

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	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	3(3-0)
AGR-712	Crop Modeling	3(2-1)
AGR-713	Crop Nutrition Management	3(2-1)
AGR-714	Crop Production and Herbicides	4(3-1)
AGR-715	Farming and Cropping Systems	3(3-0)
AGR-716	Field Crop Experimentation	4(3-1)
AGR-717	Herbicides in Plant and Soil Systems	3(2-1)
AGR-718	Integrated Agriculture	3(3-0)
AGR-719	Modern Concepts of Crop Production	3(2-1)
AGR-720	Recent Advances in Agronomy	3(3-0)
AGR-721	Seed Physiology	3(2-1)
AGR-722	Seed Science and Technology	3(2-1)
AGR-723	Stress Agronomy	4(3-1)
AGR-724	Sustainable Agriculture	3(3-0)
AGR-725	Water Relations 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)
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Objective

To deepen understanding about advanced concepts of crop growth and development

Theory

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

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.

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

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

Theory

Relationship between irrigation and crop yields; 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.

Practical

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

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)

Objective

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

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.

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.

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

Objective

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

Theory

Scope of agricultural meteorology; 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. Agrometeorology; 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.

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

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. Petdrol 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)

Objective

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

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.

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 Thirumurugam. 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(3-0)

Objective

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

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.

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.

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.

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.

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.

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.

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. Balasubramaniyan, 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.

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.

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.

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

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

Theory

Concept and indices of agricultural productivity; Key issues limiting agricultural productivity in Pakistan; Significance of crop management in determining 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; Remote sensing and its application in Agriculture; Biotechnology in improving crop production; Global warming in relation to crop productivity.

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; Field visits and observation on GAP; Demonstrations on the simulation of effects of global warming on agricultural productivity; Visits to various agricultural research facilities to acquaint the students about contemporary practices in farming.

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.

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.

AGR-721**SEED PHYSIOLOGY****3(2-1)****Objective**

To enhance students' understanding of physiological processes in seeds.

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.

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

Theory and Stress Agronomy

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 3(3-0)

Objective

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

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.

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 Physiology-2nd Edition. Wiley 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 link about crop production under changing climate.

Theory:

Climate and agriculture; Climate variability and change-past, present and future scenario; Impact of climate change in 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 Netherlands.

AGR-728 POSTHARVEST TECHNOLOGY OF CROPS 3(2-1)

Objective

To introduce and educate students with post-harvest technology of different field 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)
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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)
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AGR-731	THESIS PhD	12(0-12)
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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. Bennett, 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. Fossel, 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.
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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.
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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. Costal 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.
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 111. Kumar, R.J. and R. Jagannathan. 2007. Weed Science Principles. 2nd Ed. Kalyani Publisher, Ludhiana, India.
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 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.
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 120. Khan, M.A. 2012. Water Resources Management and Sustainable Agriculture.

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122. Macias, F.A., C.G. Galindo and J.M. G. Molinillo. 2003. Alleopathy: 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.
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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.
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**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 Francoise Grellet. Oxford Supplementary Skills. Fourth Impression 1993. ISBN 0 19 435405 7 Pages 20-27 and 35-41.
 - c) Reading/Comprehension
 1. Reading. Upper Intermediate. Brain Tomlinson and Rod Ellis. Oxford Supplementary Skills. Third Impression 1992. ISBN 0 19 453402 2.
 - d) Speaking

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 Francoise Grellet. Oxford Supplementary Skills. Fourth Impression 1993. ISBN 019 435405 7 Pages 45-53 (note taking).
 2. Writing. Upper-Intermediate by Rob Nolasco. Oxford Supplementary Skills. Fourth Impression 1992. ISBN 0 19 435406 5 (particularly good for writing memos, introduction to presentations, descriptive and argumentative writing).
- c) Reading
1. Reading. Advanced. Brian Tomlinson and Rod Ellis. Oxford Supplementary Skills. Third Impression 1991. ISBN 0 19 453403 0.
 2. Reading and Study Skills by John Langan
 3. Study Skills by Richard Yorky.

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. McGraw-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 Scharton. (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)

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

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

2. MATHEMATICS II (CALCULUS)

Prerequisite(s): Mathematics I (Algebra)

Credit Hours: 3 + 0

Specific 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

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

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

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

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

3. MATHEMATICS III (GEOMETRY)

Prerequisite(s): Mathematics II (Calculus)

Credit Hours: 3 + 0

Specific 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:

Abraham S, *Analytic Geometry*, Scott, Freshman and Company, 1969
Kaufmann JE, *College Algebra and Trigonometry*, 1987, PWS-Kent Company, Boston
Swokowski EW, *Fundamentals of Algebra and Trigonometry* (6th edition), 1986, PWS-Kent Company, Boston

Note:

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

Annexure – E

STATISTICS-I

Credit 3 (2-1)

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

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

Measure of Central tendency, Definition and calculation of Arithmetic mean, Geometric mean, Harmonic mean, Median quantiles and Mode in grouped and 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 χ^2 (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 Steel 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.
7. 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.
8. 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.
9. 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.
10. 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.
2. 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.
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 should be discouraged at MSc (Hons.)/MPhil degree programs.
5. A final copy of the curriculum (2014) 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.
7. NCRC nominated Prof. Dr. Fayyaz ul Hassan, Chairman Department of Agronomy, PMAS-Arid Agriculture, Rawalpindi to act as Focal Person for such follow up.