

CURRICULUM
OF
AGRONOMY
B.Sc.(Hons)/ BS/ / M.Sc.(Hons)/MS/ PhD

(Revised 2018)



HIGHER EDUCATION COMMISSION
ISLAMABAD

CURRICULUM DIVISION, HEC

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PREFACE

The curriculum, with varying definitions, is said to be a plan of the teaching-learning process that students of an academic programme are required to undergo to achieve some specific objectives. It includes scheme of studies, objectives & learning outcomes, course contents, teaching methodologies and assessment/ evaluation. Since knowledge in all disciplines and fields is expanding at a fast pace and new disciplines are also emerging; it is imperative that curricula be developed and revised accordingly.

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

In compliance with the above provisions, the Curriculum Division of HEC undertakes the revision of curricula regularly through respective National Curriculum Revision Committees (NCRCs) which consist of eminent professors and researchers of relevant fields from public and private sector universities, R&D organizations, councils, industry and civil society by seeking nominations from their organizations.

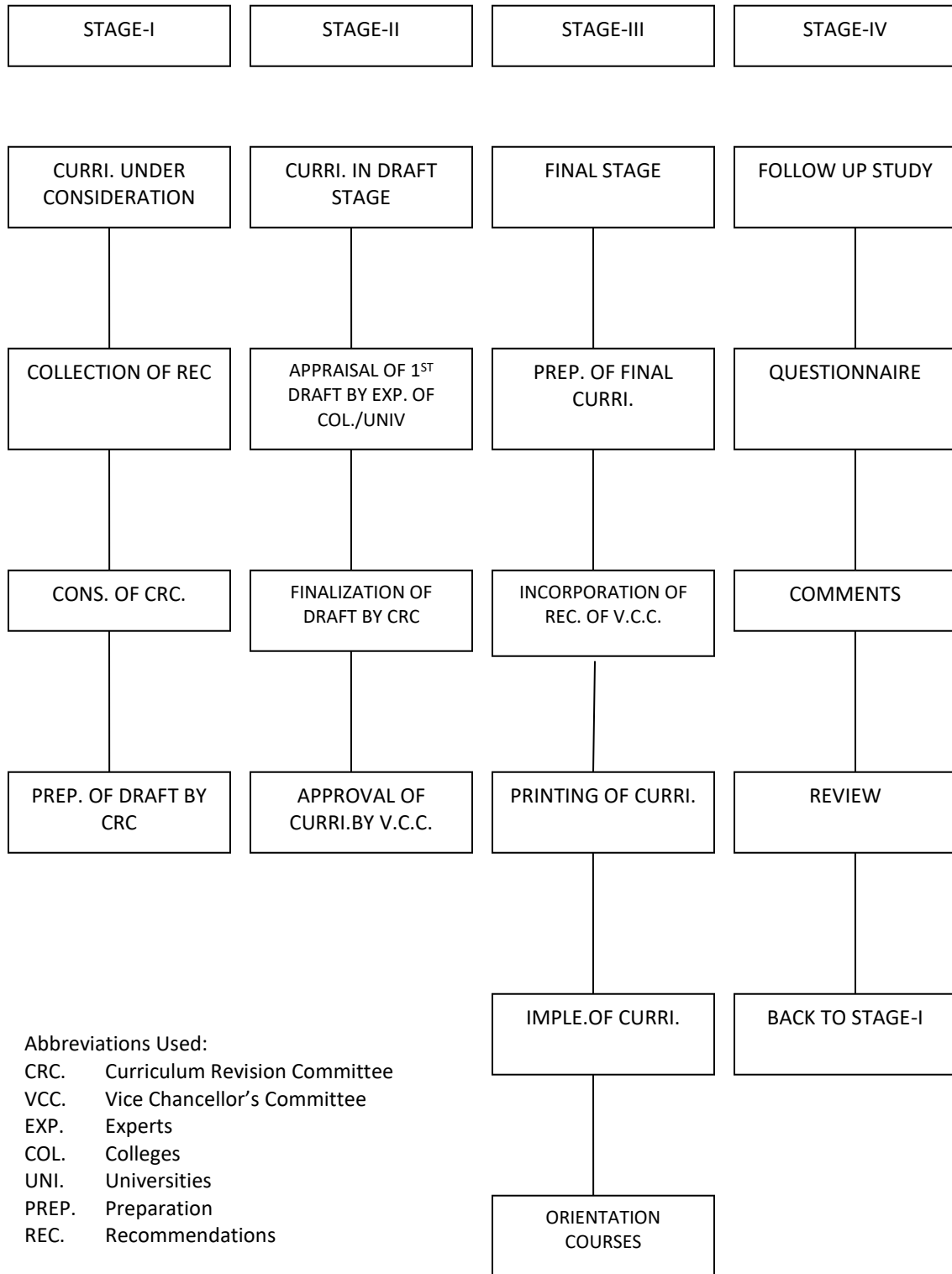
In order to impart quality education which is at par with indigenous needs and international standards, HEC NCRCs have developed unified framework/templates as guidelines for the development and revision of curricula in the disciplines of Basic Sciences, Applied Sciences, Social Sciences, Agriculture and Engineering.

It is hoped that this curriculum document, prepared by the respective NCRC's, would serve the purpose of meeting our national, social and economic needs, and it would also provide the level of competency specified in Pakistan Qualification Framework to make it compatible with international educational standards. The curriculum is also placed on the website of HEC

<http://hec.gov.pk/english/services/universities/RevisedCurricula/Pages/default.aspx>

(Muhammad Raza Chohan)
Director General (Academics)

CURRICULUM DEVELOPMENT PROCESS



CURRICULUM DEVELOPMENT CYCLE



RATIONALE OF DEGREE PROGRAMME 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 PhD 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.

Minutes of National Curriculum Revision Committee (NCRC) Final Meeting of Agronomy held from March 05-07, 2018 at HEC Regional Centre, Lahore

The final meeting of National Curriculum Revision Committee (NCRC) in the discipline of Agronomy for Bachelor, Master and Ph.D Degree programmes was held from March 05-07, 2018 (03 days) at HEC, Regional Center, Lahore. The purpose of the meeting was to finalize the draft curriculum prepared in its preliminary meeting held from 09-11 October, 2017 (03 days) at HEC, Regional Center, Lahore. Experts from academia, research and development organizations participated in the meeting. Mr. Rabeel Bhatti (Assistant Director, Curriculum, HEC, Pakistan) coordinated the NCRC meeting. The list of the participants is as below:

1.	Dr. Bashir Ahmad Professor, Department of Agronomy, University of Agriculture, Peshawar.	Convener
2.	Dr. Aijaz Ahmad Soomro Chairman / Professor, Department of Agronomy, Sindh Agriculture University, Tandojam,	Secretary
3.	Dr. Muhammad Rashid Associate Professor, Department of Agronomy, Lasbela University of Agriculture, Water & Marine Sciences, Uthal, Balochistan.	Co-Secretary
4.	Dr. Nazim Hussain Chairman / Professor, Department of Agronomy, BahauddinZakariya University, Multan.	Member
5.	Dr. Qamaruddin Chachar Chairman / Professor, Department of Crop Physiology, Sindh Agriculture University, Tandojam.	Member
6.	Dr. Riaz Ahmad Chairman / Professor, Department of Agronomy, University of Agriculture, Faisalabad.	Member
7.	Dr. Muzammil Hussain Siddiqui Professor/Chairman, Department of Agronomy, Faculty of Agriculture, The University of Poonch, Rawalakot, AJK,	Member

8.	Dr. Muhammad Naeem Shahwani, Professor, Faculty of Life Sciences & Informatics, Department of Biotechnology, BUIITEMS, Quetta.	Member
9.	Dr. Ghulam Qadir Associate Professor, Department of Agronomy, Faculty of Crop & Food Sciences, PMAS Arid Agriculture University, Rawalpindi.	Member
10.	Dr. Abdul Ghaffar Associate Professor, Department of Agronomy, Muhammad Nawaz Shareef University of Agriculture, Multan.	Member
11.	Dr. Yousaf Jamal Assistant Professor, Department of Agriculture, The University of Swabi, Anbar Swabi.	Member
12.	Dr. Zafar Hayat Khan Associate Professor, Department of Agronomy, Abdul Wali Khan University, Garden Campus, Mardan.	Member
13.	Dr. Muhammad Saleem Principal Scientist, Nuclear Institute for Agriculture & Biology (NIAB), P. O. Box No 128, Jhang Road, Faisalabad.	Member
14.	Dr. Muhammad Naeem Ch. Assistant Professor/Chairman, Department of Agronomy The Islamia University of Bahawalpur, Bahawalpur.	Member
15.	Dr. Muhammad Bilal Chattha Assistant Professor, Institute of Agricultural Sciences, University of the Punjab, Quaid-i-Azam Campus, Lahore.	Member
16.	Dr. Anser Ali Assistant Professor, Faculty of Agricultural Sciences, Department of Agronomy, Ghazi University, D. G. Khan.	Member
17.	Mr. Riaz Ahmad Ghumman Ex- Senior Manager Marketing (Agri Services) Fauji Fertilizer Company Ltd, Lahore.	Member
18.	Dr. Muhammad Aamir Iqbal Assistant Professor, Department of Agronomy, Faculty of Agriculture, The University of Poonch,	Member

	Rawalakot, AJK,	
19.	Mr. Rabeel Bhatti Assistant Director (Curriculum), Higher Education Commission, Islamabad.	Coordinator

The following members attended the preliminary meeting only and could not attend the final meeting due to pre-occupation:

1.	Dr. Zammurad Iqbal Ahmed Professor, Department of Agronomy, PMAS Arid Agriculture University, Murree Road, Rawalpindi.	Secretary
2.	Dr. Muhammad Shafi Professor, Department of Agronomy The Agriculture University, Peshawar.	Member

The following members attended the final meeting only as special invitee and were not available in preliminary meeting:

1.	Prof. Dr. Abdul Khaliq Professor, Department of Agronomy, University of Agriculture, Faisalabad.	Member
2.	Dr. Muhammad Ashraf, Agronomist, Ex. Manager, Seeds Pioneer, Pak Seed Ltd, Lahore.	Member

The meeting started with recitation from the Holy Quran. Mr. Rabeel Bhatti, Assistant Director, Curriculum, Higher Education Commission (HEC), Islamabad welcomed the members on behalf of the Chairman, HEC. He briefed the members of the responsibilities of the Commission to review/revise the curriculum. He also informed the honourable members regarding the main purpose of revising the curriculum keeping in view the framework/scheme of studies for Bachelor, Master and Ph.D Degree programmes in the discipline of Agronomy. There was a deliberate discussion among the committee members on the preliminary draft prepared in its last meeting held on 09-11 October, 2017 at HEC Regional Center, Lahore. All those members who have already sent their inputs presented their drafts before the committee for further discussion. All queries and questions were satisfactorily answered by the respective expert members of the Committee.

Prof. Dr. Bashir Ahmad, briefed the participants that key objective of final NCRC is to devise a curriculum that provides a unified framework (guidelines) to institutions offering degrees under the title of Agronomy and also match the global modifications of the Agronomy. He further requested the committee that as Dr. Zammurad Iqbal Ahmed, Secretary NCRC could not attend the final NCRC meeting due to personal reasons, Dr. Aijaz Ahmad Soomro may be selected as a secretary of the committee for final NCRC. The house unanimously agreed and Dr. Aijaz Ahmad Soomro was selected as a Secretary of the committee for final NCRC.

The members focused on nomenclatures of various degree programmes, rationale and scope of Agronomy, titles of different courses offered during 4 years Bachelor programmes, credit hours, learning outcomes, and assessment criteria of Agronomy in different Universities of Pakistan. After detailed discussion and in depth analysis of framework/scheme of studies, Course Learning Outcomes (CLOs) and course contents; the curriculum was finalized for Bachelor of Agronomy.

On second day, courses developed/improved by individual members were presented. Each course was discussed in the whole group and with through discussion on course objectives, learning outcomes, contents, teaching methods, assessment and reference books were reviewed, revised and finalized. After thorough deliberation, preliminary draft curriculum of the undergraduate (4-years) programme prepared in the preliminary meeting for Agronomy was finalized.

On third day, Prof. Dr. Bashir Ahmad, Convener of the Committee, briefed the house about progress made on the previous day. The admission criteria and courses of Master program of Agronomy were reviewed by the committee with changes and addition of courses. Furthermore, it was decided that the university may offer the courses keeping in view their expertise and resources with HEC guidelines in consideration. It was decided that the zero final draft finalized during the meeting shall be circulated by the Secretary of the Committee for final review of all the respective members.

In the end, Mr. Rabeel Bhatti thanked the Convener, Secretary, Co-Secretary and all members of the Committee for sparing their time and for their contribution to prepare the revised draft of the curriculum. He further stated that their efforts will go a long way in developing workable, useful and market oriented comprehensive degree programme in Agronomy. The Convener of the NCRC also thanked the members for their inputs in revising/updating the curriculum to make it more practical, competitive, efficient and realistic. The committee highly appreciated the efforts made by the officials of HEC Regional Centre, Lahore for making arrangements to facilitate the committee and their accommodation and recreation tour. The meeting ended with the vote of thanks to HEC and Mr. Rabeel Bhatti and his team from HEC for providing this academic and professional opportunity for national cause.

The meeting ended with vote of thanks to and from the Chair.

RECOMMENDATIONS

The following recommendations are made for implementation of these schemes in the country:

1. The committee appreciates HEC's role in improvement of Higher Education in the country and recommends uniform implementation of its policies including work load and financial matters in all public sector universities.
2. The committee strongly recommends that mathematics/biology should be considered as deficiency courses and shall not be counted towards the total credit hours of the B.Sc. (Hons.) degree.
3. To strengthen the background of agriculture students in different specializations, it is proposed to allocate at least three foundation courses from agronomy during the first four semesters.
4. The course of crop physiology may be included in interdisciplinary foundation courses template.
5. It is recommended that periodic inter-university/inter-provinces visits of the faculty 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.
6. 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.
7. It is proposed to arrange refresher courses for the faculty at national/international level for effective delivery of new topics/courses amended by NCRC.
8. NCRC recommends to regularly hold meetings of all HODs (at least once in six months).
9. It has been observed that the students opt the major subject before entering the 3rd year. In this regard, they submit their options to the Deans themselves or the coordinator of the undergraduate programmes finalize the selection of students for each department. It is strongly recommended that the chairman of the department may finalize the selection of students on merit basis, because the chairman is dealing with such students in coming years. In this way departments will get rapid development smoothly. This policy should be applied in all agriculture universities to develop / create uniformity.

SUGGESTIONS

1. Higher Education Commission is requested to arrange a training of the in-service faculty through using the capabilities and expertise of the experts from public/private sector for the areas where universities feel deficiency.
2. HEC is requested to ensure availability of **at least 10 copies of all recommended books** to the departmental libraries of all the Agricultural Universities/Faculties/Colleges of the country and to improve the

- library/documentation** of the institutions.
3. 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.
 4. To improve the standard of the higher education at national level, the committee recommends that the appointment of local examiners within the city should be discouraged at MSc (Hons.)/MPhil degree programs.
 5. A final copy of the curriculum (2017) must be provided to at least every faculty member of agronomy all over the country.
 6. A viable mechanism for follow up of implementation of recommendations/suggestions should be developed.

STANDARDIZED TEMPLATE FOR 4-YEAR B.Sc.(HONS)/BS AGRICULTURE

		Credit Hours
1. Compulsory Courses		
	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	9(----)
	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)
	Crop Physiology	3(2-1)
	Agriculture Economics	3(2-1)
	Sub-Total	27
	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	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 Title		Credit Hours No.
AGR-001	Basic Agriculture	3(2-1)
AGR-002	Principles of Agronomy	3(2-1)
AGR-003	Field Crop Production-I	3(2-1)
AGR-004	Field Crop Production-II	3(2-1)
AGR-005	Arid and Rainfed Agriculture	3(2-1)
AGR-006	Farming system and Record Management	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	
	Climate change and crop production	3(2-1)
		3(2-1)
AGR-019	Forage and Fodder Production	
AGR-020	Organic Farming	3(2-1)
AGR-021	Coastal Agriculture management	3(2-1)
AGR-022	Introduction to Weed Science	3(2-1)
AGR-023	Crop Modelling	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	Production Technology of Condiments	
	and spices'	3(2-1)
AGR-028	Research Project Studies	4(0-4)
AGR-029	Internship*	4(0-4)

Note:

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

* 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 and background about Pakistan's Agriculture.

Learning Outcomes

After studying this course, the students will be able to:-

1. Define and describe the concept of agriculture, its branches and their relationship with allied disciplines.
2. Describe the significance of agriculture sector in the country's Economy
3. Understand the Agro-Ecological zones of Pakistan and the impact of climatic factors on agricultural productivity.
4. Measure land area and to demonstrate agriculture tools and implements

Course outline

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

Practical

- Land measuring units
- Demonstration of hand tools and tillage implements
- Identification of meteorological instruments
- Identification of crop plants, weeds and seeds
- Identification of organic and inorganic fertilizers
- Demonstration of various irrigation methods
- Field visits

Teaching Methodology

- Lecturing
- Home Assignments
- Field visits/work

Assessment

Mid Term

- Written (Long Questions, Short Questions, MCQs)
- Assignments/Quiz

Final Term

- Written (Long Questions, Short Questions, MCQs)
- Assignments/Quiz
- Practical work/Lab.

Recommended Books

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

AGR-002 PRINCIPLES OF AGRONOMY

3(2-1)

Objective

- To provide basic knowledge about principles and practices of agronomy

Learning Outcomes

After studying this course, the students will be able to:-

- Define and describe the scope of agronomy
- Understand the main principles of agronomy
- Apply the knowledge to interpret the different practices of field crop production
- Compare mono and multiple cropping, manures and fertilizers
- Evaluate the application and importance of agronomic principles in field crop management

Course outline

- Agronomy-definition and scope
- Principles of Agronomy
- Tillage: objectives and types, minimum and zero tillage and laser land levelling
- Use of improved seed, seed multiplication and distribution systems

- Nutrient management; manures and fertilizers, their classification, composition, methods of application
- Irrigation management; methods and scheduling. Water use efficiency
- Crop protection
- Harvesting, postharvest management and marketing
- Crop rotations and types; Mono vs multiple cropping
- Modern concepts in agronomy.

Practical

- Demonstration and use of tillage implements; Preparatory tillage, seedbed preparation and intercultural operations
- Seed purity analysis
- Identification of organic and inorganic fertilizers and manures; Calculation of nutrient cum fertilizer unit value
- Demonstration and layout of various irrigation methods
- Identification of crop pests; Visits to University farms

Teaching Methodology

- Lecturing
- Home Assignments
- Field visits/work

Assessment

Mid Term

- Written (Long Questions, Short Questions, MCQs)
- Assignments/Quiz

Final Term

- Written (Long Questions, Short Questions, MCQs)
- Assignments/Quiz
- Practical work/Lab.

Recommended Books

1. Balasubramaniyan. 2004. Principles and Practices of Agronomy. Agrobios, Jodhpur, India.
2. Khalil, I.A. and A. Jan. 2013. (4th print). Cropping Technology. National Book Foundation, Islamabad.
3. Kirkham, M.B. (Editor). 2004. Water Use in Crop Production. Narosa Publishing House Pvt. Ltd. New Delhi, India.
4. Martin, J.H. R.P. Waldren and D.L. Stamp. 2006. Principles of Field Crop Production 4th Ed. The McMillan Co., New York.
5. Nazir, M.S., E. Bashir and R. Bantel. (Eds.) 2013.(6th edition). Crop Production. Ed. E. Bashir & R. Bantel. National Book Foundation, Islamabad.
6. Reddy, T.Y. and G.H.S. Reddi. 2004. Principles of Agronomy. Kalyani Publishers, New Delhi.

7. Zimdahl, R. 2008. Fundamentals of Weed Science. 3rd Third edition. Academic Press, USA.

AGR-003 FIELD CROP PRODUCTION-I

3(2-1)

Objective

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

Learning outcome

Upon successful completion of the course, the students will be able to :

1. Acquire the basic knowledge of cropping pattern and cropping scheme and
2. understanding production technology of cereals, fibre, sugar crops and green manure crops.
3. Evaluate, analyse and solve the problems of these crops at farmer's field.
4. Demonstrate individually the stages of latest production technology.

Course outline

Theory

- Concept and classification of field crops
- Definition and differentiation of cropping intensity, cropping schemes and cropping patterns; Cropping patterns in different ecological zones
- Factors affecting cropping patterns.
- Production technology of cereals (wheat, barley, oats, triticale, rice, maize, sorghum and millets),
- Production technology of Fibre crops (Cotton, jute, sun hemp, dcan-hemp),
- Production technology of Sugar crops (Sugarcane and sugar beet),
- Production technology of green manure crops (Guar, Jantar, pigeon pea, senji etc.).

Practical

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

Teaching Methodology

- Lecturing
- Home Assignments

- Field visits/work

Assessment

Mid Term

- Written (Long Questions, Short Questions, MCQs)
- Assignments/Quiz

Final Term

- Written (Long Questions, Short Questions, MCQs)
- Assignments/Quiz
- Practical work/Lab.

Recommended Books

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

AGR-004 FIELD CROP PRODUCTION-II

3(2-1)

Objective

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

Learning outcome

Upon successful completion of the course, the students will be able to:

1. Acquire the basic knowledge of oilseed crops, legumes, forage crop and misc. crops
2. Understand the production technology of oilseed crops, grain legume, forage crop and misc. crops.
3. Evaluate, analyse and solve the problems of these crops at farmer's field.
4. Demonstrate individually the steps of latest production technology.

5. Apply the techniques and practices for enhancing crop productivity and seed inoculation of legumes

Course outlines

Theory

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

Practical

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

Methodology

- Lecturing
- Home Assignments
- Field visits/work

Assessment

- Mid Term
- Written (Long Questions, Short Questions, MCQs)
- Assignments/Quiz
- Final Term
- Written (Long Questions, Short Questions, MCQs)
- Assignments/Quiz
- Practical work/Lab.

Recommended Books

1. Baldev, B., S. Ramamjan and H.K. Jain. 1988. Pulse Crops. Oxford and IBH Pub. Co., New Delhi.
2. Martin, J.H. R.P. Waldren and D.L. Stamp. 2006. Principles of Field Crop Production 4th Ed. The McMillan Co., New York.

3. Nazir, M.S., E. Bashir and R. Bantel. (Eds.) 1994. Crop Production. National Book Foundation, Islamabad.
4. Rahman, A. and M. Munir. 1984. Rapeseed, Mustard Production in Pakistan, PARC, Islamabad.
5. Reddy, S.R. 2004 Principles of Crop Production. 2nd Ed. Kalyani Publishers New Delhi.
6. Wolfe, T.K. and M.S. Kipps. 2004. Production of Field Crop: A Textbook of Agronomy. McGraw-Hill Book Co. New York.

AGR-005 ARID AND RAINFED AGRICULTURE

3(2-1)

Objective

Learning Objective:

1. To enhance the crop productivity by utilizing the limited and unreliable moisture efficiently
2. To produce properly trained manpower with great emphasis on dryland agriculture.

Learning Outcomes:

Upon successful completion of this course, students will be able to:

1. Understand concept and causes of aridity
2. Differentiate/recognize climatic zones of Pakistan
3. Summarize the impact of different climatic factors on crop yield, Response of crop growth and yield to different levels of moisture supply.
4. Illustrate the Concept of Evapotranspiration and its relation with crop yield
5. Utilize the dry land farming through different tillage practices to conserve the moisture
6. Apply field practices for crop specie selection, use of fertilizer and moisture conservation, mulching Crop rotation and weed management, and crop residue management.

Course outlines

Theory

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

Practical

- Demonstration of rainwater harvesting and conservation techniques;

- Determination of soil moisture;
- Mulching and tillage practices for moisture conservation;
- Field visits.

Teaching Methodology

- Lecturing
- Home Assignments
- Field visits/work

Assessment

Mid Term

- Written (Long Questions, Short Questions, MCQs)
- Assignments/Quiz

Final Term

- Written (Long Questions, Short Questions, MCQs)
- Assignments/Quiz
- Practical work/Lab.

Recommended Books

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

AGR-006 FARMING SYSTEMS AND RECORD MANAGEMENT 3(2-1)

Learning Objective

To impart awareness regarding principles of farming systems and maintenance of farm records.

Learning Outcomes:

Upon successful completion of the course, the student will be able to:

1. Understand the fundamental principles of farming system and types of farming
2. Understand the concept of farm management and maintenance of farm records
3. Solve the problems of a farm and efficient utilization of available resources

4. Apply the acquired knowledge for economic management of farm resources, and record keeping

Theory

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

Practical

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

Teaching Methodology

- Lecturing
- Home Assignments
- Field visits/work

Assessment

Mid Term

- Written (Long Questions, Short Questions, MCQs)
- Assignments/Quiz

Final Term

- Written (Long Questions, Short Questions, MCQs)
- Assignments/Quiz
- Practical work/Lab.

Recommended Books

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

AGR-007 AGRO-TECHNOLOGY OF MAJOR CROPS

3(2-1)

Learning Objective

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

Learning outcomes

Upon successful completion of course, the students will be able to:-

1. Understand the importance of food security
2. Familiarize about major crops in depth
3. Know about biotic and abiotic factors affecting growth and yield of crops
4. Train in different specific practices for each major crop
5. Develop capability to grow these crops successfully under varying soil and environmental conditions
6. Able to address the problems of the crop growers of the region

Course outline

Theory

- Food security (food availability, access, nutritional security), from different angles (history, policy, agronomy, food aid, agri. food chains, GMOs, organic, etc.) and different scales (global, national, household, individual);
- Origin, history, morphology, adaptation, distribution, economic importance and agro-technology of major field crops such as
 - wheat
 - rice
 - maize
 - cotton
 - sugarcane
 - potato
 - special focus on regional crop
 - Management of irrigation
 - Timing of planting and harvesting

- Plant protection measures
- Manuring
- Postharvest handling
- Marketing, etc.
- Management constraints and technological measures to optimize crop productivity
- Modern techniques for crop improvement

Practical

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

Teaching Methodology

- Lecturing
- Home Assignments
- Field visits/work

Assessment

Mid Term

- Written (Long Questions, Short Questions, MCQs)
- Assignments/Quiz

Final Term

- Written (Long Questions, Short Questions, MCQs)
- Assignments/Quiz
- Practical work/Lab.

Recommended Books

1. Khalil I.A and A. Jan. 2002. Cropping Technology. National Book Foundation, Islamabad.
2. Khan, S. R. A. 2001. Crop Management in Pakistan with Focus on Soil and Water. Directorate of Agricultural Information, Punjab. Lahore.
3. Martin, J.H., R.P. Waldren and D.L. Stamp. 2006. Principles of Field Crop Production, 4th Ed., The Macmillan Co., New York.
4. Stoskopf, N.C. 1981. Understanding Crop Production. Reston. Pub. Co., Inc. Reston, Virginia.
5. Nazir, M.S., E. Bashir and R. Bantel. (Eds.) 1994. Crop Production. National Book Foundation, Islamabad

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

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

Theory

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

Practical

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

Recommended Books

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

AGR-009 FIED CROP PHYSIOLOGY**3(2-1)****1)****Learning Objective**

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

Learning Outcomes:

Upon successful completion of the course, students will be able to:

1. Understand the physiological processes in crops from germination to maturity.

2. Evaluate the sequence and change/response of physiological events resulting from environmental and exogenous and endogenous variations.
3. Analyse interaction of various components and functions of plant growth and development.
4. Provide exposure to crop anatomy and diversity.
6. Use of equipment for various physiological parameters

Course outline

Theory

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

Practical

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

Teaching Methodology

- Lecturing
- Home Assignments
- Field visits/work

Assessment

Mid Term

- Written (Long Questions, Short Questions, MCQs)
- Assignments/Quiz

Final Term

- Written (Long Questions, Short Questions, MCQs)

- Assignments/Quiz
- Practical work/Lab.

Recommended Books

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

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

Learning Objective:

To provide know-how about Plant nutrients and growth regulators.

Learning Outcomes:

Upon successful completion of the course, students will be able to:

1. Understand the nutrient requirement for various crops under normal and stressful conditions.
2. Describe the nutrient uptake, translocation and its assimilation.
3. Compare the efficacy of soil vs. foliar application in different crop plants.
4. Identify the deficiency symptoms, severity and correction.
5. Evaluate the physiological response of crops to exogenous application of growth regulators.

Course outline

Theory

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

Practical

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

Teaching Methodology

- Lecturing
- Topic Discussion
- Class Presentations
- Individual Assignments
- Practical demonstrations and performances

Assessment

Mid Term

- Written (Long Questions, Short Questions, MCQs)
- Assignments/Quiz

Final Term

- Written (Long Questions, Short Questions, MCQs)
- Assignments/Quiz
- Practical work/Lab.

Recommended Books

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 AREAS

3(2-1)

Objective

To educate students about moisture resource management in rainfed areas.

Theory

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

Practical

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

Recommended Books

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

AGR-012 BIOLOGICAL NITROGEN FIXATION

3(2-1)

Learning Objective

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

Learning Outcomes

Upon successful completion of the course, the students will be able to:

1. Acquire the basic knowledge of biological nitrogen fixation and its agents.
2. Understand mechanism and biochemistry of BNF.
3. Apply the biological nitrogen agents for enhancement of production of legumes and non legumes.

Course outline

Theory

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

- Physiological limitations and genetic improvements of biological nitrogen fixation;
- Possibilities of engineering non- legume plants for nitrogen fixation.

Practical

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

Teaching Methodology;

- Lecturing
- Written Assignments
-

Assessment;

- Mid-term test
- Assignments
- Attendance
- Final Exam

Teaching Methodology

- Lecturing
- Home Assignments
- Field visits/work

Assessment

Mid Term

- Written (Long Questions, Short Questions, MCQs)
- Assignments/Quiz

Final Term

- Written (Long Questions, Short Questions, MCQs)
- Assignments/Quiz
- Practical work/Lab.

Recommended Books

1. John L. H., J. D. Beaton, S. L. Tisdale, and W. L. Nelson. 2010. Soil Fertility and Fertilizers-An introduction to nutrient management, 7th edition. Pearson Prentice Hall, New Delhi, India.
2. Ross, C. W and F. B. Salisbury. 2011. Plant Physiology 5th Ed., Wadsworth Publ. Co., Belmont, California, USA.
3. Hansen, A.P. 1994. Symbiotic N₂ fixation of crop legumes. Margref verleg weikenheim, Germany.

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

AGR-013 SEED PRODUCTION TECHNOLOGY

3(2-1)

Learning Objective

1. To familiarize students about fundamentals of seed technology.
2. To enhance students' capability of understanding seed testing techniques

Learning Outcomes

After successfully completing this course, the students will be able to:-

1. Define and describe flower and seed structure and role of seed in Agriculture enterprise
2. Understand the basic principles of seed production system
3. Identify the different stages of seed development and understand the key physiological processes involved in germination and dormancy.
4. Conduct and evaluate seed quality tests using the appropriate methodology for the species given.

Course outline

Theory

- Introduction, concept and perspective of seed technology;
- Seed production terms their definition and types of seeds
- Origin of seed industry;
- Origin of new varieties, techniques of variety development and production
- Seed quality problems: Germination, stand failures, mixtures, weeds, genetics.
- Seed certification classes: Nucleusbreeder seed, pre-basic, basic, certified and approved class.
- Seed conditioning sampling, processing, drying, cleaning, grading, treatment,
- Seed viability and vigor: Their similarity and differences;

- Seed longevity and storage;
- Seed certification: Regulations schemes and field inspection;
- Seed distribution and marketing;
- Seed act and laws;
- Promotion of seed industry; biotechnology and seed development; Economic liberalization and seed trade.

Practical

- Seed identification and their structure
- Seed testing equipment
- Seed sampling techniques
- Purity analysis
- Seed moisture test
- Seed Viability test
- Germination test (Procedure and methods (Paper, Sand and Soil
- Seed vigour test (Conductivity test, Accelerated Ageing test, Tetrazolium test)
- Visit of seed production farms/ seed processing industry

Teaching Methodology

- Lecturing
- Home Assignments
- Field visits/work

Assessment

Mid Term

- Written (Long Questions, Short Questions, MCQs)
- Assignments/Quiz

Final Term

- Written (Long Questions, Short Questions, MCQs)
- Assignments/Quiz
- Practical work/Lab.

Recommended Books

1. Ahmad, S.I. 1992. Seed Certification Manual. National Book Foundation, Islamabad.
2. Anonymous. 1992. Proceeding of International Seminar on Seed, Fauji Fertilizer Company Ltd Rawalpindi.
3. Anonymous. 2001. A Dictionary of seed technological terms. Kalyani Publisher, India.
4. Basra, A.S. (Ed). 2006. Handbook of Seed Technology. Haworth Press New York, USA.
5. Copeland L.O. and M.F. McDonald. 2001. Principles of Seed Science and Technology – 4th Ed. Burgess Pub. Co., USA

6. ISTA. 1996. International rules for seed testing. Proceedings of International Seed Testing Association, Zurich.
7. Khare, D. and M.S. Bhale. 2000. Seed Technology. Sci. Pub., India.
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.

Learning Outcomes

Upon successful completion of this course, the students will be able to:-

- A. Acquire the basic knowledge and skill of planning an experiment.
- B. Design and layout of an experiment.
- C. Analyse the data statistically
- D. Acquire the skill of scientific writing and presentation

Course outline

Theory

- Concept of research, Scientific method and experiment
- Writing of research proposal/synopsis
- Writing objectives of an experiment
- Planning
- Selection of treatments and its levels
- Experimental designs and field layout
- Research trial observations
- Collection, and processing and statistical analysis of data
- Measures of experimental variability
- Interpretation and summarization of results
- Presentation of data in tables, graphs etc.
- Interpretation and summarization of results
- Presentation of data in tables, graphs etc.
- Types of scientific writing (Technical report, thesis, research paper)
- Scientific presentation
- Developing a research proposal/synopsis.

Practicals

- Writing of research proposal
- How to identify problem of research
- Layout of field experiments
- Collection, tabulation and analysis of data

- Presentation of data in tables, curves, histograms, etc.
- Writing of scientific paper/report.
- Statistical analysis of data and presentation Teaching

Methodology

- Lecturing
- Home Assignments
- Field visits/work

Assessment

Mid Term

- Written (Long Questions, Short Questions, MCQs)
- Assignments/Quiz

Final Term

- Written (Long Questions, Short Questions, MCQs)
- Assignments/Quiz
- Practical work/Lab.

Recommended Books

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

AGR-015 CONSERVATION AGRONOMY

3(2-1)

Objective

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

Learning outcomes

After studying this course, the students will be able to:-

1. Understand the soil and water conservation
2. design strategies to conserve the soil and water
3. Learn about reclamation of problem soils and field drainage

4. Recognize water shed management and soil fertility improvement
5. familiarize with crop residue management on sustain basis

Course outline

Theory

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

Practical

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

Teaching Methodology

- Lecturing
- Home Assignments
- Field visits/work

Assessment

Mid Term

- Written (Long Questions, Short Questions, MCQs)
- Assignments/Quiz

Final Term

- Written (Long Questions, Short Questions, MCQs)
- Assignments/Quiz
- Practical work/Lab.

Recommended Books

1. Hudson, N.W. 2004. Soil and water conservation in semi-arid areas. Scientific Publishers, India.
2. Kirkham, M.B. (Editor). 2004. Water Use in Crop Production. Narosa Publishing House Pvt. Ltd. New Dehli, India.
3. Maloo, S.R. 2002. Sustainable Crop Production under stress environments. Agro-tech Publishing Academy, Udaipur.

4. Chandrasekaran,B.,K. Annadurai and E. Somasundaram. 2010. A Textbook of Agronomy. New Age International Publishers. New Delhi, India.
5. Nazir, M.S., E. Bashir and R. Bantel. (Eds.) 1994. Crop Production. National Book Foundation, Islamabad.

AGR-016 AGRO ECOLOGY

3(3-0)

Objective

To inculcate understanding about ecological principles for sustainable cropping systems.

Learning outcomes

After the completion of this course, students will be able to;

1. Know the components of eco-systems
2. Describe relationship between plants and ecosystems
3. Understand food web
4. Illustrate cycling of water and Co₂ in a cultivated ecosystem
5. Assess the effects of biotic and abiotic factors on crops yield
6. Apply principles of ecology to enhance the crop productivity.

Course outline

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.

Teaching Methodology

- Lecturing
- Home Assignments
- Field visits/work

Assessment

- Mid Term
- Written (Long Questions, Short Questions, MCQs)

- Assignments/Quiz

Final Term

- Written (Long Questions, Short Questions, MCQs)
- Assignments/Quiz
- Practical work/Lab.

Recommended Books

1. Hussain, S.S. 2003. Manual of Plant Ecology. National Book Foundation, Islamabad.
2. Kapur, P. and R.G. Sudha. 2000. Experimental Plant Ecology. CBS Publishers and Distributors, New Delhi.
3. Brown C.S. and T. Toadwine (eds.) 2007. Nature's Edge- Boundary Explorations in ecological theory and practice. State University of New York Press, Albany, USA.
4. Shukla, R. S. and P. S. Chandel, 2006. A Textbook of Plant Ecology. S. Chand & Co. Ltd. New Delhi, India.
5. Townsend, C.R., Harper, J.L. and M.E. Bego. 2000. Essentials of Ecology. Blackwell Scientific Publications, UK.

AGR-017 IRRIGATION AGRONOMY

3(2-1)

Learning Objectives

- To provide knowledge about the irrigation principles and strategies for improving water use efficiency

Learning Outcomes

Upon successful completion of the course, the students will be able to:-

1. Describe the irrigation agronomy
2. Understand the sources of irrigation water and irrigation water losses
3. Choose suitable irrigation method
4. Devise irrigation scheduling for different field crops
4. Compare different water management practices

Course outline

Theory

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

Practical

- Estimation of potential evapotranspiration by different m

Teaching Methodology

- Lecturing
- Home Assignments
- Field visits/work

Assessment

- Mid Term
- Written (Long Questions, Short Questions, MCQs)
- Assignments/Quiz

Final Term

- Written (Long Questions, Short Questions, MCQs)
- Assignments/Quiz
- Practical work/Lab. methods;
- Calculation of water use efficiency in field crops;
- Potential soil moisture deficit and its calculation.

Recommended Books

1. Ali, M. H. 2010. Fundamentals of Irrigation and On-farm Water Management. Vol. 1, Springer, New York, USA.
2. Ali, M. H. 2011. Practice of irrigation and on-farm water management volume 2, Springer, New York, USA.
3. Choudhary, M. R. 2009. A Text book of irrigation and Drainage Practices for Agriculture. University of Agric. Faisalabad, Pakistan.
4. Kirkham, M.B. (Editor). 2004. Water Use in Crop Production. Narosa Publishing House Pvt. Ltd. New Delhi, India.
5. Michael, M.A. 2003. Irrigation Theory and Practice. Vikas Publishing House Pvt. Ltd., New Delhi. India.
6. Sankara, R. G. H. and T. Y. Reddy. 2002. Efficient Use of Irrigation Water. Kalyani Publishers New Delhi, India

AGR-018 ENVIRONMENT AND CROP PRODUCTION

3(2-1)

Objective

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

Theory

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

Practical

Measurement and estimation of different environmental variables;
Calculations of potential evapotranspiration and different drought indices;

Estimation of radiation interception and its use efficiency in field crops.

Recommended Books

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

AGR-019 FORAGE AND FODDER PRODUCTION

3(2-1)

Learning Objective

- To enhance skills of students for fodder production and productivity of pastures and its preservation.
- To familiarize and enhance the understanding of fodder preservation techniques.

Learning Outcomes

After studying this course, the students will be able to:-

1. Define and describe the terms of forage and fodder.
2. Understand the basic principles of sustainable forage production.
3. Learn and apply the practical knowledge of hay and silage preparation.
4. Comparatively evaluate pastures and rangeland management.

Course Outline:

- Importance of forages and fodders
- Terminology and taxonomy of forage and fodder crops
- Forage production in Pakistan-current status and future scenario
- Agro-technology techniques for production of of legume/non-legumes forages and fodders for sustainable forage production
- Rangeland status, increasing productivity of pastures and range lands

- Seed production of forages
- Nutrient management in fodders/forages
- Forage quality-its status and improvement
- Fodder/forage production constraints and remedies
- Fodder preservation (hay and silage).
- Fodder research studies in Pakistan.
- Use of alternate forage resources for ruminant production

Teaching Methodology

- Lecturing
- Written Assignments
- Lab work

Assessment

Mid Term (40%)

- Written (Long Questions, Short Questions, MCQs) 50%
- Presentation 20%
- Assignments/Lab work 20%

Final Term (60%)

- Written (Long Questions, Short Questions, MCQs) 50%
- Presentation 20%
- Assignments/Lab work 20%
- Term Project 10%

Lab Outline:

- Identification of fodder/forage crops and seed
- Estimation of sprout density and plant population
- Silage and hay making practices
- Preparation of fodder calendar
- Determination of forage quality parameters
- Quality analyses of forages
- Visits of university farms.

AGR-020 ORGANIC FARMING

3(3-0)

Learning Objectives

- To familiarize students with the concept of organic farming and its field application
- To explore the modern techniques in organic farming

Learning Outcomes

After studying this course, the students will be able to :-

1. Define basic terminologies regarding organic farming
2. Understand the concept, history, and principles of organic farming
3. Compare organic farming and inorganic farming

4. Identify various techniques to prepare organic fertilizers and natural products to control crop pests
5. Analyze organic food for quality and quantity

Course Outline:

- Concept and terminology of organic farming
- Quality of food and crop productivity under natural ecological systems
- Principles of organic agriculture

Improvement of soil health and organic matter

- Merits and demerits-organic and inorganic farming
- Components of organic farming (crop rotation, maintenance and enhancement of soil fertility through biological nitrogen fixation, addition of organic manure and use of soil microorganisms, crop residues, bio-pesticide, biogas slurry, waste etc)
- Maintenance of buffer zone
- Natural products for control of crop pests (weeds, insects and diseases).

Practical

- Preparation of organic manures-humus, sewage sludge, organic compost; Farm waste recycling, organic mulches, bio-fertilizers, etc
- Application Identification of different organic sources of nutrients application including green manuring, crop residue incorporation, etc.
- Methods used to control weeds, insects and crop disease using cultural practices / organic products

Recommended Books

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

AGR-021 COASTAL AGRICULTURE**3(2-1)****Objective**

- To educate students about potential of agriculture in coastal areas
- To explain the plant biodiversity present in coastal areas
- To give awareness about production techniques of crops on coastal land

Learning outcomes

- To identify the crops and plants successfully cultivated on saline soils. gain knowledge about biochemical and agronomic potentials of selected plant species on coastal areas
- To learn cultivation techniques and practices for crop production on coastal areas

Theory

Coastal agriculture and its scope; Farming trends in coastal areas of Pakistan; Saline agriculture, halophytes and their classification; Coastal land management; Agronomic techniques for use of sea water;

Production and processing of coastal and biofuel crops; Post harvest techniques.

Practical

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

Recommended Books

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)****Theory**

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

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

Practical

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

Recommended Books

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

AGR-023 CROP MODELING

3(2-1)

Objective

1. To introduce students with basics of crop modeling
2. To familiarize students with the application of crop modeling for crop improvement and future predictions

Learning Outcomes:

Upon successful completion of the course, the student will be able to:

1. Understand concepts and significance of crop modeling, and components of a model
2. Use Decision Support System for Agro-technology Transfer (DSSAT) and APSIM
3. Apply crop models for crop improvement and risk assessment

Course outline:

Theory:

- History and introduction of crop growth modeling
- Fundamental concepts of crop modeling, their importance and uses
- Introduction to Decision Support System for Agro-technology Transfer **(DSSAT)**
- Components of a model
- Input data set for different models

- Modelling and crop improvement
- Modelling a tool for future predictions

Practical:

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

Teaching Methodology

- Lecturing
- Written Assignments
- Guest Speaker
- Field Visits
- Practical note book/work

Assessment

Mid Term (40%)

- **Written (Long Questions, Short Questions, MCQs)**
- **Assignments/Quiz**

Final Term (60%)

- Written (Long Questions, Short Questions, MCQs)
- Assignments
- Practical work/Lab

Text and Reference books:

1. Cao, W., J.W. White and E. Wang. 2009. Crop Modeling and Decision Support. Springer, Heidelberg, Germany.
2. Floor, M.B. and M. van Ittersum. 2010. Environmental and Agricultural Modelling: Integrated Approaches for Policy Impact Assessment. Springer, Heidelberg, Germany.
3. Singh, P. 2008. Modeling Crop Production Systems: Principles and applications. Science publishers. Enfield, New Hampshire 03784.USA.
4. Vohnout, K.D. 2003. Mathematical modeling for System Analysis in Agricultural Research. Elsevier Sci. Amsterdam, The Netherlands.
5. Wallach, D., D. Mackowski, J.W. Jones. 2006. Working with Dynamic Crop Models Evaluation, Analysis, Parameterization, and Applications. Elsevier Sci. Amsterdam, The Netherlands.

Recommended Books

1. Cao, W., J.W. White and E. Wang. 2009. Crop Modeling and Decision Support. Springer, Heidelberg, Germany.
2. Singh, P. 2008. Modeling Crop Production Systems: Principles and applications. Science publishers. Enfield, New Hampshire 03784.USA

3. Sivakumar, M. V. K. and R. P. Motha. 2007. Managing Weather and Climate: Risks in Agriculture. Springer, Berlin, Heidelberg, New York.
4. Sivakumar, M. V. K. and J. Hansen. 2007. Climate Predictions and Agriculture. Springer, Berlin, Heidelberg, New York.

AGR-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. Learning Outcomes

After studying this course, the students will be able to:-

1. Define and describe crop productivity, environment and its components.
2. Understand the stressful environments under field conditions.
3. Understand modifications in growth and development under biotic and abiotic stresses.
4. Apply approaches for ameliorating the effects of stress on crop production
5. Components of crop productivity;
6. Crop environment and its components;
7. Environmental optima for crop growth and development;
8. Concept of stress and stressful environments under field conditions;
9. Modifications in growth and developmental patterns of crop plants under biotic and abiotic stresses;
10. Approaches for ameliorating the stress effects for crop production.

Teaching Methodology

- Lecturing
- Written Assignments
- Lab work

Assessment

- Sessional (25%)
- Presentation 50%
- Assignments/Lab work 50%

Mid Term (25%)

- Written (MCQs, Short Questions-Long Questions) 60-40%

Final Term (50%)

- Written (Long Questions, Short Questions, MCQs) 50%
- Presentation 20%
- Assignments/Lab work 20%
- Term Project 10%

Lab Outline

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

Recommended Books

1. Mohammad Pessarakli (2010) Handbook of Plant and Crop Stress, Third Edition (Books in Soils, Plants, and the Environment) 3rd Edition, CRC Press, Taylor and Francis Group.
2. Arnon, I. 1992 Agriculture in Drylands: Principles and Practices. Elsevier, Amsterdam.
3. Nosberger, J.H. H. Geiger and P.C. Struik. 2001. Crop Science Progress and Prospects. CABI Pub., Oxon, UK.
4. Pessarakli, M. A. 2000. A Hand Book of Stress Physiology, Marker and Deekar.
5. Taize, L., E. Zeiger. 2006. Plant Physiology. Sinauer Pub. U.S.A.

AGR-025 MEDICINAL AND SPECIAL CROPS

3(2-1)

Objective

To introduce a production technology for medicinal and special purpose crops

Theory

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

Practical

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

Recommended Books

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

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

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

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

Objective

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

Learning outcomes

After studying this course, the students will be able to:-

- Understand the importance of soil and plant analysis
- Familiar with lab equipment used for soil and plant analysis
- Perform analytical work
- Formulate the fertilizer recommendations for different crops on the basis of soil/ plant nutrient status

Course outline

- Importance of soil and plant analysis
- Introduction of different lab equipment
- Procedures of soil and plant samples collection
- Preparation of soil and plant samples for analytical work
- Preparation of solutions of known concentrations-normal, molar, molal, ppm, etc.; Preparation of stock solutions for drawing standard curves
- Estimation of EC, pH, N, P, K, Na, Ca, Mg organic matter, etc.

Practical

- Demonstration of analytical methods in the laboratory
- Recording data
- Computation work and recommendations

Recommended Books

1. Basak, R.K. 2004. Soil Testing and Recommendation. Kalyani Publisher, New Delhi.
2. Hussain, T. and A. Jabbar. 1985. Soil and Plant Analysis. Department of Soil Science, University of Agriculture, Faisalabad.
3. Ryan, J., G. Estefan and A. Rashid. 2001. Soil and Plant Analysis Laboratory Manula. 2nd Ed., ICARDA, Aleppo, Syria and NARC, Islamabad, Pakistan.

4. Tandon, H.L.S (Ed.). 2001. Methods of Analysis of Soils, Plants, Waters and Fertilizer. Development and Consultation Organization, New Delhi, India.
5. Westerman, R.L. (Ed.). 1990. Soil Testing and Plant Analysis. 3rd Ed. Soil Sci. Am. Inc., Madison, WI, USA.
6. Jones, J. Benton. 2012. Plant Nutrition and Soil Fertility Manual. 2nd Ed. CRC Press. Taylor & Francis, London. UK.

Objective

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

Theory

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

Practical

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

Recommended Books

1. Basak, R.K. 2004. Soil Testing and Recommendation. Kalyani Publisher, New Delhi.
2. Hussain, T. and A. Jabbar. 1985. Soil and Plant Analysis. Department of Soil Science, University of Agriculture, Faisalabad.
3. Ryan, J., G. Estefan and A. Rashid. 2001. Soil and Plant Analysis Laboratory Manula. 2nd Ed., ICARDA, Aleppo, Syria and NARC, Islamabad, Pakistan.
4. Tandon, H.L.S (Ed.). 2001. Methods of Analysis of Soils, Plants, Waters and Fertilizer. Development and Consultation Organization, New Delhi, India.
5. Westerman, R.L. (Ed.). 1990. Soil Testing and Plant Analysis. 3rd Ed. Soil Sci. Am. Inc., Madison, WI, USA.
6. Jones, J. Benton. 2012. Plant Nutrition and Soil Fertility Manual. 2nd Ed. CRC Press. Taylor & Francis, London. UK.

AGR-027 PRODUCTION TECHNOLOGIES OF CONDIMENTS AND SPICES

3(2-1)

Objective

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

Theory

Concept and scope of condiments and spices; their classification and value addition; Production technology for: condiments (chillies, onion, garlic, ginger and

turmeric) and spices (cumin seed, ajwain, fenu greek, fennel, kaloongi, coriandar, mint and black cumin).

Practical

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

Rcommended Books

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

AGR-028 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-029 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 PHD 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-Bashir	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 and Environment	3(3-0)
AGR-711	Crop Management on Problem Soils-Rash	3(3-0)
AGR-712	Advanced 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-Ghuman	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 of Plant	3(2-1)
AGR-726	Weed Management	3(2-1)
AGR-727	Climate Change and Agriculture	3(3-0)
AGR-728	Postharvest Technology of Crops	3(2-1)
AGR-729	Special Problem	1(0-1)
AGR-730	Seminar	1(0-1)
AGR-731	Thesis MSc (Hons.) Agronomy	6(0-6)
AGR-732	Thesis PhD Agronomy	12(0-12)

Note: Universities/Faculties/Colleges may adopt their own system for course numbers and credit hours for different courses selected/qualified for MSc (Hons) Agronomy will not be permitted to take again in PhD.

DETAIL OF COURSES FOR MS/MSC (HONS.) AND PHD IN AGRONOMY

AGR-701

ADVANCED AGRONOMY

3(2-1)

Objective

To deeply understand modern concepts of crop growth, phenology and development of plants under varying environments

Learning outcomes

After studying this course, the students will be able to:-

- Understand phenological development of crop plants
- Know effects of photosynthesis and respiration on plant growth and development
- Analyze crop growth and its application in agronomy
- Measure radiation use efficiency

Course outline

- 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 fitting 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

Recommended Books

1. Coombs, J., D.O. Hall, S.P. Long and J.M.O. Scurlock. 1987. Techniques in Bioproductivity and Photosynthesis, 2nd Ed. Pergamon Press, Oxford.
2. Hay, R.K.M. and J.R. Porter. 2006. The Physiology of Crop Yield. 2nd Ed. Wiley-Blackwell.

3. Hunt, R. 1978. Plant Growth Analysis. Edward Arnold, London.
4. Hunt, R. 1982. Plant Growth Curves: An Introduction to the Functional Approach to Plant Growth Analysis. Edward Arnold, London.
5. Gupta, U.S. 1992. Crop Improvement. Vol-I. Physiological Attributes. Oxford and IBH Pub. Co. Pvt. Ltd., New Delhi.

AGR-702

APPLIED CROP ECOLOGY

3(3-0)

Objective

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

To impart comprehension about ecological optima in relation to sustainable food and feed production

Learning outcomes

- Define and describe dynamics of agro-ecosystems.
- Explain ecological features of intensive agriculture.
- Adopt suitable approaches to reduce soil and water pollution under different farming systems.
- Perceive ecological optimization to sustain crop productivity.
- Integrate various farm operations to protect biodiversity

Theory

Ecosystem concepts; Dynamics of Agro-ecosystems; Ecology of crop plant domestication; Ecological risk assessment, Ecological evaluation of different farming systems; Ecological characteristics of intensive agriculture with special reference to environmental pollution; Air pollution; noise pollution; Insecticide pollution, Nuclear pollution, Soil pollution; Pollution due to socio economic factors; Crop productivity and ecological optima; Biodiversity and its ecological role in agro-ecosystems; Ecology of economic crops, oil seed crops, pulses & misc. crops, sugar crops, etc.

Recommended Books

1. Allaby, M. 2000. Basics of Environmental Science. Rutledge, London.
2. Fitter, A.H. and R.K.M. Hay. 2002. Environmental Physiology of Plants. 3rd Ed. 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 Delhi.
5. Kumar, H.D. 1994. Modern Concepts of Ecology. 7th Ed. Vikas Pub. House New Delhi.
6. Larcher,W. 1995. Physiological Plant Ecology. Ecophysiology and Stress Physiology of Functional Groups. Springer Verlag, Berlin.

7. Schulze, E. B. and K. Muller-Hohenstein. 2005. Plant Ecology. State University of New York.
8. Tivy, J. 1990. Agricultural Ecology. Longman Group U.K. Ltd. Essex
9. Environmental protection act of Pakistan.

AGR-703 ADVANCED IRRIGATION AGRONOMY 3(2-1)

To impart better understanding of estimation/measurement of environment variables used in irrigation scheduling

Objective

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

Learning Outcomes

After studying this course, the students will be able to:-

1. Describe the relationship between irrigation and crop yields
2. Plan suitable irrigation schedules for field crops under different moisture regimes and prevailing weather conditions
Modify irrigation use with respect to the prevailing weather conditions
3. Use Make use of the drought stress indices for their research endeavors
4. Compare Evaluate the crop growth and yield response under varying irrigation regimesto total water received and drought
5. Interpret the criteria for drought resistance

Course Outlines

- Relationship between irrigation and crop yields
- Effects of irrigation water quality on crop growth and development
- Impact of weather conditions on irrigation scheduling
- Methods of irrigation scheduling
- Moisture sensitive periods
- Indices of drought: Stress degree days, canopy temperature variability; Crop water stress index; maximum allowable depletion, etc.
- Response of yield to irrigation
- Penman's irrigation-yield response analysis
- Concept of potential soil moisture deficit and limiting deficit
- Crop response to total water received and drought
- Criteria for drought resistance
- Concept of lost time for growth and crop yield
- Water use efficiency and factors affecting it.

Recommended Books

1. Ali, M. H. 2010. Fundamentals of Irrigation and On-farm Water Management: Volume 1. Springer, New York.

2. Ali, M. H. 2011. Practices of Irrigation and On-farm Water Management: Volume 2. Springer, New York.
3. Choudhary, M. R. 2009. A Text book of Irrigation and Drainage Practices for Agriculture. University of Agric. Faisalabad, Pakistan.
4. Kirkham, M.B. (Editor). 2004. Water Use in Crop Production. Narosa Publishing House Pvt. Ltd. New Delhi, India.
5. Michael, M.A. 2003. Irrigation Theory and Practice. Vikas Publishing House Pvt. Ltd., New Delhi. India.
6. Sankara, R. G. H. and T. Y. Reddy. 2002. Efficient Use of Irrigation Water. Kalyani Publishers New Delhi, India

AGR-704 AGRO-ENVIRONMENT CONSERVATION

3(3-0)

To enhance the understanding of environmental degradation and conservation through integrated approaches.

Learning Outcomes:

After successful completion of the course, students will be able to:-

1. Describe impact of agricultural practices and industrial/municipal wastes on the environment and ecosystem.
2. Develop strategies to minimize degradation of environment and ecosystem resulting from agro-chemicals and industry.
3. Understand the rules and regulations of environment conservation

Theory

Agro-chemicals: use, abuse, uptake, persistence, degradation and residual effects on ecosystem; 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. rules and regulations of environment conservation, EPA rules

Recommended Books

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. (Editor). 2004. Water Use in Crop Production. Narosa Publishing House Pvt. Ltd. New Delhi, India.
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.

Objective

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

Theory

Scope of agricultural meteorology; Agricultural zones of Pakistan; Crop adaptation and distribution in relation to climate; Crop weather-relationships regarding crop growth and yield formation; Diurnal and seasonal variation in photoperiod and light integral; Atmospheric pollution and plant productivity; Climate change and its potential effects on crop production; Weather and pests of crops; Crop monitoring and forecasting; Drought monitoring and planning for mitigation; Remote sensing; Geographical Information System (GIS); Global Positioning System (GPS) and their application in agricultural meteorology; Use of climate information to improve agricultural productivity.

Recommended Books

1. Ahrens, C. D. 2008. Meteorology Today Brooks/Cole Cengage Learning, Belmont, USA.
2. Brunt, D. 2007. Meteorology. Oxford University Press. UK.
3. Hall, A. E. 2001. Crop responses to environment. CRC Press. LLC, 2000 N.W. Corporate Blvd., Boca Raton, Florida 33431. USA.
4. Mavi. H.S. and G.J. Tupper. 2005. Agro-meteorology; Principles and applications of climate studies in agriculture. International Book Distributing Co. Charbagh, Lucknow 226004 U.P. India.
5. Panda, B.C. 2009. Remote Sensing; Principles and Applications. Viva Books Pvt. Ltd. 4737/23, Ansari road, New Delhi-110002. India.
6. Prasada, Rao, G.S.L.H. 2008. Agricultural Meteorology. Printice Hall of India, New Delhi.

Learning outcomes

After studying this course, the students will be able to:-

1. Describe allelopathy and types of allelochemicals.
2. Comprehend the mechanism of allelochemicals production, translocation and mode of action.
3. Understand the utilization of allelochemicals in enhancing crops production
4. Acquire the skills of allelopathic extracts preparation and its application

Objective

To educate students about allelopathic phenomena and its utilization in agro-ecosystem for sustaining productivity of crops.

Theory

Concept and history of allelopathy; 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 systems; 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.

Recommended Books

1. Gliessman, S. R. 2007. Field and Laboratory Investigations in Agroecology (2nd Ed.). 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.
6. 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)

Learning Objective

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

Learning outcomes

After studying this course, the students will be able to:-

- Understand the objectives and principles of resources with their judicious use and conservation
- Explain advance methods of conservation in different farming system
- Use of conventional and modern techniques like biological conservation and farm machinery
- Apply the acquired knowledge to conserve resources with respect to climate change

Theory

Principles, objective and types; Water resources, their conservation and economic use in irrigated and non-irrigated regions; Modern conservation practices in irrigated and non-irrigated areas; Integrated resource conservation in different farming systems; Conservation agronomy and climate change; Use of farm machinery in conservation techniques; Conservation structures; Biological conservation; Recent developments in the field of conservation agronomy.

Recommended Books

1. Arnon, I. 1992. Agriculture in drylands—principles and practices. Elsevier, Amsterdam.
2. Govindan, K. and V. Thirumurugan. 2003. Principles and Practices of Dryland Agriculture. Kalyani Publishers, New Delhi, India
3. Gurmel, S., C. Venkatarmanan, G. Sastry and B.P. Joshi. 1990. Manual of Soil and Water Conservation Practices. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
4. Hudson, N.W. 2004. Soil and Water Conservation in Semi-arid Areas. Scientific Publishers, India.
5. Kirkham, M.B. (Editor). 2004. Water Use in Crop Production. Narosa Publishing House Pvt. Ltd. New Delhi, India.
6. Maloo, S.R. 2002. Sustainable Crop Production under Stress Environments. Agro-tech Publishing Academy, Udaipur.

AGR-708

ARID ZONE AGRONOMY

3(3-0)

Objective

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

Learning Objective:

- To understand the problem, limitation and their solution in the arid zone agriculture.
- To explore the potential of Arid area and its contribution in national crop production.

Learning Outcomes:

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

- Characterize the features of Arid Agriculture
- Apply the techniques to address the constraints and problems of Arid zone agriculture.
- Manage the dry spell period during the crop growth.
- Recommend practices for moisture conservation, water shed management

and sustainable crop production in dry land Agriculture.

Theory

Constrains and techniques of arid agriculture; Characteristics of dry land agriculture; Problems, prospects and strategies of dry land agriculture; Moisture availability index; Aridity index; Moisture deficit index; Agronomic approaches for dry land agriculture (tillage requirement, selection of most adaptive crops, sowing of crops, cropping pattern, pasture management, cropping plans to meet the weather conditions, weed control, plant protection measure); Managing dry spells during crop periods, Lay farming for non-arable lands; Recommendations for dry farming areas; Plant adaptation to water stress; Soil and rainfall characteristics in dry land farming; Soil and moisture conservation techniques; Water shed management; Water harvesting; Sustainable dry land crop production.

Recommended Books

1. Balasubramaniyan, P. and SP. Palaniappan. 2005. Principles and Practices of Agronomy. Agrobios, Jodhpur, India.
2. Govindan, K. and Thriumurugam. 2003. Principles and Practices of Dry Land Agriculture. Kalyani Publishers, New Delhi, India.
3. Panda, S.C. 2005. Agronomy. Agrobios, Jodhpur, India.
4. Reddy, S.R. 2004. Principles of Crop Production. Kalyani Publishers, New Delhi, India.
5. Arnon, I. 1992. Agriculture in drylands—principles and practices. Elsevier, Amsterdam.
6. Shaw, T. 2010. Dryland Farming. Nabu Press, USA.
7. Chandrasekaran, B.,K. Annadurai and E. Somasundaram. 2010. A Textbook of Agronomy. New Age International Pub., New Delhi, India.

AGR -709

BIOLOGICAL CROP POTENTIAL

3(2-1)

Objective

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

Learning Outcomes

After studying this course, the students will be able to:-

1. Understand modern concepts of biological crop potential
2. Describe the relationship between agro-physiological factors and potential yield of crop
3. Collect and analyse the data of growth parameters of crop
4. Examine the determinants of crop growth
5. Analyze the relationship between crops and environment

Theory

Concept of biological crop potential; Agro-physiological factors limiting yield potential of crops; Ecological optima in relation to crop productivity; Blackman's principle of limiting factor; Determinants of crop growth; Components of plant leaf

area expansion, crop canopy development, canopy architecture and interception of solar radiation; Potential for increasing photosynthetic efficiency; Dry-matter partitioning; Modern agro-physiological techniques for harvesting maximum potential of field crops; Crop plants in relation to environment.

Practical

Collection of data pertaining to actual and potential yields of various crops/varieties; Determination of leaf area and dry weight of field crops to calculate relative growth rate, net assimilation rate, etc. Determination of leaf area index, leaf area duration and harvest index of various field crops. Comparative study of crop canopy development in cereals, oilseeds and grain legumes.

Recommended Books

1. N. R. Das, 2008. Tillage and Crop Production. Sci. Pub., India.
2. Premjit Sharma, 2007. Precision Farming. Gene Tech Book, New Delhi, India
3. M. A. Khan, 2012. Water Resources Management and Sustainable Agriculture.
4. John H. Martin, Richard P, Waldren and David L. Stamp, 2006. Principles of Field Crop Production 4th Ed. The McMillan Co., New York

AGR-710 CROP AND ENVIRONMENT

3(3-0)

Objective

To broaden the understanding of relationships between crop and environment.

Learning outcome

1. Understand the environmental physiology and its impact on crop production
2. Explain global warming and greenhouse effects on plant growth and development
3. Elaborate environmental pollution and energy exchange by plants in ecosystem
4. Manage crop production under different environmental conditions.

Course outline

Theory

- Crop environment, components, determinants and their role in crop productivity; Microclimate in relation to crop management; Global warming and green house effects; Environmental pollution and plant growth; Energy exchange by plants in ecosystem; Evapotranspiration and its reduction approaches; Antitranspirants, reflectants; Plant physiological aspects and plant architecture.

Recommended Books

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.

Learning outcome

Upon successful completion of the course, student will be able to:-

1. Understand the problem soils and their types
2. Manage different types of problem soils
3. Apply different crop management practices to reduce the intensity of problem soils

Course outline

Theory

- Concept and perspective of crop productivity in eroded, salt affected, water deficit and water-logged soils;
- their improvement and reclamation;
- Site specific cultural practices;
- Fertilizer and irrigation adjustments;
- Specific cropping patterns and crop management practices for economic crop production in problem soils;
- Demonstration of degraded soils

Teaching Methodology

- Lecturing
- Home Assignments
- Field visits/work
- Assessment
- Mid Term
- Written (Long Questions, Short Questions, MCQs)
- Assignments/Quiz
- Final Term
- Written (Long Questions, Short Questions, MCQs)

- Assignments/Quiz

Recommended Books

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 enhance the knowledge of crop modeling and its application in agriculture.

Learning Outcomes:

Upon successful completion of the course, the student will be able to:

1. Understand components of crop modeling,
2. Use different models (DSSAT, APSIM and AQUACROP)
3. Integrate crop models with remote sensing and GIS
4. Apply modelling for crop improvement and predictions

Theory

Philosophy and terminology of system science, scope of system analysis; Crop modeling, concept and types of models, specification and uses; Statistical parameters in modeling; Parameterization and evaluation of crop models; Model application in crops, soil, water and agrometeorology; Modeling for crop improvement and risk assessment; Crop models application in research, education and extension; Integration of crop models with GIS and remote sensing.

Practical

Working with different models like DSSAT, APSIM, AQUACROP; Setting of appropriate coefficients for cultivars, calibration, evaluation and validation; Preparation of different input files; crop management, and experimental data files; Preparation of weather and soil files; Working with sequence, seasonal, economic analysis, easy grapher, etc.

Recommended Books

1. Cao, W., J.W. White and E. Wang. 2009. Crop Modeling and Decision Support. Springer, Heidelberg, Germany.
2. Floor M. B. and M. van Ittersum. 2010. Environmental and Agricultural Modeling: Integrated Approaches for Policy Impact Assessment, Springer, Heidelberg, Germany.
3. Singh, P. 2008. Modeling crop production systems: Principles and applications. Science publishers. Enfield, New Hampshire 03784.USA.

4. Vohnout, K. D. 2003. Mathematical modeling for system analysis in agricultural research. Elsevier Sci., Amsterdam, The Netherlands.
5. Wallach, D., D. Makowski, J.W. Jones. 2006. Working with Dynamic Crop Models Evaluation, Analysis, Parameterization, and Applications. Elsevier Sci., Amsterdam, The Netherlands.

AGR-713 CROP NUTRIENT MANAGEMENT

3(2-1)

Objective

To equip students with latest developments in crop nutrition.

Learning Outcomes:

At the end of the course, students will be able to:

1. Understand the physiological role of macro and micro-nutrients.
2. Learn modern strategies to improve crop nutrition
3. Compare the efficacy of different fertilizers in crop plants.
4. Minimize the nutrient losses and apply judicious use of fertilizer
5. Analyse the nutrient content both in plant and growth media.

Theory

Crop nutrition in modern agriculture; Rationale for use of fertilizers; Biofortification; Physiological classification of minerals; Dynamics of plant nutrients in normal, flooded and salt affected soils; Nutrient uptake and assimilation; Nutrient losses and causes of low efficiency; Improving nutrient use efficiency; Balanced nutrition and integrated plant nutrient management systems; Concept of remote sensing in crop nutrition; Nutrient indexing.

Practical

Demonstration of nutrient deficiency symptoms. Preparation of different nutrient solutions for field, pots and hydroponic cultures; Nutrient analysis (macro and micro) of soil and plants.

Recommended Books

1. Fageria. N.K. 2009. The Use of Nutrients in Crop Plants. CRC Press, London.
2. IFPRI. 2012. Reshaping Agriculture for Nutrition and Health. International Food Policy Research Institute, Washington DC, USA.
3. Krishna, K.R. 2002. Soil Fertility and Crop Production. Oxford and IBH publishing Co. New Delhi, India.
4. Marschner, H. 1995. Mineral Nutrition of Higher Plants. Elsevier, Amsterdam.
5. Singh, S.S. 2003. Soil Fertility and Nutrient Management. Kalyani Publishers, India.

AGR-714 CROP PRODUCTION AND HERBICIDES**3(2-1)****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 equipment; 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 crops. Tank mixing of herbicides.

Recommended Books

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 Publishers, USA.
3. Ross. M. A. and C. A. Lembi, 2009. Applied Weed Science: including the Ecology and Management of Invasive plants. 3rd edition, Practice Hall, USA.
4. Walia, V. S. 2003. Weed Management. Kalyani Pub. New Delhi.
5. Zimdhal, T.L. 2007. Fundamentals of Weed Science. 3rd ed. Academic Press, Ins. New York.

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

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

Learning Outcomes:

Upon successful completion of the course, the student will be able to:

1. Understand the concepts and significance of farming/cropping systems
2. Assess input use efficiencies in various farming/cropping systems
3. Use allied enterprises in agriculture based systems
4. Apply the acquired knowledge for sustainable production

Theory

Concept, scope, classification and components; Agricultural resources, their utilization and management; Major farming and cropping systems of Pakistan; Role of tillage, root dynamics, cover crops, crop residues in cropping system; Assessing input use efficiencies in various farming/cropping systems; Role of precision agriculture in farming system; Study of allied enterprises (livestock, poultry, aquaculture, mushroom culture, tunnel farming); Emerging trends in farming/cropping system research; Researchable issues and research methods in farming and cropping systems.

Recommended Books

1. Balasubramanian, P. and S.P. Palaniappan. 2009. Principles and Practices of Agronomy. Agrobios, Jodhpur, India.
2. Dixit, R.S. 2007. Cropping System Research. Kalyani Publishers, New Delhi, India.
3. Panda, S.C. 2006. Crop Management and Integrated Farming. Agrobios, Jodhpur, India.
4. Shrestha, A. 2003. Cropping Systems Trends and Advances. Food Products Press, Binghamton, NY, USA.

AGR-716 FIELD CROP EXPERIMENTATION

3(2-1)

Objective

To plan the experiments according to different design and layout therein the field and to collect the data, analysis it and interpretation.

Learning outcomes

1. formulate null and alternate hypothesis.
2. select appropriate experimental design and execute its layout in the field.
3. analyse the data and interpret the results
4. determine possible relationships among variables
5. summarize the findings of the research and reporting

Theory

Methods of scientific inquiry; general types of experiments; Principles of experimental design; Planning, layout and conducting field experiments; Recording research observations; Transformation of data ; Planned F test; Data processing, analyses and its statistical interpretation; Means separation; Probability; F and t distributions; Regression and correlation; Research results reporting.

Practical

Statistical calculations based on sample data; Exercise in the layout of experiments; Transformation of Experimental data; Preparation of analysis of variance table; Use of different tests of significance; Factorial experiments and

their uses in scientific research; Reporting results of experiment; calculation of linear regression and correlations; Use of statistical packages for data.

Suggested Readings

1. Das, N.R. 2006. Agronomic Research Management. Agrotech Publishing Academy, Udaipur, India.
2. Gomez, K.A. and A.A. Gomez, 1984. Statistical Procedures for Agricultural Research. 2nd Ed. John Wiley and Sons, New York, USA.
3. Leclergy, E.L., W.H. Leonard and A.G. Clark. 1980. Field Plot Technique, 1st Ed. Reprinted by the National Book Foundation, Islamabad.
4. 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.

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.

Learning outcomes

After studying this course, the students will be able to:-

- Know the mode of action of herbicides and their effect on photosynthesis , respiration, protein and nucleic acid metabolism etc.
- Understand the fate of herbicides, their lethal effect and interaction
- Demonstrate herbicide resistance, residual effect on germination and seedling growth of succeeding crops
- Use instrumental techniques for herbicide analysis

Theory

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

Practical

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

Recommended Books

1. Kumar, R. J. and R. Jagannathan. 2007. Weed Science Principles. 2nd Ed. Kalyani Publisher, Ludhiana, India.

2. Powles, S. B. and J. A. M. Holtum. 1994. *Herbicide Resistance in Plants: Biology and Biochemistry*, Lewis Pub., Albany, USA.
3. Prado, R. De. J. Jossin and L. G. Torres. 1997. *Weed and Crop Resistance to Herbicides*. Kluwer Academic Publishers. Dordrecht/Boston/London.
4. Rao, V. S. 2002. *Principles of Weed Science*. Science Publishers. U.S.A.
5. Walia. U. S. 2010. *Weed Management*. Kalyani Publishers, Ludhiana, India.
6. Zimdhal, R. 2007. *Fundamentals of Weed Science*. 3rd ed. Academic Press, Ins. New York.

AGR-718 INTEGRATED AGRICULTURE

3(3-0)

Objective

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

Learning objectives

To integrate crop husbandry with livestock, fisheries, cottage and poultry industry for sustainable agriculture (Dr. Nazim, will discuss next meeting)

Learning outcomes

After studying this course, the students will be able to:-

1. Define and describe the potential of agriculture for socio-economic uplift of country.
2. Understand challenges faced by Pakistan's Agriculture and remedial strategies.
3. Comprehend the role of natural resource management in rural development.
4. Evaluate the working of agricultural institutions and agriculture related policies.

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.

Recommended Books

1. Ahmad, N. and A. Hamid. 1997. *Plant Nutrients Management for Sustainable Agriculture Growth*. Proc. Symposium held on December 8-10, 1997. Planning & Development Division, National Fertilizer Development Center, 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, Eswaru, and I. P. Abarol. 1994. Stressed Ecosystems and Sustainable Agriculture. Oxford & IBH Pub. Co., New Delhi.

AGR -719 MODERN CONCEPTS OF CROP PRODUCTION 3(2-1)

Objectives

1. To enable the students an insight understanding of Agro-physiological factors affecting crop potential.
2. To harvest the maximum out of possessed genetic potential of a variety by integrating all the yield determinants.

Laerning outcomes

1. Acquire indepth modern knowledge of crop productivity
2. Analyse the issues of crop production with refrence to modern concepts
3. Apply modern techniques for maximizing crop harvest.

Theory

- Concept and indices of agricultural productivity;
- Key issues limiting agricultural productivity in Pakistan;
- Significance of crop management in determing crop productivity; Dynamics of stand establishment;
- Multiple cropping;
- Manipulation of different tillage systems;
- Manipulation of crop development by the use of growth regulators; Concept and components of good agricultural practices (GAP), Organic farming;
- Precision agriculture and its tools;
- Zero tillage: conditions, areas and crops
- Alternate wetting and drying (AWD) techniques: conditions, areas and crops
- Biofertifcation of staple food crops: concept, significance and crops
- Biotechnology in improving crop production;

Practical

- Study of different factors influencing stand establishment under field conditions;
- Evaluation of some case histories for economic feasibility of different cropping systems;
- Field observation of different tillage systems;
- Filed visits and observation on GAP;
- Demonstrations on the simulation of effects of global warming on agricultural productivity;

- Methods of biofortification of crops (Zn, Fe, Ca etc).
- Visits to different agricultural research institutes and farmers field (where Zero tillage, AWD are under practice).

Recommended Books

1. Byerlee, D. and T. Hussain. 1992. Farming Systems of Pakistan. Vanguard Books Pvt. Ltd. Lahore.
2. Chandrasskaran, B., K. Annadurai and E. Somasundaram. 2010. A Textbook of Agronomy. New Age Int. (P) Ltd. Publishers, New Delhi, India.
3. Hester, R.E. and R.M. Harrison. 2005. Sustainability in Agriculture. Vol. 21. RSC Publishing, Thomas Graham House, Sci. Park, Milton Road, Cambridge, UK.
4. Singh, N.P. and R.A. Singh. 2002. Scientific Crop Production. Kalyani Publishers, Ludhiana, India.

AGR-720 RECENT ADVANCES IN AGRONOMY

3(3-0)

Objective

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

Learning Objectives

- To adapt the current research and developments in agronomic research

Learning Outcomes

After studying this course, the students will be able to:

1. Analyze the recent technologies for enhancing field crop productivity
2. Compare traditional and new interventions
3. Evaluate the new tools for agronomic research and development

Theory

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

Recommended Books

1. Advances in Agronomy. All volumes from last three years. Academic Press Inc., New York.
2. Agronomy for Sustainable Development. All volumes of last three years. INRA-CMSE-PME, Dijon, France and Springer, the Netherlands.
3. European Journal of Agronomy, Elsevier, Amsterdam, the Netherlands.
4. Critical 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, the Netherlands.

Objective

To enhance students' understanding of physiological processes in seeds.

Learning outcomes;-

1. Understand embryogenesis and flowers identification
2. Comprehend seed formation and development
3. Classify the chemical composition of seed.
4. Understand growth regulators and their role in seed development and dormancy.
5. Analyse Moisture content, temperature and oxygen relations to germination process

Theory

Seeds and human beings; Review of embryogenesis; Physiological development of "seed"; Implications of seed maturation; Chemical composition of seed, its phylogenetic implications, importance in storage, energy relationships; Dormancy, its survival value, occurrence and persistence of dormancy in cultivated, weedy and wild species, methods of overcoming dormancy; Role of growth regulators in seed development and dormancy; Seed sink strength and intensity; Seed food reserves, location and composition; Physiological and biochemical manifestation of seed aging; Seed deterioration-factors influencing rate of deterioration, theories of seed dying; Concept of seed vigor; Seed enhancement-production and yield; Requirements for germination-re-hydration and water relations, temperature and oxygen relations.

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.

Recommended Books

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.

Learnig outcome

1. Understand functional concept of seed production
2. Evaluate Seed vigor, quality management and maintenance
3. Understand the role of seed industry, concept and future need for seed demand
4. Examine Seed health, fortification and invigoration and ageing

Theory

Functional concept of seed production; Recent trends in seed technology and management; Hybrid and synthetic seed production; 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; Genetically modified seeds (GMOs); Transgenetics for crop improvement; Seed quality, control and management; Seed fortification and invigoration; Seed health. Organic seed production.

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.

Recommended Books

1. Advances in seed sciences and technology 2006 Agro Bios, India.
2. Ahmad, S.I. 1992. Seed Certification Manual. National Book Foundation, Islamabad.
3. Copeland L.O. and M.F. McDonald. 2001. Principles of Seed Science and Technology – 4th Ed. Burgess Pub. Co., USA
4. ISTA. 1996. International rules for seed testing, Vol. 26, 31, 35, and 37. Proceedings of International Seed Testing Association, Zurich, Switzerland.
5. McDonald, M.B. and L.O. Copeland. 1989. Seed Science and Technology Laboratory Manual. Iowa State University Press / Ames, USA .

AGR-723**STRESS AGRONOMY****3(2-1)****Objective**

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

Learning Outcomes:

At the end of the course, students will be able to:

1. Understand types of stresses and their impact on morphological, physiological and biochemical processes
2. Describe the natural tolerance ability of various crop plants and manage crops through agro-management practices
4. Induce the different stress in different growth media in field, pots and hydroponic experiments

Theory

Concepts 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.

Recommended Books

1. Arnon, I. 1992. Agriculture in drylands—principles and practices. Elsevier, Amsterdam.
2. Fitter, A.H. and R.K.M. Hay. 2002. Environmental Physiology of Plants. 3rd Ed. Academic Press, Inc., London.
3. Guar, R.K. and P. Sharma, 2014 Approaches to Plant Stress and their Management. Springer, India
4. Nösberger, J., H.H. Geiger and P.C Struik. 2001. Crop Science: Progress and Prospects. CABI, Pub., Oxon, UK.
5. Pessarakli, M. (Ed.). 1994. Handbook of Plant and Crop Stress. 2nd Edition. Marcel and Dekker Inc., New York.

AGR-724 SUSTAINABLE AGRICULTURE **Learning objective**

3(3-0)

Objective

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

Learning Outcomes

1. learn the concept, components and significance of Sustainable Agriculture.
2. plan efficient utilization of soil, and water resources.
3. Acquire the understanding and skill of Integrated nutrients management.
4. Examine the effect of crop production practices on environmental

5. pollution.

Theory

Definition, concept and significance; Evolution of sustainable agriculture; Management practices for sustainable agriculture; Sustainable utilization of land water, resources and agro-biodiversity; Integrated nutrient management; Sustainable Weed management; Integrated farming systems to sustain farm productivity; Alternate and uses; Agriculture; Climate change and carbon sequestration; Latest research methodologies related to the above topics.

Recommended Books

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. Maloo, S. R. 2002. Sustainable Crop Production under Stress Environments. Geeta Soman; Agrotech Publishing Academy, Udaipur, India.
5. Reddy, T.y. and G.H.S. Reddy. 2002. Principles of Agronomy. Third Edition, Kalyani Publishers, New Delhi.
6. Singh, S.S. 1998. Crop management under irrigated and rain fed conditions, 3rd Edition. Kalyani Publishers, New Delhi.
7. Trivedi, P. C. 2011. Organic farming for sustainable Agriculture. Aavishkar Publishers, Distributors. Jaipur (Raj) India.

AGR-725 WATER RELATIONS OF PLANTS

3(2-1)

Objective

To enhance the understanding of relationship between plants and water.

Learning Outcomes:

At the end of the course, students will be able to:

1. Define the terminology and describe theories related to soil plant relationship
2. know the physico-biochemical role of water in crop plants
3. Understand mechanisms involved in water mobility from soil through the plant into the atmosphere.
4. Analyze the plant water status and irrigate the crop as per requirement to ensure the judicious use of water
5. Learn practically induce the water stress in different growth media in field, pots and hydroponic experiments

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 equation, matric potential; Ohm's law to study the movement of water in the soil-plant atmosphere system.

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.

Recommended Books

1. Kirkham, M.B. 2004. Principles of Soil and Water Relations, Academic Press, London.
2. Kramer, P.J. and J.S. Boyer. 1995 Water Relations of Plants and Soils. San Diego, CA: Academic Press, New York.
3. Nobel, P.S. 2009. Physicochemical and Environmental Plant Physiology. San Diego, CA: Academic Press, New York.

AGR-726 WEED MANAGEMENT

3(2-1)

Objective

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

Theory

Concept of weed management and its significance in modern agriculture; Weed management using principles of competition, Integrated weed management; weed management for field crops, Weed Management for Horticultural crops, Weed management in lawn, turf grass, pastures, forestry and range lands, Management of problematic, parasitic and non-cropped area, Invasive weeds and their management, Herbicide tolerant crops, herbicide resistant weeds and their management, Natural products as lead for new herbicides.

Practical:

Identification and collection of weeds; Demonstration of competitive effect of weeds on crop growth, Determination of critical period of weed interference in crops; use of tillage implements for effective and economical weed control. Testing of herbicide resistance in weeds.

Recommended Books

1. Anderson, W.P. 2007. Weed Science: Principles and Applications. 4th Ed. Waveland Pr Inc
2. Andrew H. Cobb and John P.H. Reade. 2010 Herbicide and plant Plant physiology Physiology-2nd Edition. Willey Blackwell, UK.
3. Cobb, A.H. and J.P.H. Reade. 2010. Herbicides and Plant Physiology. 2nd Ed. Wiley Blackwell, UK.
4. M.K. Upadhyaya and R.E. Blackshaw. 2007. Non-chemical weed management. Principle concepts and technology. Biddle Ltd. Kings Lynh UK.
5. Monaco T.J. 2002. Weed Science Principles and practices-4th Edition. Johnwiley & Sons Inc. USA.
6. Tanveer, A., A. Khaliq, A. Ali and M.A. Khan. 2005. Weed Science Research in Pakistan – A Compendium. Agriculture Department, Government of Punjab.
7. Zimdahl R.L. 2013. Fundamentals of Weed Science. 4th Ed. Academic press.
8. Zimdahl, R.L. 2004. Weed-Crop Competition- a review. 2nd Ed. Wiley Blackwell, UK.

AGR -727 CLIMATE CHANGE AND AGRICULTURE

3(3-0)

Objective

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

Learning Outcomes

After studying this course, the students will be able to:-

1. Comprehend importance of climate in agriculture.
2. Compare climate variability and change: past, present and future scenario
3. Analyze impact of climate change in different regions;
4. Interpret influence of climate change on productivity of major and minor crops;
5. Examine implications of changing climatic scenario for pests, livestock and natural resources;
6. Design strategies for managing climate change and vulnerability;

Theory:

Climate and agriculture; Climate variability and change-past, present and future scenario; Impact of climate change in different regions; Influence of climate change on productivity of major and minor crops; Implications of changing climatic scenario for pests, livestock and natural resources; Strategies for managing climate change and vulnerability; Capacity building and action plan for policy makers and planners.

Recommended Books

1. Hillel, D. and C. Rosenzweig. 2013. Handbook of Climate Change and Agroecosystems: Global and Regional Aspects and Implications. Imperial College Press, London, UK.
2. Anboumozhi, V., M. Breiling, S. Pathmarajah and V.R. Reddy. 2012. Climate Change in Asia and the Pacific: How can Countries Adapt? SAGE Publication India Pvt. Ltd.
3. Sivakumar, M.V.K. and R.P. Motha. 2007. Managing Weather and Climate: Risks in Agriculture. Springer, Berlin, Heidelberg, New York.
4. Sivakumar, M.V.K. and J. Hansen. 2007. Climate Predictions and Agriculture. Springer, Berlin, Heidelberg, New York.
5. Mavi, H.S. and G.J. Tupper. 2005. Agrometeorology Principles and Application of Climate Studies in Agriculture. International Book Distribution Co., Lucknow, India.
6. 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.

AGR-728 POSTHARVEST TECHNOLOGY OF CROPS

3(2-1)

Objective

Learning objectives

To educate students with harvesting post-harvest technology, losses and marketing of crop produce

Learning outcomes

After studying this course, the students will be able to:-

- Describe the importance of post harvest technology and optimum harvesting time of crops
- Understand about the processing, grading, seed treatment, storage of different crops
- Impart new techniques for harvesting and processing of crop produce
- Demonstrate different harvesting and post harvesting processes along with packing and marketing of crops

Theory

Concepts, objectives and importance of Post harvest Technology in field crops. Objects of harvesting, threshing, processing, cleaning and grading, Seed treatment and storage. Modern technology of harvesting, threshing, shelling, cleaning, drying, grading of cereal grains. Reaping, beating/threshing, cleaning and drying of wheat and paddy rice. Picking, ginning and separating lint and seed of cotton. Cutting, stripping and topping of sugarcane. Harvesting,

beating/threshing and cleaning of grain legumes and oilseeds. Digging, cleaning, topping and washing of root and tuber crops. Marketing of field crop products.

Practical

Demonstration of harvesters, reapers and pickers, threshers, air screen cleaners (Wheat and paddy) and ginner (Cotton). Field demonstration for sugarcane cutting and sugar beet digging by manual methods. Seed processing, cleaning, grading and packing practices in cereals, legumes, oilseeds, condiments, spices and vegetables etc. Visits of local farms.

Recommended Books

1. ARNON, I. 1972. Crop production in dry regions. Volume II: Plant Science Monographs Series. by I. Edited by Nicholas Polunin.
2. Bhatti, I. M and A. H. Soomro. 1996. Agriculture Inputs and field crop production in Sindh, Directorate of Agriculture Research Sindh, Hyderabad.
3. Nazir, M. S. 1994. Crop Production. National Book foundation, Islamabad
4. Reddy, S. R. 2004. Principles of Crop Production (2nd edition). Kalyani Publishers, New Delhi.

AGR-729 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.*

AGR-729 SEMINAR 1(0-1)

Objective

To improve students' communication and presentation skills.

Selection of topic, preparation of material for presentation, and presentation by the student in the class on a particular topic.

Note: *M.Sc (Hons.) students will deliver one seminar while PhD students will deliver two seminars. The Seminar delivered on synopsis/research proposal and/or thesis will not be considered extra credit hour for academic purposes.*

AGR-730 THESIS MSc (HONS) AGRONOMY

6(0-6)

AGR-731 THESIS PhD

12(0-12)

Annexure

LIST OF RECOMMENDED BOOKS FOR AGRONOMY

1. Abbas, M.A. 2006. General Agriculture. Emporium Urdu Bazar, Lahore.
2. Advances in Agronomy, All volumes. Academic Press Inc., New York.
3. Vanangamudi, K. Advances in Seed Science and Technology. 2008. AgroBios, India.
4. Agronomy for Sustainable Development. All volumes of last three years. INRA-CMSE-PME, Dijon, Francis and Springer, The Netherlands.
5. Ahmad, N. and A. Hamid. 1997. Plant Nutrients Management for Sustainable Agriculture Growth. Proc. Symposium held on December 8-10, 1997. Planning & Development Division, National Fertilizer Development Center, Islamabad.
6. Ahmad, S.I. 1992. Seed Certification Manual. National Book Foundation, Islamabad.
7. Ahrens, C.D. 2008. Meteorology Today Brooks/Cole Cengage Learning, Belmont, USA.
8. 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.
9. Ali, M.H. 2011. Practice of irrigation and on-farm water management Vol. 2, Springer, New York, USA.
10. Ali, M.H. 2010. Fundamentals of irrigation and on-farm water management Vol. 1, Springer, New York, USA.
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. Altaf, Z. and A. Qarshi. 2013. Medicinal Plants. Qarshi Industries, Lahore.
14. Anboumozhi, V., M. Breiling, S. Pathmarajah and V.R. Reddy. 2012. Climate Change in Asia and the Pacific: How can Countries Adapt? SAGE Publication India Pvt. Ltd.
15. Anderson, W.P. 2007. Weed Science Principles and Application. 4th Ed. West Publishing Co. St. Paul. New York.
16. Andrew H. Cobb and John P.H. Reade. 2010 Herbicide and Plant physiology. 2nd Ed. Willey Blackwell, UK.
17. Anonymous. 2001. A Dictionary of Seed Technological terms. Kalyani Publisher, India.
18. Anonymous. 1988. Publications Handbook and Style Manual. ASA-CSSA-SSSA, Madison.

19. Anonymous. 1992. Proceeding of International Seminar on Seed, Fauji Fertilizer Corporation. Islamabad.
20. Anonymous. 1997. Irrigation Agronomy Manual. Ministry of Food Agriculture and Livestock, Islamabad.
21. Anonymous. 1999. Sustainable Agriculture Solutions. Novellow Press, Ltd., London.
22. Arnon, I. 1992 Agriculture in Drylands: Principles and Practices. Elsevier Amsterdam.
23. ASA. 1995. Climate Change and Agriculture: Analysis of Potential International Impacts. ASA Special Publication No. 59. American Society of Agronomy, Inc., Madison, Wisconsin, USA
24. Ashiq, M., M.M. Nayyar and J. Ahmad. 2003. Weed Control Hand Book. Directorate of Agronomy, AARI, Faisalabad.
25. Balasubramaniyan, P. and S.P. Palaniappan. 2009. Principles and Practices of Agronomy. Agrobios, Jodhpur, India.
26. Balasubramaniyan, P. and S.P. Palaniappan. 2005. Principles and Practices of Agronomy. Agrobios, Jodhpur, India.
27. Baldev, B., S. Ramamjan and H.K. Jain. 1988. Pulse Crops. Oxford and IBH Pub. Co., New Delhi.
28. Basak, R.K. 2004. Soil Testing and Recommendation. Kalyani Publisher, New Delhi.
29. Bashir, E. and R. Bantel. 1996. Soil Science. National Book Foundation, Islamabad.
30. Basra, A.S. (Ed). 2006. Handbook of Seed Technology. Haworth Press New York, USA.
31. 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.
32. Benett, H.H. 2003. Soil Conservation for Sustainable Agriculture. Agrobios, Jodhpur, India.
33. Beth, Lanfalvaj, C.J. and R.C. Linduman. 1992. Mycorrhizae in Sustainable Agriculture, Pub. No. 54. ASA. Madison, USA.
34. Bewley, J.D. and M. Black. 1994. Seeds: Physiology of Development and Germination. 2nd Ed. Plenum Press, New York.
35. Bhatti, I.M. and A.H. Soomro. 1996. Agricultural Inputs and Field Crop Production in Sindh, Directorate General, Agri., Res. Institute, Sindh, Hyderabad.
36. Brown C.S. and T. Toadwine. 2007. Nature's Edge- Boundary Explorations in ecological theory and practice. State University of New York Press, Albany, USA.
37. Brunt, D. 2007. Meteorology. Oxford University Press, UK.
38. Byerlee, D. and T. Hussain, 1992. Farming Systems of Pakistan. Vanguard Books, Lahore.
39. Cao, W., J.W. White and E. Wang. 2009. Crop Modeling and Decision Support. Springer, Heidelberg, Germany.

40. Causton, D.R. and J.C. Venus. 1981. *The Biometry of Plant Growth*. Edward Arnold, London.
41. Chandrasekaran, B.K., Annadurai and E. Somasundaram. 2010. *A Textbook of Agronomy*. New Age International Pub., New Delhi, India.
42. Choudhary, M.R. 2009. *A Text book of irrigation and Drainage Practices for Agriculture*. University of Agric. Faisalabad, Pakistan.
43. Cobb, A.H. and J.P.H. Reade. 2010. *Herbicides and Plant Physiology*. 2nd Ed. Wiley Blackwell, UK.
44. Coombs, J., D.O. Hall, S.P. Long and J.M.O. Scurlock. 1987. *Techniques in Bioproductivity and Photosynthesis*, 2nd Ed. Pergamon Press, Oxford.
45. Copeland L.O. and M.F. McDonald. 2001. *Principles of Seed Science and Technology*. 4th Ed. Burgess Pub. Co., USA.
46. *Critical Review in Plant Sciences*. All Volumes. Taylor and Francis, New York.
47. Dahama, A.K. 2002. *Organic Farming for Sustainable Agriculture*. 2nd Ed. Agrobios, Jodhpur, India.
48. Das, N.R. 2006. *Agronomic Research Management*. Agrotech Publishing Academy, Udaipur, India.
49. Das, P.C. 2000. *Crops and their production technology under different conditions*. Kalyani Publishers, New Delhi, India.
50. Dixit, R.S. 2007. *Cropping System Research*. Kalyani Publishers, New Delhi, India.
51. Dovrat, A. 1993. *Irrigated Forage Production*. Elsevier Scientific Publishers, The Netherlands.
52. Dris, R., J. Mohan and I.A. Khan. 2002. *Environment and Crop Production*. Science Pub. Inc., New York.
53. Epstein, E. and A. J. Bloom. 2004 *Mineral Nutrition of Plants: Principles and Perspectives*. John Wiley and Sons Inc., USA.
54. Eric, L. 2009. *Organic Farming, Pest Control and Remediation of Soil Pollutants*. Springer Dordrecht Heidelberg, Germany.
55. *European Journal of Agronomy*. All Volumes. Elsevier, Amsterdam, the Netherlands.
56. Fageria. N.K. 2009. *The Use of Nutrients in Crop Plants*. CRC Press, London.
57. Fitter, A.H. and R.K.M. Hay. 2002. *Environmental Physiology of Plants*. 3rd Ed. Academic Press, Inc., London.
58. Floor M.B. and M. van Ittersum. 2010. *Environmental and Agricultural Modeling: Integrated Approaches for Policy Impact Assessment*, Springer, Heidelberg, Germany.
59. Fossil, P.V. 2007. *Organic Farming: Everything you need to know*. MBI Publishing Co., USA.
60. France, J. and J.M.M. Thornley, 1984. *Mathematical Models in Agriculture*. Butter-worths, London.
61. G.O.P. 1997. *Irrigation Agronomy Manual*. Ministry of Food Agriculture and Livestock, Islamabad.

62. George A. 2004. Principles of Crop Production: Theory, Teaching and Technology. Printice Hall, New Jersey, USA.
63. Ghani, M.A. and E. Ahmad. 2000. Principles of Accounting. Pak. Imperial Book Depot, Chowk Urdu Bazar, Lahore.
64. Gliessman, S.R. 2007. Field and Laboratory Investigations in Agroecology. 2nd Ed. Taylor and Francis, USA.
65. Gomez, K.A. and A.A. Gomez, 1984. Statistical Procedures for Agricultural Research. 2nd Ed. John Wiley and Sons, New York, USA.
66. Govindan, K. and Thriumurugam. 2003. Principles and Practices of Dry Land Agriculture. Kalyani Publishers, New Delhi, India.
67. Guar, R.K. and P. Sharma, 2014 Approaches to Plant Stress and their Management. Springer, India
68. Gupta, U.S. 1992. Crop Improvement. Vol. I. Physiological Attributes. Oxford and IBH Pub. Co. Pvt. Ltd., New Delhi.
69. Gupta, U.S. 2005. Physiology of Stressed Crops: Nutrient relations. Science Pub., India.
70. Gurevitch, J., M. Schiner and A.F. Gordon. The Ecology of Plant. 2nd Ed. 2006. State University of New York.
71. Gurmel, S., C. Venkatarmanan, G. Sastry and B.P. Joshi. 1990. Manual of Soil and Water Conservation Practices. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
72. Hall, A.E. 2001. Crop Responses to Environment. CRC Press, Boca Raton, Florida, USA.
73. Hammer, G.L., N. Nicholls and C. Mitchell. 2000 Application of Seasonal Climate Forecasting in Agricultural and Natural Ecosystems. Kluwer Academic Publisher, London.
74. Hansen, A.P. 1994. Symbiotic N₂ fixation of crop legumes. Margref verleg weikenheim, Germany.
75. Hari, M., S. Seshadri, K. Perumal. 2010. Biofertilizer (Phosphobacteria). Shri AMM Murugappa Chettiari Research Centre, India.
76. Harinder P.S., D.R. Batish and R.K. Kohli. 2006. Handbook of Sustainable Weed Management. Haworth Press, USA.
77. Hashmi, N. 1989. Style Manual of Technical Writing, 2nd Ed. Pakistan Economic Analysis Network Project. Ministry of Food and Agric., Islamabad.
78. Havlin, J.L., Tisdale, S.L., J.D. Beaton and W.L. Nelson. 2005. Soil Fertility and Fertilizers. 7th Ed. Macmillan Publishing Co., New York, USA.
79. Hay, R.K.M. and J.R. Porter. 2006. The Physiology of Crop Yield. 2nd Ed. Wiley-Blackwell, USA.
80. Hester, R.E. and R.M. Harrison. 2005. Sustainability in Agriculture. Vol. 21. RSC Publishing, Thomas Graham House, Sci. Park, Milton Road, Cambridge, UK.
81. Hillel, D. and C. Rosenzweig. 2013. Handbook of Climate Change and Agroecosystems: Global and Regional Aspects and Implications. Imperial College Press, London, UK.

82. Hinrichsen, D., 1998. Coastal Waters of the World: Trends, Threats, and Strategies. Island Press, Washington, DC, USA
83. Hudson, N.W. 2004. Soil and Water Conservation in Semi-arid Areas. Scientific Publishers, India.
84. Hunt, R. 1978. Plant Growth Analysis. Edward Arnold, London.
85. Hunt, R. 1982. Plant Growth Curves: An Introduction to the Functional Approach to Plant Growth Analysis. Edward Arnold, London.
86. Hussain, S.S. 2003. Manual of Plant Ecology. National Book Foundation, Islamabad.
87. Hussain, T. and A. Jabbar. 1985. Soil and Plant Analysis. Department of Soil Science, University of Agriculture, Faisalabad.
88. ICIMOD. 1997. Appropriate Farm Technologies in Arid and Semi-Arid Mountainous Areas of Pakistan. Katmandu, Nepal.
89. IFPRI. 2012. Reshaping Agriculture for Nutrition and Health. International Food Policy Research Institute, Washington DC, USA.
90. IIMI. 1997. Salinization, Alkalinisation and Sodification on Irrigated Areas in Pakistan. Lahore.
91. ISTA. 1996. International Rules for Seed Testing, Vol. 26, 31, 35, and 37. Proceedings of International Seed Testing Association, Zurich, Switzerland.
92. Jaya K.R. and R. Jagannathan. 2007. Weed Science Principles. Kalyani Publishers, New Delhi.
93. Thornley, J. H.M. and I. R. Johnson. 2000. Plant and Crop Modeling: A Mathematical Approach to Plant and Crop Physiology. The Blackburn Press, Caldwell, New Jersey, USA.
94. John H. Martin, R. P. Waldren and D. L. Stamp. 2006. Principles of Field Crop Production 4th Ed. The McMillan Co., New York.
95. John L.H., J.D. Beaton, S.L. Tisdale, and W.L. Nelson. 2010. Soil Fertility and Fertilizers-An introduction to nutrient management, 7th Ed. Pearson Prentice Hall, New Delhi, India.
96. John R. Clark. 1995. Coastal Zone Management Handbook. Mote Marine Laboratory of Sarasota, Florida, USA.
97. John R. Clark. 1998. Coastal Seas: The Conservation Challenge. 989 Market Street San Francisco, CA.
98. Johnson, C.B. 1981. Physiological Processes Limiting Plant Productivity. Butterworths, London.
99. Jones, J. Benton. 2012. Plant Nutrition and Soil Fertility Manual. 2nd Ed. CRC Press, Taylor & Francis, London, UK.
100. Kapur, P. and R.G. Sudha. 2000, Experimental Plant Ecology. CBS Publishers and Distributors, New Delhi.
101. Kay, R. and J. Alder. 2005. Coastal Planning and Development. Taylor and Francis, London.
102. Khalil, S.K. and P. Shah, 2007. Scientific Writing and Presentation. HEC Monograph, Islamabad.
103. Khan, S.R.A. 2001. Crop Management with focus on soil and water. Agric. Dept. Govt. of Punjab, Lahore.

104. Khare, D. and M.S. Bhale. 2000. Seed Technology. Sci. Pub., India.
105. Kirkham, M.B. (Editor). 2004. Water Use in Crop Production. Narosa Publishing House Pvt. Ltd. New Delhi, India.
106. Kirkham, M.B. 2004. Principles of Soil and Water Relations, Academic Press, London.
107. Kohli, K.R., H.P. Singh and D. R. Batish. 2004. Allelopathy in Agroecosystems. IDBC Lucknow, India.
108. Kramer, P.J. and J.S. Boyer. 1995 Water Relations of Plants and Soils. Academic Press, San Diego, USA.
109. Krishna, K.R. 2002. Soil Fertility and Crop Production. Oxford and IBH publishing Co. New Delhi, India.
110. Kumar, H.D. 1994. Modern Concepts of Ecology. 7th Ed. Vikas Pub. House New Delhi.
111. Kumar, R.J. and R. Jagannathan. 2007. Weed Science Principles. 2nd Ed. Kalyani Publisher, Ludhiana, India.
112. Lambers, H., F.S. Chapin, and T.L. Pons. 2009. Plant Physiological Ecology. Springer-Verlag, Inc., New York.
113. Lampkin, N. 2002. Organic Farming. Old Pond Publishing. UK.
114. Larcher, W. 2003. Physiological Plant Ecology. 4th Ed., Springer Verlag, Berlin.
115. Lauchli, A. and U. Luttge. 2002. Salinity: Environment-plant-molecules. Lavoisier, France.
116. Leclergy, E.L., W.H. Leonard and A.G. Clark. 1980. Field Plot Technique, Reprinted by the National Book Foundation, Islamabad.
117. Lenk, D. 2006. Commercial Spice Crops. Kalyani, Publishers, New Delhi.
118. Lichtfouse, E.M. Nanarrete, B. Debacke, and V. Souchere. 2009. Sustainable Agriculture. Springer, The Netherland.
119. Loomis, R.S. 1992. Crop Ecology. Productivity and Management in Agricultural System. Cambridge University Press, U.K.
120. Khan, M.A. 2012. Water Resources Management and Sustainable Agriculture.
121. Upadhyaya, M.K. and R.E. Blackshaw. 2007. Non-chemical weed management. Principle concepts and technology. Biddle Ltd. Kings Lynh, UK.

122. Macias, F.A., C.G. Galindo and J.M. G. Molinillo. 2003. Allleopathy: Chemistry and Mode of Action of Allelochemicals. CRC Press, New York, USA.
123. Majeedano, H.I. 2012. Agro Digest. Agriculture Research Institute, Tandojam.
124. Maloo, S.R. 2002. Sustainable Crop Production under Stress Environments. Geeta Soman; Agrotech Publishing Academy, Udaipur, India.
125. Marschner, H. 1995. Mineral Nutrition of Higher Plants. Elsevier, Amsterdam.

126. Martha, D. 2005. Scientific Papers and Presentations. Academic Press, San Deigo, California, USA.
127. Mavi, H.S. and G.J. Tupper. 2005. Agrometeorology: Principles and Application of Climate Studies in Agriculture. International Book Distribution Co., Lucknow, India.
128. McDonald, M.B. and L.O. Copeland. 1989. Seed Science and Technology Laboratory Manual. Iowa State University Press, Ames, USA.
129. Mead, R. 2003. Statistical Methods in Agricultural & Experimental Biology. 3rd Ed. Pak Book Corp. Lahore.
130. Mengel, K., E.A. Kirkby, H. Kosegarten and T. Appel. 2001. Principles of Plant Nutrition. 5th Ed. International Potash Institute, Bern, Switzerland.
131. Michael, M.A. 2003. Irrigation Theory and Practice. Vikas Publishing House Pvt. Ltd., New Delhi. India.
132. Misra, R.D. and M. Ahmad. 1990. Manual of Irrigation Agronomy. Oxford and IBH Publishing Co., New Delhi.
133. Pessarakli, M. 2008. Handbook of Turf Grass Management and Physiology, CRC Press, UK.
134. Monaco T.J. 2002. Weed Science Principles and practices-4th Ed. John Wiley & Sons Inc., USA.
135. Moses, B. and Carson. 2009. Book Keeping and Accounts for Beginners. Custom Books, India.
136. Muhammad, F. 2004. Statistical Methods and Data Analysis. Abid Umair Printing Press, Faisalabad.
137. Mukherjee, A.K. and S.Maiti. 2009. Forage Crop Production and Conservation. Kalyani Publishers, New Delhi, India.
138. Murthy, V. 2002. Basic Principles of Agricultural Meteorology. Pak Book Corp. Lahore.
139. Das, N.R. 2008. Tillage and Crop Production, Sci. Pub., India
140. Narayan, D.P., S.S. Purohit, A.K. Sharma and Tarun, K. 2003. A Handbook of Medicinal Plants. Agrobios, India.
141. Naylor, R.E.L. 2002. Weed Management, Principles and Practices Practices. Blackwell Science, UK.
142. Nazir, M.S., E. Bashir and R. Bantel. (Eds.) 1994. Crop Production. National Book Foundation, Islamabad.
143. Niir, B. 2004. The Complete Technology Book on Bio-Fertilizer and Organic Farming. National Institute of Industrial Research, India.
144. Nobel, P.S. 2009. Physicochemical and Environmental Plant Physiology. Academic Press, San Diego, New York.
145. Nosberger, J.H.H. Geiger and P.C. Struik. 2001. Crop Science Progress and Prospects. CABI Pub., Oxon, UK.
146. Palaniappan, and K. Annadurani. 2006. Organic Farming Theory and Practice. Scientific Publishers. Jodhpur, India.
147. Panda, B.C. 2009. Remote Sensing; Principles and Applications. Viva Books Pvt. Ltd. 4737/23, Ansari road, New Delhi-110002. India.
148. Panda, S.C. 2005. Agronomy. Agrobios, Jodhpur, India.

149. Panda, S.C. 2006. Crop Management and Integrated Farming. Agrobios, Jodhpur, India.
150. Paul C. Struik. 2007. Plant Research International and Wageningen University, Netherland
151. Percy, R.W., J.R. Ehleringer, H.A. Mooney and P.W. Rundal. 1989. Plant Physiological Ecology: Field Methods and Instrumentation. Chapman and Hall, London, New York.
152. Pessaraskli, M. (Ed.). 2014. Handbook of Plant and Crop Physiology, 3rd Ed. Taylor and Francis, Boca Raton, USA.
153. Pessaraskli, M.A. (Ed.). 2000. A. Hand Book of Stress Physiology, Marker and Deekar.
154. Petersen, R.G. 1994. Agricultural Field Experiments: Design and Analysis. Marcel Dekker AG., Switzerland.
155. Powles, S.B. and J.A.M. Holtum. 1994. Herbicide Resistance in Plants: Biology and Biochemistry, Lewis Pub., Albany, USA.
156. Prado, R. De. J. Jossin and L.G. Torres. 1997. Weed and Crop Resistance to Herbicides. Kluwer Academic Publishers. Dordrecht/Boston/London.
157. Prasada, Rao, G.S.L.H. 2008. Agricultural Meteorology. Printice Hall of India, New Delhi.
158. Premjit Sharma, 2007. Precision Farming, Gene Tech. Book, New Delhi, India
159. Prihar S.S. 2003. Intensive Cropping, Efficient use of Water, Nutrients, and Tillage. Pak Book Corp. Lahore.
160. Pritchard, S.G., J.S. Amthor. 2005. Crops and Environmental Changes: an introduction of global warming. CSSA, Madison, Wisconsin, USA.
161. Qureshi, M.A. M.A. Zia and M.S. Qureshi. 2006. Pakistan Agriculture Management and Development. A-One Publisher, Urdu Bazar, Lahore.
162. Rachel, F., S. Heather and T. Robbin. 2012. All the Dirt: Reflections on Organic Farming. TouchWood Editions, Canada.
163. Rahman, A. and M. Munir. 1984. Rapeseed, Mustard Production in Pakistan, PARC, Islamabad.
164. Rao, V.S. 2002. Principles of Weed Science. Science Publishers. U.S.A.
165. Rashid, A. and K.S. Memon. 2005. Soil Science. Ed. E. Bashir and R. Bantel. National Book Foundation, Islamabad.
166. Raven, P.H. Berg, L.R. and G.B. Johnson. 1993. Environment. International Ed. Saunders College Publishing, New York.
167. Ravindra, S. 2004. Agro-Techniques of Medicinal Plants. Daya Publishing House, New Delhi, India.
168. Reddy, S.R. 2004 Principles of Crop Production. 2nd Ed. Kalyani Publ., New Delhi.
169. Reddy, T.Y. and G.H.S. Reddy. 2002. Principles of Agronomy. 3rd Ed., Kalyani Pub., New Delhi.

170. Reigosa, M.J., N. Petdrol and L. Gonzalez. 2006. Allelopathy: A physiological process with ecological implications. Springer, Heidelberg, Germany.
171. Rice, E.L. 1997. Allelopathy. 4th Ed. Academic Press, Inc. Orlando, Florida, USA.
172. Ross, C.W and F.B. Salisbury. 2011. Plant Physiology 5th Ed., Wadsworth Publ. Co., Belmont, California, USA.
173. Ross. M.A. and C.A. Lembi, 2009. Applied Weed Science: including the Ecology and Management of Invasive plants. 3rd edition, Practice Hall, USA.
174. Rowan, S. 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.
175. Ryan, J., G. Estefan and A. Rashid. 2001. Soil and Plant Analysis Laboratory Manual. 2nd Ed., ICARDA, Aleppo, Syria and NARC, Islamabad, Pakistan.
176. Sankara, R.G.H. and T.Y. Reddy. 2002. Efficient Use of Irrigation Water. Kalyani Publishers, New Delhi.
177. Schultz, E.D. 2005. Plant Ecology. Springer Verlag, Berlin. Heidelberg.
178. Schulze, E.B. and K. Muller-Hohenstein. 2005. Plant Ecology. State University of New York, USA.
179. Sergey Shabla, 2012. Plant stress Physiology.
180. Shamshad, K.M. 1988. The Meteorology of Pakistan. Royal Book Co., Karachi.
181. Sharma, K. 2005. Hand Book of Agriculture. Indian Council of Agricultural Research, New Delhi
182. Sharma. R. 2004. Agro-techniques of Medicinal Plants. Daya Publishing House, Delhi.
183. Shaw, T. 2010. Dry land Farming. Nabu Press, USA.
184. Shrestha, A. 2003 Cropping System. Food Products Press. Haworth Press, Inc. Binghamton, New York NY.
185. Shrestha, A. 2003. Cropping Systems Trends and Advances. Food Products Press, Binghamton, NY, USA.
186. Shukla, R.S. and P. S. Chandel, 2006. A Text Book of Plant Ecology. S. Chand & Co. Ltd. New Delhi, India.
187. Singh G. 2000. Economics of Seed Production at Farm level. Pak Book Corp. Lahore.
188. Singh, A.K., M.A. Khan, N. Subash and K.M. Singh. 2011. Forages and Fodders. Daya Publishing House, Delhi, India.
189. Singh, J.V., B.S. Chhilar, B.D. Yadav and U.N. Joshi. 2010. Forage Legumes. Scientific Publishers, Jodhpur, India.
190. Singh, N.P. and R.A. Singh. 2002. Scientific Crop Production. Kalyani Publishers, Ludhiana, India.
191. Singh, P. 2008. Modeling Crop Production Systems: Principles and applications. Science publishers. Enfield, New Hampshire 03784. USA

192. Singh, S.S. 1998. Crop management under irrigated and rain fed conditions, 3rd Edition. Kalyani Publishers, New Delhi.
193. Singh, S.S. 2003. Soil Fertility and Nutrient Management. Kalyani Publishers, India.
194. Sivakumar, M.V.K. and R. P. Motha. 2007. Managing Weather and Climate: Risks in Agriculture. Springer, Berlin, Heidelberg, New York.
195. Sivakumar, M.V.K. and J. Hansen. 2007. Climate Predictions and Agriculture. Springer, Berlin, Heidelberg, New York.
196. 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.
197. Stacy, G., R.H. Burris and H.J. Evans. 1992. Biological Nitrogen Fixation. Chapman and Hall, London.
198. Stanwood, P.C. and M.B. McDonald. 1989. Seed Moisture. ASA, Madison, Wisconsin.
199. 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.
200. Stephen B. Pawles and Dale L. Shanner. 2001. Herbicide Resistance and World Grain. CRX press LLC,
201. Stoskopf, N.C. 1981. Understanding Crop Production. Reston. Pub. Co., Inc. Reston, Virginia.
202. Sukumar, B., 2008. Water Quality Management for Coastal Aquaculture. Daya Publishing House, India.
203. Sustainable Agriculture Reviews. All volumes of last three years. Springer, the Netherlands.
204. Taize, L. and E. Zeiger. 2002. Plant Physiology 3rd ed. Sinauers Associate, Inc. Sunderland, Massachusetts, USA.
205. Taize, L. and E., Zeiger. 2010. Plant Physiology 5th Ed. Sinauers Associate, Inc. Sunderland, Massachusetts, USA.
206. Tandon, H.L.S (Ed.). 2001. Methods of Analysis of Soils, Plants, Waters and Fertilizer. Development and Consultation Organization, New Delhi, India.
207. Tanveer, A. 2008. Biology and Ecology of Weed. HEC, Pakistan.
208. Tanveer, A., A. Khaliq, A. Ali and M.A. Khan. 2005. Weed Science Research in Pakistan – A Compendium. Agriculture Department,. Government of Punjab.
209. Tivy, J. 1990. Agricultural Ecology. Longman Group U.K. Ltd. Essex.
210. Townsend, C.R., Harper, J.L. and M.E. Bego. 2000. Essentials of Ecology. Blackwell Scientific Publications, UK.
211. Trivedi, P. C. 2011. Organic farming for sustainable Agriculture. Aavishkar Publishers, Distributors. Jaipur (Raj) India.
212. Tsuji, G.Y., G. Hoogenboom, and P.K. Thornton. 1998. Understanding Options for Agricultural Production. Kluwer Academic Publishers, Dordrecht, Boston, London.

213. Tunio, S.D. 2004. *Condiment Crops*. Directorate of Agriculture Information, Hyderabad, Sindh.
214. Tunio, S.D. 2010. *Vegetables and Spices of Sindh*. Roshni Publication, Kandiaro.
215. Turner, N.C. and P.J. Kramer. 1980. *Adaptation of Plants to Water and High Temperature Stress*.
216. Virmani, S.M.J. C. Katyal, Eswaru, and I.P. Abarol. 1994. *Stressed Ecosystems and Sustainable Agriculture*. Oxford & IBH Pub. Co., New Delhi.
217. Vohnout, K.D. 2003. *Mathematical modeling for system analysis in agricultural research*. Elsevier science B.V. Sara Burgerharstraat 25, Amsterdam, the Netherlands.
218. Walia, U.S. 2003. *Weed Management*. Kalyani Publishers, New Delhi, India.
219. Walia. U.S. 2010. *Weed Management*. Kalyani Publishers B-1/292. Rahinder Nagar. Ludhiana-141008.
220. Wallach, D., D. Makowski, J.W. Jones. 2006. *Working with Dynamic Crop Models Evaluation, Analysis, Parameterization, and Applications*. Elsevier science B.V. Sara Burgerharstraat 25, Amsterdam, The Netherlands.
221. Weixing, C., W.W. Jeffrey and E. Wang. 2009. *Crop Modeling and Decision Support*. Springer, Heidelberg, Germany.
222. Westerman, R.L. 1990. *Soil Testing and Plant Analysis*. 3rd Ed. Soil Sci. Am. Inc., Madison, WI, USA.
223. William, L. 2007. *Organic Farming an International History*. CAB International, UK.
224. Wolfe, T.K. and M.S. Kipps. 2004. *Production of Field Crop: A Textbook of Agronomy*. McGraw Hill Book Co. New York.
225. Wood, F. and Sheila Robinson 2009. *Book Keeping and Accounts*. 7th Ed. Trans-Atlantic Publication Inc. India.
226. Yi- Peng Wang, Min Lee, Zhe- Xian Tian, William E. Newton. (eds.). 2005. *Biological Nitrogen Fixation, sustainable agriculture and the environment*. Proc. 14th Int. Congress Biological Nitrogen Fixation. Springer, Netherlands.
227. Youdeowei, A., P. Stapleton, and R. Obubo. (eds.). 2012. *Scientific Writing for Agricultural Research Scientists-A Training Resource Manual*, Wageningen, The Netherlands.
228. Zeng, R.S, A.U. Mallik and S.M. Luo. 2008. *Allelopathy in Sustainable Agriculture and Forestry*. Springer, USA.
229. Zimdahl R.L. 2013. *Fundamentals of Weed Science*. 4th Ed. Academic press.
230. Zimdahl, R. 2012. *Weed Science A plea for thought-Revisited*. Springer press Heidelberg New York.
231. Zimdahl, R.L. 2004. *Weed-Crop Competition- a review*. 2nd Ed. Wiley Blackwell, UK.

232. Ziska, L.H. and J. S. Duke. 2011. *Weed Biology and Climate Change*. John Willey, Hoboken, NJ, USA.

**DETAIL OF COMPULSORY COURSES
IN ENGLISH FOR
UNDERGRADUATE LEVEL**

English I (Functional English)

Credit Hrs. 3

Objective: 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

Objective

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 Yorke.

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

Objective

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 northern 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)**

Objective:

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 Holy Quran

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

Study of Selected Text of Holly Quran

- 1) Verses of Surah Al-Ihzab Related to Adab al-Nabi (Verse No.6,21,40,56,57,58.)
- 2) Verses of Surah Al-Hashar (18,19,20) Related to thinking, Day of Judgment
- 3) Verses of Surah Al-Saf Related to Tafakar, Tadabar (Verse No-1,14)

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

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

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

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

Introduction To Sunnah

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

Selected Study from Text of Hadith

Introduction To Islamic Law & Jurisprudence

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

Islamic Culture & Civilization

- 1) Basic Concepts of Islamic Culture & Civilization
- 2) Historical Development of Islamic Culture & Civilization
- 3) Characteristics of Islamic Culture & Civilization
- 4) Islamic Culture & Civilization and Contemporary Issues

Islam & Science

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

Islamic Economic System

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

Political System of Islam

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

Islamic History

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

Social System of Islam

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

3) Ethical Values of Islam

Reference Books:

- 1) Hameed ullah Muhammad, "Emergence of Islam", IRI, Islamabad
- 2) Hameed ullah Muhammad, "Muslim Conduct of State"
- 3) Hameed ullah Muhammad, "Introduction to Islam"
- 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 Jurisprudence and the Quranic Law of Crimes" Islamic Book Service (1982)
- 8) H.S. Bhatia, "Studies in Islamic Law, Religion and Society" Deep & Deep Publications New Delhi (1989)
- 9) Dr. Muhammad Zia-ul-Haq, "Introduction to Al Sharia Al Islamia" Allama Iqbal Open University, Islamabad (2001)

**PAKISTAN STUDIES
(COMPULSORY)**

Introduction/Objective

- 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-e-Azam Muhammad Ali Jinnah.
- b. Factors leading to Muslim separatism
- c. People and Land
 - i. Indus Civilization
 - ii. Muslim advent
 - iii. Location and geo-physical features.

2. Government and Politics in Pakistan

Political and constitutional phases:

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

3. Contemporary Pakistan

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

Recommended Books

1. Burki, Shahid Javed. *State & Society in Pakistan*, the Macmillan Press Ltd 1980.
2. Akbar, S. Zaidi. *Issue in Pakistan's Economy*. Karachi: Oxford University Press, 2000.
3. S.M. Burke and Lawrence Ziring. *Pakistan's Foreign policy: An Historical analysis*. Karachi: Oxford University Press, 1993.

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

**COMPULSORY MATHEMATICS
COURSES FOR BSC (HONS) AGRICULTURE**

1. MATHEMATICS I (ALGEBRA)

Prerequisite(s): Mathematics at secondary level

Credit Hours: 3 + 0

Specific Objective 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)

1. Kaufmann JE, *College Algebra and Trigonometry*, 1987, PWS-Kent Company, Boston
2. 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 Objective 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

1. Anton H, Bevens I, Davis S, *Calculus: A New Horizon* (8th edition), 2005, John Wiley, New York
2. Stewart J, *Calculus* (3rd edition), 1995, Brooks/Cole (suggested text)
Swokowski EW, *Calculus and Analytic Geometry*, 1983, PWS-Kent Company, Boston
3. 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 Objective 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:

1. Abraham S, Analytic Geometry, Scott, Freshman and Company, 1969
Kaufmann JE, College *Algebra and Trigonometry*, 1987, PWS-Kent Company, Boston
2. 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.*

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 un-grouped 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

Recommended Book

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 X² (chi-square) Testing hypothesis about variance.

Practical

- 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

Recommended Book

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-material 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.

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.

Recommendations

After thorough discussion, the participants of the National Curriculum Revision Committee in Agronomy 2014 formulated the following recommendations for uniform and effective implementation of the HEC policies at national level.

1. The committee appreciates HEC's role in improvement of Higher Education in the country and recommends uniform implementation of its policies including work load and financial matters in all public sector universities.
2. The committee strongly recommends that mathematics/biology should be considered as deficiency courses and shall not be counted towards the total credit hours of the B.Sc. (Hons.) degree.
3. As proposed earlier in the meeting of 2010 of NCRC in agronomy, the courses of Statistics 1 & 2 should be merged into one course in the proposed scheme of studies. It has been adopted by some of the universities and others need to implement the same for its uniformity across the country.
4. The existing template should be revised by the HEC before arranging the final meetings of all NCRCs in agricultural disciplines.
5. To strengthen the background of agriculture students in different specializations, it is proposed to allocate at least three foundation courses from agronomy during the first four semesters.
6. The course of crop physiology may be included in interdisciplinary foundation courses template.
It is recommended that periodic inter-university/inter-provinces visits of the faculty 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.
7. 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.
8. It is proposed to arrange refresher courses for the young faculty at national/international level for effective delivery of new topics/courses amended by NCRC.
9. NCRC recommends to regularly hold meetings of all HODs (at least once in six months).

Suggestions

1. Higher Education Commission is requested to arrange a training of the in-service young faculty through using the capabilities and expertise of the experts from public/private sector for the areas where universities feel deficiency.

HEC is requested to ensure availability of **at least 10 copies of all recommended books** (Annexure enclosed) to the departmental libraries of all the Agricultural Universities/Faculties/Colleges of the country and to improve the **library/documentation** of the institutions.

2. 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.
3. To improve the standard of the higher education at national level, the committee recommends that the appointment of local examiners should be discouraged at MSc (Hons.)/MPhil degree programs.
4. A final copy of the curriculum (2014) must be provided to at least every faculty member of agronomy all over the country.
5. A viable mechanism for follow up of implementation of recommendations/suggestions should be developed.
6. NCRC nominated Prof. Dr. Fayyaz ul Hassan, Chairman Department of Agronomy, PMAS-Arid Agriculture, Rawalpindi to act as Focal Person for such follow up.