Crop Growth. Academic Press, Australia.
2. Fageria, N. K. VB.C. Baligar, R.B. Clark and R. B. Clark. 2006. Physiology of Crop Production. Haworth Press, USA.
3. Hay, R.K.M. and A.J. Walker. 1989. An Introduction to Physiology of Crop Yield. Longman Scientific and Technical Group UK Ltd., Essex.
4. Loomis, R.S. and D. J. Connor. 1993. Crop Ecology. Productivity and Management in Agricultural Systems. Cambridge University Press, New York.
5. Nelson, C. J. 2004. Physiology of Crop Plants. 2nd Ed. Amazon, USA.

6. Schulze, E. Beck & K. Muller-Hohenstein. 2005. Plant Ecology. State University of New York.
7. Squire, G.R. 1990. The Physiology of Tropical Crop Production. CAB international. Wallingford, UK.
8. Wani, S. P., J. Rockstrom and T. Oweis. 2009. Rainfed Agriculture: Unlocking the potential. IARC, New Dehli, India.

AGR-710 CROP AND ENVIRONMENT 3(3-0)

Objective

- To broaden the understanding of relationships between crop and environment.

Theory

Crop environment and its components. Major determinants of the environment and their role in crop production. Microclimate in relation to crop management. Green house effects. Environmental pollution and plant growth. Energy exchange by plants in ecosystem. Evapotranspiration and approaches to reduce evapotranspiration, antitranspirants, reflectants, plant physiological aspects and plant architecture.

Books Recommended:

1. Loomis, R.S. 1992. Crop Ecology. Productivity and Management in Agricultural System. Cambridge University Press, U.K.
2. Nobel, P.S. 2005. Physiochemical and Environmental Plant Physiology. 5th Ed. Academic Press, New York.
3. Pritchard, S. G., J. S. Amthor. 2005. Crops and Environmental Changes: an introduction of global warming. CSSA, Madison, Wisconsin, USA.
4. Schultz, E.D. 2005. Plant Ecology. Springer Verlag, Berlin. Heidelberg.
5. Townsend, C.R., Harper, J.L. and Bego, M.E. 2000. Essentials of Ecology. Blackwell Scientific Publications, UK.

AGR -711 CROP MANAGEMENT ON PROBLEM SOILS 3(3-0)

Objective

- To strengthen the knowledge for raising crops successfully on problem soils.

Theory

Perspective and problems of crop production in eroded, salt affected, water deficient and water-logged soils. Site specific cultural practices. Fertilizer and irrigation adjustment. Specific cropping patterns and crop management practices for economic production. Soil improvement/reclamation. Demonstration of problem soils.

Books Recommended:

1. Gupta, U.S. 2005. Physiology of Stressed Crops: nutrient relations. Science Pub., India.
2. IIMI. 1997. Salinization, Alkalinisation and Sodification on Irrigated Areas in Pakistan. Lahore.
3. Lauchli, A. and U. Luttge. 2002. Salinity: environment-plant-molecules. Lavoisier, France.

AGR -712 CROP MODELING 3(2-1)

Objective

- To strengthen and broaden the knowledge of crop modeling and its application for field crops.

Theory

Crop modeling: concept, types of models, specification and uses. Parameters of models and calibration. Statistical parameters in modeling. Model application evaluation and validation. Modeling in relation to climate change. Use of models for cereals, legumes and other crops. Modeling for crop improvement and risk assessment. Simulation of management strategies for changing climatic optima.

Practical

Preparation of file X, file A, file T. Preparation of weather and soil files. Working with different models. Setting of appropriate coefficient for cultivars, calibration, evaluation and validation. Working with sequence, seasonal, economic analysis, easy grapher etc.

Books Recommended:

1. Allen R. O. and R.V. Scholtz III. 2002. Mathematical Models of Crop Growth and Yield. CRC Press, USA
2. Floor M. B. and M. van Ittersum. 2010. Environmental and Agricultural Modeling: Integrated Approaches for Policy Impact Assessment, Springer, Heidelberg, Germany

3. John H. M. Thornley and Ian R. Johnson. 2000. Plant and Crop Modeling: A Mathematical Approach to Plant and Crop Physiology. The Blackburn Press, Caldwell, New Jersey, USA
4. Paul C. Struik. 2007. Plant Research International and Wageningen University, Netherland
5. Weixing, C., Jeffrey, W. W. and E. Wang (Ed). 2009. Crop Modeling and Decision Support. Springer, Heidelberg, Germany.

AGR-713 CROP NUTRITION 3(2-1)

Objective

- To equip students with latest developments in crop nutrition.

Theory

Crop nutrition and its role in productivity. Essential crop nutrients and sources. Soil and foliar application methods and dynamics of availability. Uptake, assimilation and physiological functions of macro and micronutrients. Nutrient requirement of legume and non-legume crops in mono and multicultures. Integrated nutrient management under dry and irrigated cropping systems. Nutritional disorder and deficiency symptoms in crops. Relationship between mineral nutrition and plant pests.

Practical

Demonstration of nutrient deficiency symptoms. Calculation of fertilizer levels. Preparation of different nutrient solutions. Nutrient analysis (macro & micro) of soil and plants

Books Recommended:

1. Epstein, E. and A. J. Bloom. 2004. Mineral Nutrition of Plants: Principles and Perspectives. John Wiley and Sons Inc., USA.
2. Havlin, J.L., J.D. Beton, S.L. Tisdal and W.L Nelson. 2007. Soil Fertility and Fertilizers. 7th Ed. Prentice hall, upper Saddle river New Jersey.
3. IAEA. 2006. Management practices for improving sustainable crop production in tropical environments. IAEA, Vienna, Austria.
4. Krishna K.R. 2002. Soil Fertility and Crop Production. Oxford and IBH publishing Co. New Delhi.
5. Mengel, K., E. A. Kirkby, H. Kosegarten, and T. Appel. 2001. Principles of Plant Nutrition. 5th Ed. International Potash Institute, Bern, Switzerland.

AGR-714 CROP PRODUCTION AND HERBICIDES 4(3-1)

Objective

- To enhance students capability about herbicides and their use for crop maximization.

Theory

Herbicides: Importance, nomenclature, registration, classification systems. Chemical classification. Bio-herbicides. Herbicide formulations, surfactants and adjuvants. Application and incorporation techniques and equipments. Spray drift management, Herbicide selectivity, herbicide mixtures and compatibility, Effect of herbicide residues on succeeding crops. Herbicide hazards, toxicity, environmental pollution. Storage, transportation and disposal of herbicides.

Practical

Calculation of herbicide dosage. Determination of active ingredients in various herbicide formulations. Types of sprayers, their parts and spray calibration. Boom height adjustment and study of overlapping. Study of residual effects on soil and succeeding crop. Tank mixing.

Books Recommended:

1. Anderson, W.P. 2007. Weed Science Principles and Application. 4th Ed. West Publishing Co. St. Paul. New York
2. Rao, V.S. 2002. Principles of Weed Science, Science Pub., U.S.A.
3. Walia, U.S. 2003. Weed Management. Kalyani Pub., New Delhi
4. Zimdhal, T.L. 2008. Fundamentals of Weed Science. 3rd ed. Academic Press, Inc. New York.

AGR-715 FARMING AND CROPPING SYSTEMS 3(3-0)

Objective

- To identify the issues of farming/cropping systems and to demonstrate research methods for sustainable production.

Theory

Farming system, scope, classification, components of farming system. Interaction between components. Cropping system. Complementary and competitive interaction. Effect of preceding crops and associated crops. Indices of evaluation for cropping systems. Agronomic requirements in management of cropping system. Cropping scheme. Sustainable agriculture. Role of integrated farming system in sustainable agriculture.

Factors governing choice and size of enterprises and resource allocation in farming system. Organic farming. Resource management under constraint situations. Low Input Sustainable Agriculture (LISA) concepts and principles. Low cost technology and non monetary inputs.

Books Recommended:

1. Byerlee, D. and T. Hussain. 1992. Farming Systems of Pakistan. Vanguard Books Pvt. Ltd. Lahore.
2. Dixit, R.S. 2007. Cropping systems research. Kalyani Pub. New Dehli.
3. Kay, R.D., W. M. Adwards and P.A. Duffy. 2004. Farm Management. 5th Ed. McGraw-Hill Co., Inc., New York.
4. Jayanthi *et.al.*, 2002. Integrated Farming System: A Path to Sustainable Agriculture. TNAU publication Nol.14/2002
5. Panda, S.C. 2003. Cropping and Farming systems. Agro bios, Jodhpur, India.
6. Rangasamy, A., K. Annadarai, P. Subbian and C. Jayanthi. 2002. Farming Systems in the Tropics. Kalyani Publishers, India.
7. Shrestha, A. 2003 Cropping System. Food Products Press. Haworth Press, Inc. Binghamton, New York.

AGR-716 FIELD CROP EXPERIMENTATION 4(3-1)

Objective

- Capacity building for designing, handling of experiment, data collection and interpretation.

Theory

Methods of scientific inquiry. General types of experiments. Principles of experimental designs. Planning, layout and conducting field experiments. Recording data, trimmed and Winsorized means, separation of means, probability, Chi-square, F-test, and t distribution. Measures of dispersion; Types of field experiments, Experimental designs used in field and lab trials. Regression and correlation analyses. Transformation of data.

Practical

Lay-out of experiments. Preparation of analysis of variance table. Use of different tests of significance. Separation of means. Data analysis and interpretation of factorial experiments. Reporting results of experiments. Computation of linear regression and correlations. Transformation of experimental data and use of statistical packages for data analysis.

Books Recommended:

1. Alan G. Clewer and David H. Scarisbrick. 2001. Practical Statistics and Experimental Design for Plant and Crop Science. John Wiley and Sons, Ltd., Chichester, England.
2. LeClerg, E.L., W.H. Leonard and A.G. Clark. 1990. Field Plot Technique. National Book Foundation, Islamabad.
3. Petersen, R.G. 1994. Agricultural Field Experiments: Design & Analysis. Marcel Dekker AG., Switzerland.
4. Peterson, R.G. 1985. Design and Analysis of Experiments. Marcel Dekker, Inc. New York.
5. Steel, R. G. D., J. H. Torrie and D. Dickey. 1997. Principles and Procedures of Statistics: a biometric approach, 3rd Ed. McGraw Hill Book Co. Inc., New York. USA.
6. Muhammad, F. 2004. Statistical methods and data analysis. Abid Umair printing press, Faisalabad.

AGR-717 HERBICIDES IN PLANT AND SOIL SYSTEMS 3(2-1)

Objective

- To elucidate role of herbicides in plants and their dynamics in soil and environment.

Theory

Absorption and translocation of herbicides. Effects of herbicides on photosynthesis, respiration, protein, nucleic acid metabolism and enzymes. Metabolism of herbicides in plants. Sublethal effects of herbicides. Herbicides and soil interaction. Fate of herbicides in soils. Herbicide persistence and factors influencing it. Management of herbicide residues in soil. Bioassay techniques in herbicide residue analysis. Instrumentation techniques for herbicide analysis. Herbicide resistance. Methods to combat herbicide resistance.

Practical

Demonstration of herbicide resistance through dose response test. Demonstration residual effect on germination and seedling growth of succeeding crops. Demonstration of herbicide movement in soils.

Books Recommended:

1. Kumar, R. J. and R. Jagannathan. 2007. Weed Science Principles. Kalyani Publishers, B-1/292, Rajinder Nagar, Ludhiana – 141008. 2nd Edition.
2. Powles, S.B. and J.A. M. Holtum. 1994. Herbicide Resistance in Plants: Biology and Biochemistry, Lewis Pub.

3. Walia, U.S. 2010. Weed Management. Kalyani Publishers, B-I/292, Rajinder Nagar, Ludhiana-141008.
4. Zimdahl, R.L. 2007. Fundamentals of Weed Science. 3rd Academic Press, New York.
5. Kumar, R. J. and R. Jagannathan. 2007. Weed Science Principles. Kalyani Publishers, B-I/292, Rajinder Nagar, Ludhiana – 141008. 2nd Edition.
6. Powles, S.B. and J.A. M. Holtum. 1994. Herbicide Resistance in Plants: Biology and Biochemistry, Lewis Pub.
7. Prado, R. De., J. Jossin and L. G. Torres. 1997. Weed and Crop resistance to herbicides. Kluwer Academic Publishers. Dordrecht/Boston/London.
8. Walia, U.S. 2003. Weed Management. Kalyani Publishers, B-I/292, Rajinder Nagar, Ludhiana-141008.
9. Zimdahl, R.L. 2003. Fundamentals of weed science. Academic Press 24-48 Oval, London NW,17DX, UK. 2nd Edition

AGR -718 INTEGRATED AGRICULTURE 3(3-0)

Objective

- To equip students with the challenges and potential of Pakistan Agriculture.

Theory

Concept of integrated agriculture. Challenges in Pakistan's Agriculture. Present scenario and future prospects. Analytical overview: issues and strategies for improvement of crop management, livestock management, fisheries, cottage industry, national resource management and rural development. Institutions and policies: issues and options.

Books Recommended:

1. Ahmad, N. and A. Hamid. 1997. Plant Nutrients Management for Sustainable Agricultural Growth. Proceedings of the Symposium held on December 8-10, 1997. Planning & Development Division, National Fertilizer Development Centre, Islamabad.
2. Anonymous. 1999. Sustainable Agriculture Solutions. Novellow Press, Ltd. London.
3. ICIMOD. 1997. Appropriate Farm Technologies in Arid and Semi-Arid Mountainous Areas of Pakistan. Katmandu, Nepal.
4. Virmani, S.M., J.C.Katyal, H. Eswaru, and I.P. Abarol. 1994. Stressed Ecosystems and Sustainable Agriculture. Oxford & IBH Publishing Co., New Delhi.

AGR -719 MODERN CONCEPTS OF CROP PRODUCTION 4(3-1)

Objective

- To build capacity of students to understand various developments related to crop productivity.

Theory

Modern concepts of tillage. Crop productivity in relation to sowing time, seed priming, growth duration, plant population, planting pattern, integrated nutrient and pest management. Irrigation management. Multiple cropping. Manipulation of crop development through growth regulators. Senescence and abscission. Organic farming and sustainable agriculture. Global warming in relation to crop productivity. Remote sensing. Integrated crop management in rainfed and irrigated areas. Biotechnology and its role in crop improvement. Determinants of yield stability. Precision agriculture. Controlled environment agriculture. Farming system research.

Practical

Measurement of growth and yield determinants. Planning multiple cropping systems. Calculation of Land Equivalent Ratio (LER), Area Time Equivalent Ratio (ATER), Crowding Coefficient, Competition Index, etc. Field visits.

Books Recommended:

1. Benett, H. H. 2003. Soil Conservation for Sustainable Agriculture. Agrobios, Jodhpur India.
2. Epstein, E. and A. J. Bloom. 2004. Mineral Nutrition of Plants: Principles and Perspectives. John Wiley and Sons Inc., USA.
3. Hester, R.E. and R.M. Harrison. 2005. Sustainability in Agriculture. Vol. 21. RSC Publishing, Thomas Graham House, Sci. Park, Milton Road, Cambridge CB4 0WF, UK.
4. Nelson, C. J. 2004. Physiology of Crop Plant. 2nd Ed. Amazon, USA.
5. Singh, N.P. and R.A.Singh.2002. Scientific Crop Production. Kalyani Publishers, Ludhiana

AGR-720 RECENT ADVANCES IN AGRONOMY 3(3-0)

Objective

- To inculcate knowledge with respect to current developments in agronomic research.

Theory

Selected topics in recent advances in agronomy. Evaluation of the most recent research of the entire field. Lectures and discussions by the specialists in the areas of their research.

Periodicals Recommended:

Advances in Agronomy. All volumes from last three years. Academic Press Inc., New York.

1. Agronomy for Sustainable Development. All volumes of last three years. EDP Science's INRA-CMSE-PME, Dijon, France.
2. Agronomy, J. All volumes of last three years. ASA, Wisconsin, Madison, USA.
3. European J. Agronomy, Elsevier, Amsterdam.
4. MaCritical Review in Plant Sciences. All volumes during last three years. Taylor and Francis, New York.
5. Sustainable Agriculture; Reviews. All volumes of last three years. Springer, Netherlands.

AGR-721 SEED PHYSIOLOGY 3(2-1)

Objective

- To enhance students' understanding of physiological processes in seeds.

Theory

Flower structure and anatomy. Pollination, fertilization, pollen compatibility and incompatibility. Physiology of seed development: transport of assimilates to the developing seed. Starch and protein synthesis. Role of growth regulators in seed development and dormancy. Seed sink strength and intensity. Seed food reserves, location and composition. Metabolism in the germinating seed. Physiological and biochemical manifestation of seed aging and deterioration. Seed priming: osmo-conditioning and matri-conditioning.

Practical

Seeds germination, monocot, dicot flower & seed structure. Seed priming techniques and their performance under different moisture regimes. Changes in protein and carbohydrate contents of seeds during germination. Determination of enzyme activities (amylase, glutamine synthetase) in germinating seeds.

Books Recommended:

1. Bewley, J.D. and M. Black. 1994. Seeds: Physiology of

- Development and Germination. 2nd Ed. Plenum Press, New York
2. Copeland L.O. and M.F. McDonald. 2001. Principles of Seed Science and Technology – 4th Ed. Burgess Pub. Co., USA
 3. McDonald, M.B. and L.O. Copeland. 1989. Seed Science and Technology Laboratory Manual. Iowa State University Press / Ames, USA .
 4. Stanwood, P.C. and M.B. McDonald. 1989. Seed Moisture. ASA, Madison, Wisconsin.

AGR-722 SEED SCIENCE AND TECHNOLOGY 3(2-1)

Objective

- Augmenting students capacity regarding principles of seed production and innovations in seed technology.

Theory

Concept and perspective of seed production. Kind of seeds. Terminology used in seed production. Production and multiplication of quality seed. Hybrid seed production. Seed sampling techniques. Seed testing. Seed processing; cleaning, grading, drying, treatment and storage. Seed vigor and quality. Ecological aspects of seed production. Seed certification standards. Seed storage, structures and related problems. Seed industry. Import/export of seed, seed legislation and quarantine laws.

Practical

Analysis for quality tests: physical purity, seed viability, germination and vigor tests. Seed cleaning, grading, treatment. Seed priming. Sampling techniques involved in seed testing. Visit to seed farms, storage houses and processing plants.

Books Recommended:

1. Ahmad, S.I. 1992. Seed Certification Manual. National Book Foundation, Islamabad.
2. Copeland L.O. and M.F. McDonald. 2001. Principles of Seed Science and Technology – 4th Ed. Burgess Pub. Co., USA
3. ISTA. 1996. International rules for seed testing, Vol. 26, 31, 35, and 37. Proceedings of International Seed Testing Association, Zurich, Switzerland.
4. McDonald, M.B. and L.O. Copeland. 1989. Seed Science and Technology Laboratory Manual. Iowa State University Press / Ames, USA .

AGR-723

STRESS AGRONOMY

4(3-1)

Objective

- To broaden the knowledge regarding various stresses influencing crop production and their management

Theory

Concept of stress agronomy. Plant stress factors and their impact on productivity of cropping systems. Types of stresses (Water, nutrient, salt, temperature, CO₂, light, inter and intra plant competition, etc.), Crop responses and adaptation to different stresses and their individual and interactive impact on plant growth and development. Agro-management practices for successful crop husbandry under stress environments

Practical

Experiments will be designed to invoke understanding among the students about plant behavior to various types of stresses. Field visits to demonstrate types of stresses and their impact on crop productivity.

Books Recommended:

1. Arnon, I. 1992. Agriculture in drylands—principles and practices. Elsevier, Amsterdam.
2. Fitter, A.H. and R.K.M Hay. 1983. Environmental physiology of plants. Academic Press, Inc. London.
3. Nösberger, J., H.H. Geiger and P.C Struik. 2001. Crop Science: Progress and Prospects. CABI, Pub., Oxon, UK.
4. Pessarakli, M. (Ed.). 1994. Handbook of Plant and Crop Stress. 2nd Edition. Marcel and Dekker Inc., New York.

AGR-724

SUSTAINABLE AGRICULTURE

3(3-0)

Objective

- To extend students' knowledge about management of agricultural resources on sustainable basis.

Theory

Concept of sustainable agriculture. Threatened agricultural resources in Pakistan. Soil, water and environment. Sustaining soil resources. Organic farming. Soil erosion control. Soil amendments, sewage sludge and other organic wastes. Sustaining water resources. Control of run-off and evaporation losses, reduction of water losses from deep percolation, use of salt tolerant and drought resistant crops and varieties. Reduction of agricultural pollutants. Optimum use of agricultural chemicals,

fertilizers. Cropping systems to sustain productivity. Multiple cropping, rotations, N-fixation and mycorrhizae and alternate land uses, compromise between higher yields and resource conservation. Site specific technological options for sustainable crop production.

Books Recommended:

1. Beth, Lanfalvaj, C.J. and R.C. Linduman. 1992. Mycorrhizae in Sustainable Agriculture. Pub. No.54. ASA, Madison, USA.
2. DAS, P.C. 2000. Crops and their production technology under different conditions. First Edition. Kalyani Publishers. New Delhi.
3. Lichtfouse, E., M. Nanarrete, B. Debacke, and V. Souchere. 2009. Sustainable Agriculture. Springer, The Netherland.
4. Reddy, T.Y. and G.H.S. Reddy. 2002. Principles of Agronomy. Third Edition, Kalayani Publishers, New Delhi.
5. Singh, S.S. 1998. Crop management under irrigated and rainfed conditions. 3rd Edition. Kalayani Publishers, New Delhi.

AGR-725 WATER RELATIONS IN PLANTS 3(2-1)

Objective

- To enhance the understanding of relationship between plants and water.

Theory

Importance of water in plants. Physical and chemical properties of water. The ascent of sap. The cohesion mechanism, anatomy of pathway; water potential gradient, capillary rise in xylem. Free energy and chemical potential. Water potential and its components, analysis of chemical potential, standard state, hydrostatic pressure, water activity and osmotic potential, Van't Hoff relations, matric potential. Water potential and plant cells. Plasmolysis, chemical and water potential of water vapors, plant air interface, water flux and kinetics of volume change.

Practical

Techniques and experimental approaches for measurement of plant water status: Measurement of water content, water potential, pressure chamber technique and psychrometric techniques. Methods of inducing water stress in plants.

Books Recommended:

1. Khan, S. R. A. 2001. Crop Management with focus on soil and water. Agric. Deptt. Govt. of Pb., Lahore.

2. Misra, R.D. and M. Ahmad. 1990. Manual of Irrigation Agronomy. Oxford and IBH Publishing Co. New Delhi.
3. Nobel, P.S. 2005. Physio-chemical and Environmental Plant Physiology. 5th Ed. Academic Press, New York.
4. Prihar S.S. 2003. Intensive Cropping, Efficient use of Water, Nutrients, and Tillage. Pak Book Corp. Lahore.
5. Turner, N.C. 1981. Techniques and Experimental Approaches for Measurement of Plant Water Status. Plant and Soil. Vol. 58. Dr. W. Junk Publishers. Hague, Netherlands.

AGR-726 WEED MANAGEMENT 3(2-1)

Objective

- To acquaint students with comprehensive knowledge of weed management in field crops.

Theory

Weeds in agricultural perspective; Systems concept for weed management; Nature of weed-crop competition; Critical period of weed interference. Economic threshold level. Characteristics, diversity and distribution of weeds; Ecology of weeds. Elements of weed control. Merits and limitations of different weed control methods; Advantages of integrated weed management (IWM); Weed management systems for field crops. Management of problematic, parasitic, invasive weeds and non-crop land weeds. Tillage implements for weed control. Current developments and research trends in weed management.

Practical

Collection, identification and classification of weeds. Demonstration of competition, duration and timing on crop growth. Demonstration of integrated weed management.

Books Recommended:

1. Camper, N.D. 1986. Research Methods in Weed Science. 3rd Ed. Southern Weed Science Society, Campaign.
2. Rizvi, S.J. and V. Rizvi. 1992. Allelopathy-Basic and Applied Aspects. Chapman and Hall, London.
3. Ross, M.A., and C.A. Lembi. 1985. Applied Weed Science. Burgess Pub. Co., Minneapolis.
4. Tanveer, A., A. Khaliq, A. Ali and M.A. Khan. 2005. Weed Science Research in Pakistan—a compendium. Agriculture Department, Government of Punjab, Lahore.
5. Zimdahl, R.L. 1980. Weed-Crop Competition-A review. International Plant Protection Center, Corvallis.

AGR-727 CLIMATE CHANGE AND AGRICULTURE 3(3-0)

Objective

- To develop ink-link about crop production under changing climate.

Theory:

Climate and agriculture; Climate variability and change, past, present and future scenario; Impact of climate change in temperate, humid, sub-humid, semi-arid and arid regions; Impact of climate change on vegetation (C₃ & C₄), crops, pests, livestock and natural resources; Strategies for managing climate change vulnerability.

Books Recommended:

1. ASA. 1995. Climate Change and Agriculture: Analysis of Potential International Impacts. ASA Special Publication No. 59. American Society of Agronomy, Inc., Madison, Wisconsin, USA
2. Mavi, H.S. and G.J. Tupper. 2005. Agrometeorology Principles and Application of Climate Studies in Agriculture. International Book Distribution Co., Lucknow, India.
3. Sivakumar, M.V.K. and J. Hansen. 2007. Climate Predictions and Agriculture. Springer, Berlin, Heidelberg, New York.
4. Sivakumar, M.V.K. and R.P. Motha. 2005. Increasing Climate Variability and Change: Reducing the vulnerability of agriculture and forestry. Springer, Dordrecht, The Netherland.
5. Sivakumar, M.V.K. and R.P. Motha. 2007. Managing Weather and Climate: Risks in Agriculture. Springer, Berlin, Heidelberg, New York.
6. Tsuji, G.Y., G. Hoogenboom and P.K. Thornton. 1998. Understanding Options for Agricultural Production. Kluwer Academic Publishers, London.

AGR-728 SPECIAL PROBLEM 1(0-1)

Objective

- To broaden student capacity for handling a project independently.

Preparation of research proposals for plant science. Field / Laboratory Experiment. Collection, Compilation and presentation. Interpretation of results and report writing by the student.

Note: *The post-graduate students will be assigned the topics on recent developments in agronomy by the concerned teacher.*

departmental libraries of all the Agricultural Universities / Faculties / Colleges of the country and to improve the **library / documentation** of the institutions.

8. Professors and Associate Professors should also be considered for different administrative courses run by national policy institutes/public administration staff colleges to enhance administrative and financial management skills.
9. To improve the standard of the higher education at national level, the committee recommends that the appointment of local examiners should be discouraged at M.Sc (Hons)/M.Phil degree programs.
10. The below suggestion is not in practice
11. It is recommended that periodic inter-university/inter-provinces visits of the Faculty Members along with PhD Scholars should be made compulsory to enhance the exchange of views and observe the site specific technology developed in different provinces/universities.
12. 10 HEC is requested to review the policy for funding Lab establishment with priority for the proposal relevant to practical facilities of the newly developed courses being offered at different institutions.

List of Books Recommended for Agronomy

1. Abbas, M. A. 2006. General Agriculture. Emporium Urdu Bazar, Lahore
2. Advances in Agronomy. All volumes from last three years. Academic Press Inc., New York.
3. Agronomy for Sustainable Development. All volumes of last three years. EDP Science's INRA-CMSE-PME, Dijon, France.
4. Agronomy, J. All volumes of last three years. ASA, Wisconsin, Madison, USA.
5. Ahmad, N. and A. Hamid. 1997. Plant Nutrients Management for Sustainable Agricultural Growth. Proceedings of the Symposium held on December 8-10, 1997. Planning & Development Division, National Fertilizer Development Centre, Islamabad.
6. Ahmad, N. and G.R. Chaudhry. 1988. Irrigated Agriculture of Pakistan. Publisher, Shahzad Nazir, Lahore.
7. Ahmad, S.I. 1992. Seed Certification Manual. National Book Foundation, Islamabad.
8. Ahrens, C. D. 2008. Meteorology Today. Brooks/Cole Cengage Learning, Belmont, USA.
9. Alan G. Clewer and David H. Scarisbrick. 2001. Practical Statistics and Experimental Design for Plant and Crop Science. John Wiley and Sons, Ltd., Chichester, England.
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11. Allaby, M. 2000. Basics of Environmental Science. Rutledge, London.
12. Allen R. O. and R.V. Scholtz III. 2002. Mathematical Models of Crop Growth and Yield. CRC Press, USA
13. Allen R.G. L.S. Pereira, D. Raes, and M. Smith. 1998. Crop evapotranspiration: Guidelines for computing crop water requirements. FAO. Irrigation and Drainage paper No. 56. Rome.
14. Anderson, W.P. 2007. Weed Science Principles and Application. 4th Ed. West Publishing Co. St. Paul. New York
15. Anonymous. 1996. Fodder Production in Pakistan. Proc. National Conf. Improvement, Production and Utilization of Fodder Crops in Pakistan, NARC. March 25-27, 1996, Islamabad.
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17. Anonymous. 1992. Proceeding of International Seminar on Seed, Fauji Fertilizer Corporation. Islamabad.
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27. Basra, A.S. (Ed). 2006. Handbook of Seed Technology. Haworth Press New York, USA.
28. Beatley, T., D. Brower and A. Schwab. 2002. An Introduction to Coastal Zone Management. Island Press, 1718 Connecticut Avenue, N.W. Suite 300, Washington, D.C.
29. Benett, H. H. 2003. Soil Conservation for Sustainable Agriculture. Agrobios, Jodhpur India.
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35. Brown C.S. and T. Toadwine (eds.) 2007. Nature's Edge-Boundary Explorations in ecological theory and practice. State University of New York Press, Albany, USA.
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199. Turner, N.C. and P.J. Kramer. 1980. Adaptation of plants to water and high temperature stress.
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201. Vendermeer, J. 1989. The Ecology of Intercropping. Cambridge University Press.
202. Virmani, S.M., J.C.Katyal, H. Eswaru, and I.P. Abarol. 1994. Stressed Ecosystems and Sustainable Agriculture. Oxford & IBH Publishing Co., New Delhi.
203. Walia, U.S. 2003. Weed Management. Kalyani Pub., New Delhi
204. Wani, S. P., J. Rockstrom and T. Oweis. 2009. Rainfed Agriculture: Unlocking the potential. IARC, New Dehli, India.
205. Weixing,C., Jeffrey,W. W. and E. Wang (Ed). 2009. Crop Modeling and Decision Support. Springer, Heidelberg, Germany.
206. Westerman, R.L. (Ed.). 1990. Soil Testing and Plant Analysis. 3rd Ed. Soil Sci. Am. Inc., Madison, WI, USA.
207. Wolfe, T.K. and M.S. Kipps .2004. Production of Field Crop: A Textbook of Agronomy. McGraw Hill Book Co. NewYork.
208. Yi-Ping Wang, Min Lin, Zhe-Xian Tian, William E. Newton. Eds. 2005. Biological Nitrogen Fixation, Sustainable Agriculture and the Environment. Proc. 14th Int. Congress Biological Nitrogen Fixation. Springer, Netherlands.
209. Zeng, R.S, A.U. Mallik and S.M. Luo. 2008. Allelopathy in sustainable agriculture and forestry. Springer, USA.
210. Zimdahl, R. 2008. Fundamentals of Weed Science. Third edition. Academic Press, USA.
211. Zimdahl, R.L. 1980. Weed-Crop Competition-A review. International Plant Protection Center, Corvallis.
212. Zimdahl, R. L. 2007. Fundamental of Weed Science 3rd Ed. Elsevier, Academic Press, USA.

Annexure – A

DETAILS OF COMPULSORY COURSES COMPULSORY COURSES IN ENGLISH FOR Undergraduate Level

English I (Functional English)

Credit Hrs. 3

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

Translation skills

Urdu to English

Paragraph writing

Topics to be chosen at the discretion of the teacher

Presentation skills

Introduction

Note: Extensive reading is required for vocabulary building

Recommended books:

1. **Functional English**
 - 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 Françoise 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. Brian Tomlinson and Rod Ellis. Oxford Supplementary Skills. Third Impression 1992. ISBN 0 19 453402 2.
- d) Speaking

English II (Communication Skills)

Credit Hrs. 3

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

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:

Communication Skills

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

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

- c) Reading
 - 1. Reading. Advanced. Brian Tomlinson and Rod Ellis. Oxford Supplementary Skills. Third Impression 1991. ISBN 0 19 453403 0.
 - 2. Reading and Study Skills by John Langan
 - 3. Study Skills by Richard Yorky.

English III (Technical Writing and Presentation Skills) Crh. 3

Objectives

Enhance language skills and develop critical thinking

Course Contents

Presentation skills

Essay writing

Descriptive, narrative, discursive, argumentative

Academic writing

How to write a proposal for research paper/term paper

How to write a research paper/term paper (emphasis on style, content, language, form, clarity, consistency)

Technical Report writing

Progress report writing

Note: Extensive reading is required for vocabulary building

Recommended books:

Technical Writing and Presentation Skills

- a) Essay Writing and Academic Writing
 1. Writing. Advanced by Ron White. Oxford Supplementary Skills. Third Impression 1992. ISBN 0 19 435407 3 (particularly suitable for discursive, descriptive, argumentative and report writing).
 2. College Writing Skills by John Langan. Mc=Graw-Hill Higher Education. 2004.
 3. Patterns of College Writing (4th edition) by Laurie G. Kirszner and Stephen R. Mandell. St. Martin's Press.
- b) Presentation Skills
- c) Reading

The Mercury Reader. A Custom Publication. Compiled by norther Illinois University. General Editors: Janice Neulib; Kathleen Shine Cain; Stephen Ruffus and Maurice Scharon. (A reader which will give students exposure to the best of twentieth century literature, without taxing the taste of engineering students).

**ISLAMIC STUDIES
(Compulsory)**

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.

Detail of Courses

Introduction to Quranic Studies

- 1) Basic Concepts of Quran
- 2) History of Quran
- 3) 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) Quranic & 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"
- 4) Mulana Muhammad Yousaf Islahi,"
- 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 Jrisprudence 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)

**PAKISTAN STUDIES
(Compulsory)**

Introduction/Objectives

- Develop vision of historical perspective, government, politics, contemporary Pakistan, ideological background of Pakistan.
- Study the process of governance, national development, issues arising in the modern age and posing challenges to 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

Books Recommended:

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 Banglades.*, 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.

Annexure - D

COMPULSORY MATHEMATICS COURSES FOR B.Sc (Hons) AGRICULTURE

1. MATHEMATICS I (ALGEBRA)

Prerequisite(s): Mathematics at secondary level

Credit Hours: 3 + 0

Specific Objectives of the Course: 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:

Preliminaries: Real-number system, complex numbers, introduction to sets, set operations, functions, types of functions.

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.

Trigonometry: Fundamentals of trigonometry, trigonometric identities.

Recommended Books:

Dolciani MP, Wooton W, Beckenback EF, Sharron S, *Algebra 2 and Trigonometry*, 1978, Houghton & Mifflin,

Boston (suggested text)

Kaufmann JE, College *Algebra and Trigonometry*, 1987, PWS-Kent Company, Boston

Swokowski EW, *Fundamentals of Algebra and Trigonometry* (6th edition), 1986, PWS-Kent Company, Boston

2. MATHEMATICS II (CALCULUS)

Prerequisite(s): Mathematics I (Algebra)

Credit Hours: 3 + 0

Specific Objectives of the Course: To prepare the students, not majoring in mathematics, with the essential tools of calculus to apply the concepts and the techniques in their respective disciplines.

Course Outline:

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:

Anton H, Bevens I, Davis S, *Calculus: A New Horizon* (8th edition), 2005, John Wiley, New York

Stewart J, *Calculus* (3rd edition), 1995, Brooks/Cole (suggested text)

Swokowski EW, *Calculus and Analytic Geometry*, 1983, PWS-Kent Company, Boston

Thomas GB, Finney AR, *Calculus* (11th edition), 2005, Addison-Wesley, Reading, Ma, USA

3. MATHEMATICS III (GEOMETRY)

Prerequisite(s): Mathematics II (Calculus)

Credit Hours: 3 + 0

Specific Objectives of the Course: To prepare the students, not majoring in mathematics, with the essential tools of geometry to apply the concepts and the techniques in their respective disciplines.

Course Outline:

Geometry in Two Dimensions: Cartesian-coördinate mesh, slope of a line, equation of a line, parallel and perpendicular lines, various forms of

equation of a line, intersection of two lines, angle between two lines, distance between two points, distance between a point and a line.

Circle: Equation of a circle, circles determined by various conditions, intersection of lines and circles, locus of a point in various conditions.

Conic Sections: Parabola, ellipse, hyperbola, the general-second-degree equation

Recommended Books:

Abraham S, Analytic Geometry, Scott, Freshman and Company, 1969
Kaufmann JE, College *Algebra and Trigonometry*, 1987, PWS-Kent Company, Boston

Swokowski EW, *Fundamentals of Algebra and Trigonometry* (6th edition), 1986, PWS-Kent Company, Boston

Note:

1. *Two courses will be selected from the following three courses of Mathematics.*
2. *Universities may make necessary changes in the courses according to the requirement as decided by the Board of Studies.*

Annexure - E

Statistics-I

Credit 3 (2-1)

Definition and importance of Statistics in Agriculture, Data Different types of data and variables

Classification and Tabulation of data, Frequency distribution, stem-and-Leaf diagram, Graphical representation of data Histogram, frequency polygon, frequency curve.

Measure of Central tendency, Definition and calculation of Arithmetic mean, Geometric mean, Harmonic mean, Median quantiles and Mode in grouped and ungrouped data.

Measure of Dispersion, Definition and Calculation of Range, quartile deviation, Mean deviation, Standard deviation and variance, coefficient of variation.

Practicals

- a. Frequency Distribution
- b. Stem-and-Leaf digram
- c. Various types of Graphs
- d. Mean, Geometric mean Harmonic Mean,
- e. Median, Quartiles Deviation, mean Deviation.
- f. Standard Deviation, Variance, Coefficient of variation,
- g. Skewness and kenosis

Book Recommended:

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

Statistics-II

Credit 3 (2-1)

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 χ^2 (chi-square) Testing hypothesis about variance.

Practicals

- a. Sampling random sampling
- b. Stratified random sampling.
- c. Sampling distribution of mean
- d. Testing of hypotheses regarding population mean
- e. Testing of hypotheses about the difference between population means
- f. Chi-square test
- g. Testing of Correlation Coefficient
- h. Fitting of simple linear regression
- i. One-way ANOVA
- j. Two-way ANOVA

Book Recommended:

1. Introduction to Statistical Theory Part-II by Sher Muhammad and Dr. Shahid Kamal (Latest Edition)
2. Statistical Methods and Data Analysis by Dr. Faquir Muhammad
3. Principles and Procedures of Statistics A Bio-metrial approach, 2nd Edition, 1980 by R.G.D Steal and James H. Tarric
4. Statistical Procedures for Agricultural Research 2nd Edition (1980) by K.A. Gomez and A.A. Gomez

Note: *Universities may make necessary changes in the courses according to the requirement as decided by the Board of Studies.*

Annexure – F

Course Name:

Introduction to Information and Communication Technologies

Course Structure: Lectures: 2 Labs: 1 **Credit Hours: 3**

Pre-requisite: None **Semester: 1**

Course Description:

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
- : Project Week
- : Review Week

Text Books/Reference Books:

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

Functional Biology-I***Credit Hours 3+0*****Biological Methods**

Principles of Cellular Life
Chemical Basis
Structure and Function
Principles of Metabolism
Energy Acquisition
Principles of Inheritance
Mitosis and Meiosis
Chromosomes
Observable Inheritance Patterns
DNA Structure and Function
RNA and Proteins
Genes
Genetic Engineering and Biotechnology
Biodiversity
Fundamental Concept of Biodiversity
One or two examples of each of the following from commonly found organism
Prions
Viruses
Bacteria
Protistans
Algae
Fungi
Plants
Crops
Animals
Invertebrates
Vertebrates

Reading

1. Roberts, M.M., Reiss and G.Monger. 2000. Advanced Biology, Nelson.
2. Starr, C, and R, Taggart, 2001. Biology: The Unity and Diversity of Life Brooks and Cole.
3. Campbell, N.A., J.B, Reece, L.G. Mitchell, M.R, Taylor. 2001. Biology: Concepts and Connections. Prentice-Hall.

Functional Biology-II

Credit Hours 3+0

Myths and Realities of Evolution

Microevolution

Speciation

Macroevolution

Level of Organization

Plants

Tissues

Nutrition and Transport

Reproduction

Growth and Development

Animals

Tissue, Organ System and Homeostasis

Information Flow and Neuron

Nervous System

Circulation and Immunity

Nutrition and Respiration

Reproduction and Development

Ecology and Behavior

Ecosystems

Biosphere

Social Interactions

Community Interactions

Human Impact on Biosphere

Environment Conservation

Reading

1. Roberts, M.M., Reiss and G.Monger. 2000. Advanced Biology, Nelson.
2. Starr, C, and R, Taggart, 2001. Biology: The Unity and Diversity of Life Brooks and Cole.
3. Campbell, N.A., J.B, Reece, L.G. Mitchell, M.R, Taylor. 2001. Biology: Concepts and Connections. Prentice-Hall.

Note: *Universities may make necessary changes in the courses according to the requirement as decided by the Board of Studies.*