

**CURRICULUM**

**OF**

**SOIL SCIENCE**

**BS/B.Sc (Hons)**

**MS/M.Sc (Hons)**

(Revised 2010)



**HIGHER EDUCATION COMMISSION  
ISLAMABAD**

# **CURRICULUM DIVISION, HEC**

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## PREFACE

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

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

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

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

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

**PROF. DR. ALTAF ALI G. SHAIKH**  
**Member Academics**

**March 2010**

# CURRICULUM DEVELOPMENT

## Abbreviations Used:

NCRC. National Curriculum Revision Committee

VCC. Vice-Chancellor's Committee

EXP. Experts

COL. Colleges

UNI. Universities

PREP. Preparation

REC. Recommendations

LI Learning Innovation

R&D Research & Development Organization

HEC Higher Education Commission

## INTRODUCTION

A meeting of the National Curriculum Revision Committee of Soil Sciences was held on June 07-09, 2010 at HEC Regional Centre, Lahore to finalize the draft curriculum prepared in its meeting held on January 25-27, 2010. The following attended the meeting.

Prof. Dr. Anwar-ul-Hassan, Director, Institute of Soil & Environmental Sciences, University of Agriculture Faisalabad.	Convener
Prof. Dr. Abdulrauf Farooqi, Department of Environmental Sciences, International Islamic University, Islamabad.	Member
Prof. Dr. Safdar Ali, Chairman, Department of Soil Sciences and Soil & Water Conservation, PMAS – Arid Agriculture University, Rawalpindi.	Member
Prof. Dr. Zahir Shah, Department of Soil & Environmental Sciences, KPK Agriculture University, Peshawar.	Member
Dr. Inayatullah Rajpar, Associate Professor & Chairman, Department of Soil Sciences, Sindh Agriculture University, Tandojam.	Member
Mr. Nasir Rahim, Assistant Professor, Chairman, Department of Soil and Environmental Sciences, University of AJ&K, Faculty of Agriculture, Rawalakot.	Member
Dr. Muhammad Jamil Khan, Associate Professor & Chairman, Department of Soil & Environmental Sciences, Gomal University, D.I. Khan.	Member

Dr. Ghulam Sarwar, Assistant Professor, Department of Soil & Environmental Sciences, University College of Agriculture, University of Sargodha, Sargodha.	Member
Dr. Moazzam Jamil, Associate Professor & Principal, Department of Soil Science, University College of Agriculture & Environmental Sciences, The Islamia University of Bahawalpur.	Member
Dr. Muhammad Salim, Chief Scientist, National Agriculture Research Centre, Park Road, Chak Shahzad Islamabad.	Member
Mr. Riaz Ahmad, Technical Services Manager, Fauji Fertilizer Company Ltd, Lahore Trade Centre, 11-Shahrah-E-Aiwan-E-Tijarat, Lahore.	Member
Mr. Zubair Rehman, Head of Soil Science Department, Baluchistan Agriculture College, Chaman Road, Beleli, Quetta.	Member
Ms. Saima Kalsoom Babar, Assistant Professor, Lasbela University of Agriculture, Water & Marine Sciences, Uthal, Baluchistan.	Member
Prof. Dr. Muhammad Abid, Department of Agronomy & Soil Science, University College of Agriculture, B.Z. University, Multan.	Secretary

The meeting started with recitation from the Holy Quran by Dr. Muhammad Tahir Ali Shah, Deputy Director (Curriculum) Higher Education Commission (HEC) Islamabad.

Mr. Bashir Ahmed, Director HEC Regional Centre, Lahore welcome the participants. Dr. Muhammad Tahir Ali Shah, briefed about the objectives of the meeting.

The committee, after considering the draft curriculum and suggestions received from the experts for its improvement, finalized the curriculum along with scheme of studies in the subject of Soil Science for B.Sc. (Hons.), M.Sc. (Hons.)/M.Phil. and Ph.D. degree programs.

The meeting adjourned with vote of thanks by the Convener.



# Template for 4-Year BS/B.Sc. (Hons) in Agricultural Disciplines

## 1. Compulsory Courses

	Credits Hours
Mathematics / Biology (2 courses)	6 (3-0) (2-1)
Statistics 1 & 2	6 (3-0) (3-0)
Computers / IT	3 (2-1)
Pakistan Studies	2 (2-0)
Islamic Studies	2 (2-0)
Communications Skills	3 (3-0)
English	3 (3-0)
Basic Agriculture	3 (2-1)
	Sub-Total 28

## 2. Interdisciplinary Foundation Courses

Agronomy	3 (2-1)
Plant Breeding & Genetics	3 (2-1)
Entomology	3 (2-1)
Plant Pathology	3 (2-1)
Food Technology	3 (2-1)
Horticulture	3 (2-1)
Soil Sciences	3 (2-1)
Agriculture Economics	3 (2-1)
	Sub-Total 24

## 3. Supporting Courses {6-8 courses (3 Cr. hr) amongst below}

Agriculture Extension	
Forestry & Range Management	
Animal Science	
Marketing & Agri Business	
Rural Development	
Human Nutrition	
Agriculture Chemistry	
Agriculture Engineering	
Water Management	
Any other discipline recommended by the university	
	Sub-Total 18-24

<b>Sub-Total during the first four semesters</b>	70-76
<b>Semester 5, 6, 7 &amp; 8</b>	56-60
<b>Project / Internship</b>	04
<b>Grand Total</b>	130-140

- 1 credit of theory = one contact hour per week for 16-18 weeks and 1 practical/Lab hour = 3 contact hours per week for 16-18 weeks.
- In case of non availability of department of supporting courses, courses from foundation courses can be opted.

**SCHEME OF STUDIES  
CURRICULUM FOR SOIL SCIENCE  
BS/BSc. (HONS.) AGRICULTURE**

**Foundation Course**

SS-301 Introduction to Soil Science 3(2-1)

**Major Courses**

SS-501 Physical Properties of Soil 4(3-1)

SS-502 Salt-Affected Soils and Water Quality 4(3-1)

SS-503 Chemical Properties of Soil 4(3-1)

SS-504 Soil Fertility and Fertilizers 4(3-1)

SS-505 Analytical Techniques in Soil Science 3(1-2)

SS-506 Soil Survey and Land Evaluation 3(2-1)

SS-507 Soil Genesis and Taxonomy 3(2-1)

SS-508 Soil and Water Conservation 3(2-1)

SS-601 Soil Microbiology 4(3-1)

SS-602 Soil Water Plant Relationship 3(3-0)

SS-603 Environmental Pollution and Management 3(3-0)

SS-604 Land Degradation and Management 3(3-0)

SS-605 Research Project and Scientific Writing 3(2-1)

SS-606 Trace Elements in Agriculture 3(2-1)

SS-607 Municipal Waste Management 3(3-0)

SS-608 Internship/ Research Project 6(0-6)

**Total 56 (38-18)**

## SEMESTER WISE BREAK UP

Course No.	Course Title	Credit Hours
<b>5<sup>th</sup> Semester</b>		
SS-501	Physical Properties of Soil	4(3-1)
SS-503	Chemical Properties of Soil	4(3-1)
SS-505	Analytical Techniques in Soil Science	3(1-2)
SS-507	Soil Genesis and Taxonomy	3(2-1)
	Elective – I	3(3-0)
	<b>Total Credit Hours</b>	<b>17</b>
<b>6<sup>th</sup> Semester</b>		
SS-502	Salt-Affected Soils and Water Quality	4(3-1)
SS-504	Soil Fertility and Fertilizers	4(3-1)
SS-506	Soil Survey and Land Evaluation	3(2-1)
SS-508	Soil and Water Conservation	3(2-1)
	Elective – II	3(3-0)
	<b>Total Credit Hours</b>	<b>17</b>
<b>7<sup>th</sup> Semester</b>		
SS-601	Soil Microbiology	4(3-1)
SS-603	Environmental Pollution and Management,	3(3-0)
SS-605	Research Project and Scientific Writing	3(2-1)
SS-607	Municipal Waste Management	3(3-0)
	Elective – III	3(3-0)
	<b>Total Credit Hours</b>	<b>16</b>
<b>8<sup>th</sup> Semester</b>		
SS-602	Soil Water Plant Relationship	3(3-0)
SS-604	Land Degradation and Management	3(3-0)
SS-606	Trace Elements in Agriculture	3(2-1)
SS-608	Internship/ Research Project	6(0-6)
	<b>Total Credit Hours</b>	<b>15</b>
	<b>Sub Total</b>	<b>135</b>

## DETAIL OF COURSES

### Foundation Course

**SS-301 INTRODUCTION TO SOIL SCIENCE 3(2-1)**

#### Objectives

This course is designed to introduce the concept and importance of soil science for agriculture students at under-graduate level.

#### Course Outline

1. Definition of earth, geology and soil science; Disciplines of soil science.
2. Soil forming rocks and minerals: Types and their formation.
3. Weathering of rocks and minerals: Parent materials
4. Soil formation: Processes and factors affecting
5. Soil profile and its description
6. Physical, chemical and biological properties of soil
7. Introduction to soil classification and land use capability classes
8. Soil organic matter: Sources, composition and significance
9. Elements essential for plant growth
10. Organic and inorganic fertilizers
11. Salt-affected and waterlogged soils
12. Soil and water conservation
13. Soil and water pollution

#### Practicals

1. Soil sampling and handling
2. Preparation of saturated soil paste
3. Determination of soil water contents
4. Analysis of irrigation water, report writing and interpretation.
5. Determination of soil texture and bulk density
6. Fertilizers: Identification, composition and calculation of nutrient percentage
7. Determination of soil pH and E<sub>c</sub>
8. Determination of soil organic matter

#### Books Recommended

1. Bashir, E. and R. Bantel. 2001. Soil Science. National Book Foundation, Islamabad.
2. Brady, N.C. and R.R. Weil. 2007. The Nature and Properties of Soils. 14<sup>th</sup> Ed. Pearson Education, Upper Saddle River, NJ, USA.
3. Singer, M.J. and D.N. Munns. 2002. Soils- An Introduction. 5<sup>th</sup> Ed.

Prentice-Hall, Inc., Upper Saddle River, NJ, USA.

4. Hillel, D. 2008. Soil in the Environment: Crucible of Terrestrial Life. Elsevier Inc., Burlington, MA, USA.

## **Major Courses**

**SS-501      PHYSICAL PROPERTIES OF SOIL      4(3-1)**

### **Objectives**

The students will learn important physical properties of soil and their role in water and nutrient holding capacity, aeration and their significance in crop growth.

### **Course Outline**

1. Introduction
2. Soil texture, specific surface area and importance
3. Soil structure: Genesis, description and importance
4. Soil crusting and sealing: Mechanism and significance
5. Particle and bulk density: Description and significance
6. Total porosity and pore-size distribution and their significance
7. Soil air and aeration: Description and significance
8. Soil temperature: Factors affecting, significance and management
9. Soil color: Causes and significance
10. Soil consistency and strength: Description and significance
11. Soil water: Soil water potential and its components; Soil hydraulic properties; Soil available water capacity
12. Soil compaction: Causes and remedies
13. Soil tillage: Systems and significance
14. Introduction to solute movement in soil

### **Practicals**

1. Textural analysis: Hydrometer, Pipette and Feel methods
2. Determination of bulk and particle density
3. Total soil porosity estimation
4. Aggregate stability estimation
5. Measurement of soil water contents
6. Soil color and its interpretation
7. Determination of soil strength/soil penetrometer resistance

### **Books Recommended**

1. Brady, N.C. and R.R. Weil. 2009. Elements of the Nature and Properties of Soils. 3<sup>rd</sup> Ed. Pearson Education, Upper Saddle River,

NJ, USA.

2. Hillel, D. 2004. Introduction to Environmental Soil Physics. Elsevier, San Diego, CA, USA.
3. Jury, W. A. and R. Horton. 2004. Soil Physics. 6<sup>th</sup> Ed. John Wiley & Sons. Inc., NY, USA.
4. Hillel, D. 2008. Soil in the Environment: Crucible of Terrestrial Life. Elsevier Inc., Burlington, MA, USA.

## **SS-502      SALT-AFFECTED SOILS AND WATER QUALITY**

**4(3-1)**

### **Objectives**

The objective of this course is to introduce the kinds of salts present in soil and irrigation water, their impacts on soil management and crop growth, and how such soils can be reclaimed.

### **Course Outline**

1. Salt-affected soils: Introduction, classification, properties and extent
2. Salination and sodication: Gapon and pHc equations
3. Systems of characterization of salt-affected soils
4. Chemistry of soil solution
5. Root zone salinity
6. Reclamation and management of salt-affected soils
7. Irrigation water: Criteria and classification
8. Groundwater: Characteristics and resources
9. Salinity build up and prediction
10. Waterlogged soils: Causes, impact and management
11. Bio-saline Agriculture

### **Practicals**

1. Sampling of salt-affected soils and irrigation water
2. Saturated soil extract analysis
3. Analysis of irrigation water, classification and report preparation
4. Determination of gypsum requirement of soil and water
5. Field visits of salt-affected / waterlogged areas and projects

### **Books Recommended**

1. Ghafoor, A., M. Qadir and G. Murtaza. 2004. Salt-Affected Soils: Principles of Management. Allied Book Center, Lahore, Pakistan.
2. Bohn, H.L., B.L. McNeal and G.A.O. Connor. 2001. Soil Chemistry. 3<sup>rd</sup> Ed. John Wiley & Sons Inc., NY, USA.
3. Essington, M.E. 2004. Soil and Water Chemistry: An Integrated Approach. CRC Press, Boca Raton, FL, USA.
4. Molden, D. (ed.). 2007. Water for Food, Water for Life: A Comprehensive Assessment of Water Management in Agriculture. Earthscan Colombo,

IWMI, Sri Lanka.

5. Tanji, K.K. and N.G. Kielm. 2002. Agricultural Drainage Water Management in Arid and Semi-arid Areas. FAO Agri. Drainage Paper 61. Rome, Italy.

## **SS-503      CHEMICAL PROPERTIES OF SOIL      4(3-1)**

### **Objectives**

The students will learn chemical properties of soil and their role in nutrient availability and plant growth.

### **Course Outline**

1. Introduction
2. Silicate clay minerals: Structures and properties
3. Allophanes and sesquioxides
4. Soil colloids: Inorganic and organic
5. Charge characteristics of colloids: Sources and significance
6. Cation exchange and its significance
7. Zero point of charge
8. DDL theory: Assumptions and properties
9. Anion exchange and its significance
10. Soil pH: Description and significance
11. Basic cation saturation percentage: Description and significance; Buffering capacity of soils and significance
12. Exchange equations: Limitations and assumptions
13. Sorption in soils

### **Practicals**

1. Determination of pH of different soil to water ratios and saturated soil paste
2. Determination of soluble and extractable cations in soil
3. Determination of CEC
4. Determination of basic cation saturation percentage
5. Determination of lime contents in soil

### **Books Recommended**

1. Bohn, H. L., D. L. McNeal and G. A. O'Connor. 2001. Soil Chemistry. 3<sup>rd</sup> Ed. John Wiley & Sons. Inc., NY, USA.
2. Essington, M.E. 2004. Soil and Water Chemistry: An Integrated Approach. CRC Press, Boca Raton, FL, USA.
3. Sparks, D.L. 2003. Environmental Soil Chemistry. 2<sup>nd</sup> Ed. Academic Press, Inc., San Diego, CA, USA.
4. Sposito, G. 2008. The Chemistry of Soils. 2<sup>nd</sup> Ed. Oxford University

Press, NY, USA.

5. Tan, K.H. 2009. Environmental Soil Science. 3<sup>rd</sup> Ed. CRC Press, Greensboro, GA, USA.

## **SS-504 SOIL FERTILITY AND FERTILIZERS 4(3-1)**

### **Objectives**

This course is aimed to highlight the role of essential plant nutrients in crop production and how these nutrients can be replenished in soil through application of organic and inorganic fertilizers.

### **Course Outline**

1. Crop growth and factors affecting
2. Essential plant nutrients: Functions, deficiency and toxicity
3. Movement of nutrients to roots and uptake by plants
4. Nitrogen: Gains and losses in soil
5. N-fertilizers and their fate in soil
6. Phosphorus: Forms in soil
7. P-Fertilizers and their behavior in soils; Crop responses; Factor affecting and residual effects
8. Potassium: Forms, amount, exchange equilibrium and factors affecting
9. Soil status of calcium, magnesium and sulfur and factors affecting
10. Integrated plant nutrient management: Organic and inorganic sources
11. Nutrients behavior in submerged soils

### **Practicals**

1. Fertilizers: Identification and composition
2. Fertilizer requirement calculation
3. Fertilizer analyses: Urea, CAN, DAP, SOP
4. Determination of available P and K in soil
5. Plant analysis for N, P and K
6. Visit to fertilizer factories, soil fertility institutes and demonstration trials

### **Books Recommended**

1. Ahmad, N. and M. Rashid. 2003. Fertilizer and Their Use in Pakistan: An Extension Guide. Planning Commission, National Fertilizer Development Centre, Islamabad, Pakistan.
2. Havlin, J.L., J.D. Beaton, S.L. Tisdale and W.L. Nelson. 2005. Soil Fertility and Fertilizers: An Introduction to Nutrient Management. 7<sup>th</sup> ed. Pearson Education, Prentice Hall, Upper Saddle River, NJ, USA.
3. Mengel, K. and E.A. Kirkby. 2001. Principles of Plant Nutrition. 5<sup>th</sup> Ed. International Potash Inst., Bern, Switzerland.



4. Elsworth, L. and W.O. Relay (eds.). 2009. Fertilizers: Properties, Applications and Effects. Nova Science. Publ. Inc., NY, USA.

## **SS-505 ANALYTICAL TECHNIQUES IN SOIL SCIENCE 3(1-2)**

### **Objectives**

This course is aimed to teach students how soil and plant samples are collected, processed, analyzed and interpreted.

### **Course Outline**

1. Quality assurance and safety measures in the laboratory
2. S.I. and derived S.I. units
3. Extraction, digestion and dry ashing
4. Analytical techniques
5. Interpretation of analytical results

### **Practicals**

1. Preparation of standard solutions
2. Soil and plant sampling and preparation
3. Introduction to specialized equipments
4. Instrumental analyses
  - a. Conductivitymetry: Principle and instrumentation
  - b. Potentiometry: Principle and instrumentation
  - c. Spectrophotometry: Principle and instrumentation
  - d. Emission spectroscopy: Principle and instrumentation
  - e. Absorption spectroscopy: Principle and instrumentation

### **Books Recommended**

1. Ryan, J., G. Estefan and A. Rashid. 2001. Soil and Plant Analysis. Laboratory Manual. International Centre for Agricultural Research in the Dry Areas. Aleppo, Syria.
2. Smith, K.A. and M.S. Cresser. 2003. Soil and Environmental Analysis: Modern Instrumental Techniques. CRC Press. Boca Raton, FL, USA.
3. Sparks, D. L. et al. (eds.). 1996. Methods of Soil Analysis. Part 3. Chemical Methods. SSSA, ASA Series No.5, Madison, WI, USA.
4. Carter, M.R. and E.G. Gregorid (eds.). 2008. Soil Sampling and Methods of Analysis. 2<sup>nd</sup> Ed. Taylor & Fancis Group, Boca Raton, FL, USA.
5. Jones, J.B. Jr. 2001. Laboratory Guide for Conducting Soil Tests and Plant Analysis. CRC Press, Boca Raton, FL, USA.
6. Tandon, H.L.S. 2005. Methods of Analysis of Soils, Plants,

**SS-506 SOIL SURVEY AND LAND EVALUATION 3(2-1)**

**Objectives**

The objective of this course is to teach students about techniques used for soil survey and characteristics of soils assessed for their suitability for various uses.

**Course Outline**

1. Soil and landform
2. Kinds and levels of soil survey
3. Aerial photographs and their interpretation
4. Stereoscopic vision theory
5. Field traverse selection
6. Purposes, characteristics and identification of mapping units
7. Mapping legends, mapping and taxonomic units
8. Interpretation and use of soil survey reports
9. Land capability and suitability classification
10. Application of GIS, GPS and remote sensing in soil survey

**Practicals**

1. Reading of topographic maps and calculation of slope percentage
2. Stereoscope: Types and uses
3. Interpretation of aerial photographs
4. Demonstration of GIS, GPS and remote sensing techniques
5. Field visits

**Books Recommended**

1. Soil Survey Division Staff. 2002. Soil Survey Manual. USDA, University Press of Pacific, Washington, DC, USA.
2. Lagacherie, P., A. McBratney and M. Voltz. 2007. Digital Soil Mapping – An Introductory Perspective. Elsevier Publishers, Amsterdam, The Netherlands.
3. Burt, R. (ed.). 2004. Soil Survey Laboratory Methods Manual Soil Survey Investigations Report No. 42, Version 4.0. USDA, Washington, DC, USA.

**Objectives**

The aim of this course is to teach students the soil formation, morphology and how different soils are named and classified.

**Course Outline**

1. Weathering of rocks and minerals; Types of parent materials
2. Soil genesis and factors affecting
3. Pedogenic processes
4. Soil morphology
5. Description of soil profiles; Special soil features
6. Soil taxonomy: Categories and nomenclature
7. Soil orders in Pakistan: Extent and their significance

**Practicals**

1. Soil profile description of important soil series
2. Field trips
3. Identification of soil orders

**Books Recommended**

1. Buol, S.W., M.P. Walker, R.J. Southard and P.A. McDaniel. 2003. Soil Genesis and Classification. 5<sup>th</sup> Ed. Iowa State University Press, Ames, IA, USA.
2. Rabenhorst, M. C. et al. (eds.). 1998. Quantifying Soil Hydromorphology. SSSA Special Publ. No. 54, Madison, WI, USA.
3. Soil Survey Staff. 2006. Keys to Soil Taxonomy. 10<sup>th</sup> Ed. USDA, Washington, DC, USA.
4. Schaetzl, R. and S. Anderson. 2005. Soils: Genesis and Geomorphology. Cambridge University Press, Cambridge, UK.

**Objectives**

In this course, students will learn various ways and means of soil and water losses and how these losses can be decreased with various strategies for their conservation.

**Course Outline**

1. Soil erosion: Description, types and impact on environment
2. Water and wind erosion: Forms, causes and damages
3. Gravity erosion and landslides
4. Erosion prediction: Modified Universal Soil Loss Equation; Wind erosion

equations

5. Erosion control and management: Agronomic, engineering and bioengineering practices
6. Hydrological cycle and its components
7. Water conservation and management practices, and water harvesting techniques
8. Strategies for soil, water and environment conservation
9. Socio-economic issues of soil and water conservation

## **Practicals**

1. Measurement of slope gradient and discharge in water course
2. Calculation of runoff and soil losses
3. Visit to agro-meteorological / weather station
4. Visit of agronomical, engineering and bio-engineering practices used for soil and water conservation

## **Books Recommended**

1. Bhushan, L.S., I.P. Abrol, and M.S.R.M. Rao. 1998. Soil and Water Conservation: Challenges and Opportunities. Vol. 1 & 2 A. A. Balkema, Rotterdam, The Netherlands.
2. Ehlers, W. and G. Michael. 2003. Water Dynamics in Plant Production. CAB Publishing, Cambridge, UK.
3. Morgan, R.P.C. 2005. Soil Erosion and Conservation. 3rd Ed. Longman Group Ltd., Essex, UK.
4. Unger, P.W. 2006. Soil and Water Conservation Handbook: Policies, Practices, Conditions and Terms. Haworth Food and Agriculture Products Press, NY, USA.
5. Fangmeier, D.D., W.J. Elliot and S.R. Workman. 2006. Soil and Water Conservation Engineering. 5<sup>th</sup> Ed. Thomson Delmar Learning, NY, USA.

## **SS-601 SOIL MICROBIOLOGY**

**4(3-1)**

### **Objectives**

The objective of this course is to introduce the kinds and significance of microorganisms present in soil and their role in crop productivity and environmental quality.

### **Course Outline**

1. Introduction
2. Distribution, functions and classification of bacteria, archaea, actinomycetes, fungi, algae and protozoa
3. Growth phases and environmental factors affecting soil microflora
4. Soil organic matter decomposition; Immobilization and mineralization of carbon; Microbial fixation and release of CO<sub>2</sub>

5. Microbial transformations of nitrogen; N<sub>2</sub>-fixation
6. Microbial transformations of P, K, S, Fe and Mn
7. Microbial inoculants for N and P
8. Microbial transformations in flooded soils

## **Practicals**

1. Introduction to laboratory equipments
2. Media preparation
3. Measurement of microbial population and activity in soil
4. Algal culturing and their microscopy
5. Study of mineralization, nitrification and denitrification

## **Books Recommended**

1. Sylvia, D.M., J.J. Fuhrmann, P.G. Hartel and D.V. Zuberer. 2005. Principles and Applications of Soil Microbiology. Prentice Hall International, NJ, USA.
2. Paul, E.A. (ed.). 2007. Soil Microbiology, Ecology and Biochemistry. 3<sup>rd</sup> Ed. Elsevier, Oxford, UK.
3. Coyne, M.S. 1999. Soil Microbiology: An Exploratory Approach. Delmar Publishers, NY, USA.
4. Coyne, M.S. 1999. Lab Manual to Accompany Soil Microbiology: An Exploratory Approach. Delmar Publishers, NY, USA.

## **SS-602 SOIL WATER PLANT RELATIONSHIP 3(3-0)**

### **Objectives**

In this course, students will learn mechanisms of water and nutrient movement in soils and plants, and their relationships.

### **Course Outline**

1. Functions and properties of water
2. Components of soil and plant water potentials
3. Soil-plant-water relations
4. Movement of water and ions in soil and plant
5. Water absorption and root stem pressure
6. Water and mineral nutrient uptake
7. Photosynthesis and transpiration
8. Soil-plant-atmosphere continuum
9. Adaption of plants to adverse soil-water conditions

### **Books Recommended**

1. Kirkham, M.B. 2005. Principles of Soil and Plant Water Relations. 1<sup>st</sup> Ed. Elsevier Academic Press, San Diego, CA, USA.
2. Kramer, P.J. and J.S. Boyer. 1995. Water Relations of Plants and Soils. Academic Press, San Diego, CA, USA.

3. Rending, V.V. and H.M. Taylor. 1989. Principles of Soil-Plant Inter Relationships. McGraw Hill Publishing Co., NY. USA.
4. Jury, W.A. and R. Horton. 2004. Soil Physics. 6<sup>th</sup> Ed. John Wiley & Sons, Inc., Hoboken, NJ, USA.
5. Hillel, D. 2008. Soil in the Environment: Crucible of Terrestrial Life. Elsevier Inc., Burlington, MA, USA.

**SS-603 ENVIRONMENTAL POLLUTION AND MANAGEMENT**

**3(3-0)**

**Objectives**

The aim of this course is to teach students regarding the soil, water and air pollution and impact on soil and human health.

**Course Outline**

1. Introduction to soil, water and air pollution
2. Sources and causes of pollution
3. Types of pollutants: Inorganic, organic and radioactive
4. Fate of pollutants: Adsorption, precipitation, degradation, movement and plant uptake
5. Degradation of pollutants: Chemical, biological and light
6. Factors affecting movement of pollutants in soil
7. Impact of pollutants on soil, plant, animal and human health
8. Water pollution: Drinking and irrigation; BOD, COD and eutrophication
9. Atmospheric pollutants; Green house gases
10. Strategies for pollution control
11. Management and control: Control measure at source, soil and water treatment Public awareness
12. Legislation and socio-economic issues of environmental pollution

**Books Recommended**

1. Harrison, R.M. (ed.). 2001. Pollution: Causes, Effects and Control. 4<sup>th</sup> Ed. The Royal Society of Chemistry, Cambridge, UK.
2. Ashfar, M. and M.A. Saleem. 2010. Environmental Pollution and Agriculture. Pak Book Empire, Lahore.
3. Raven, B., L.R. Berg and D.M. Hassenzahl. 2008. Environment. 6<sup>th</sup> Ed. John Wiley & Sons, NY, USA.
4. Clinic, C., M. Ignazio and G.M. Lodovica. 2008. Sustainable Development and Environmental Management: Experiences and Case Studies. 1<sup>st</sup> Ed. Springer Publishers, Dordrecht, The Netherlands.
5. Cunningham, W.P., M.A. Cunningham and B.W. Saigo. 2007. Environmental Science: A global Concern. 9<sup>th</sup> Ed. McGraw Hill, NY, USA.
6. Asthana, D.K. and M. Asthana. 2003. Environment Problems &

**SS-604 LAND DEGRADATION AND MANAGEMENT 3(3-0)**

**Objectives**

In this course, students will learn types of degraded lands and their efficient utilization for crop production.

**Course Outline**

1. Total land resources and their use: Global and Pakistan
2. Degraded lands: Introduction, causes and types
3. Nutrient dynamics and management in degraded lands
4. Threats to national land use
5. Drought; Low and erratic precipitation, lowering of water table; Rising temperature
6. Water and wind erosion
7. Nutrient and organic matter depletion
8. Salinization of soil and water
9. Sea water intrusion
10. Soil physical degradation: Crusting and compaction
11. Water-logging
12. Land sliding

**Books Recommended**

1. Pessarakali, M. (ed.). 2010. Handbook of Plant and Crop Stress. 3<sup>rd</sup> Ed. Marcel and Dekker Inc., NY, USA.
2. Wong, M.H., J.W.C. Wong and A.J.M. Baker. 1999. Remediation and management of degraded lands. CRC Press, Boca Raton, FL, USA.
3. Johnson, D.L. and L.A. Leiois. 2007. Land Degradation: Creation and Destruction. 2<sup>nd</sup> Ed. Rowman & Littlefield Publishers, Inc. USA.
4. Chisholm, A. and R. Dumsday. 2009. Land Degradation: Problems and Policies. Cambridge University Press, London, UK.

**SS-605 RESEARCH PROJECT AND SCIENTIFIC WRITING 3(2-1)**

**Objectives**

This course will enable the students to conceive problem oriented research, plan, execute and document research results.

**Course Outline**

1. The purpose and kinds of research
2. General consideration and identification of the problem
3. Background reading and review of literature: Objectives, sources,

- collection and citation
4. Preparation of research project: Title, objectives, methodology, work plan and budget.
  5. Scientific writing
    - 5.1 Aims, components and organizing the material
    - 5.2 Techniques of composition: Table of contents, list of tables and figures, standard abbreviation
    - 5.3 Footnoting, documentation
    - 5.4 Referencing: Alphabetical and chronological order
    - 5.5 Appendices and bibliography
  6. Editing and evaluating the final draft.

## **Practicals**

1. Exercise of writing research proposal
2. Assigning different titles to the students
3. Exercise of collecting materials from different sources on assigned topics
4. Oral presentation

## **Books Recommended**

1. Ghafoor, A., G. Murtaza and S.I. Hussain. 2006. Fundamental of scientific communications and presentations. Allied Book Centre, Urdu Bazaar, Lahore. (ISBN 969-547-01-7). 190 p.
2. Blaxter, L., C. Hughes and M. Tight. 2006. How to Research. 3<sup>rd</sup> Ed. Open University Press McGraw Hill, Berkshire, UK.
3. Luellen, R.W. 2001. Fine-tuning your writing. Wise Owl Publishing Company, Madison, WI, USA.
4. Ghafoor, A. 2007. Manual for Synopsis and Thesis Preparation. Univ. Agri., Faisalabad, Pakistan (ISBN 969-8237-7-0). 109 p.
5. Katz, M.J. 2009. From Research to Manuscript – A Guide to Scientific Writing. 2<sup>nd</sup> Ed. Springer-Verlag, Frankfurt, Germany.
6. Harrad, S., L. Batty, M. Diamond and G. Arhonditsis. 2008. Students Projects in Environmental Science. John Wiley & Sons Ltd. West Sussex, England.

## **SS-606 TRACE ELEMENTS IN AGRICULTURE 3(2-1)**

### **Objectives**

The objective of this course is to equip the students with knowledge about nutritional importance and environmental hazards of trace elements in agriculture.

### **Course Outline**

1. Introduction
2. Trace elements status of Pakistan soils and their response to various



- crops.
3. Use of trace elements as commercial fertilizers.
  4. Micronutrients: Forms in soils and factors affecting their availability
  5. Trace elements in agriculture (Zn, Mn, Cu, Fe, Mo, Co, B, Cl): Nutritional aspects, availability, deficiency, toxicity and interactions.
  6. Critical limits and functions in plants and their mobility.
  7. Trace elements pollutants (Ag, As, Cd, Co, Cr, Hg, Ni, Pb, Se and V) in terrestrial and atmospheric eco-systems and their effects on plants, animal and human health.
  8. Study of National Environmental Quality Standards (NEQS) in soil and water.

## **Practicals**

1. Analytical test of trace elements in soil and plant.
2. Deficiency and toxicity symptoms

## **Books Recommended**

1. Adriano, D.C. 2001. Trace elements in the Terrestrial Environment: Biogeochemistry, Bioavailability and Risks of Metals. Springer – Verlag New York, USA.
2. Bell, R.W. and B. Dell. 2008. Micronutrients for Sustainable Food, Feed, Fiber and Bio-energy Production. International Fertilizer Industry Association (IFA), Paris, France.
3. Kabata – Pendias, A. and H. Pendias. 2001. Trace Elements in Soils and Plants. 3<sup>rd</sup> Ed. CRC Press, Inc. Boca Raton, FL, USA.
4. Mortvedt, J.J., F.R. Cox, L.M. Shuman and R.M. Welch. 1991. Micronutrients in Agriculture. 2<sup>nd</sup> Ed. Soil Sci. Soc. Am. Inc., Madison, WI, USA.

## **SS-607      MUNICIPAL WASTE MANAGEMENT      3(3-0)**

### **Objectives**

The aim of this course is to equip the students with knowledge of types and extent of municipal waste generation and to convert into useful products.

### **Course Outline**

1. Introduction
2. Municipal waste: Sources, types and composition
3. Nature and management of sewerage and industrial waste water
4. Solid waste management and role of community
5. Methods and technologies in solid waste management
6. Utilization of municipal waste as organic fertilizer and soil conditioner
7. Production of energy from municipal waste

8. Ethical issues of municipal waste management
9. International waste management strategies

### **Books Recommended**

1. Pichtel, J. 2005. Waste Management Practices: Municipal, Hazardous and Industrial. CRC Press, Taylor and Francis Group, Boca Raton, FL, USA.
2. Pepper, I.L., C.P. Gerba and M.L. Brusseau (eds.). 2006. Environmental and Pollution Science. 2<sup>nd</sup> Ed. Elsevier / Academic Press, San Diego, CA, USA.
3. Dhamija, U. 2006. Sustainable Solid Waste Management: Issues, Policies, and Structures. Academic Foundation, New Delhi, India.
4. Cheremisiuff, N.P. 2002 Handbook of Solid Waste Management and Waste Minimization Technologies. Elsevier Science, Burlington, MA, USA.
5. Tchobanoglous, G., H. Theisen and S. Vigil. 1993. Integrated Solid Waste Management. Irwin McGraw Hill. USA.
6. Ghafoor, A. 2010. Environmental Pollution:Types, sources and management. Allied Book Centre, Lahore.

### **SS-608      INTERNSHIP/RESEARCH PROJECT      6(0-6)**

It will include orientation regarding literature review and project planning, e.g., title, hypothesis, objectives, methodology, execution, report writing, presentation and evaluation. The mode of evaluation of the progress of work will be determined by the respective host institution.

In case of research projects, each student will conduct research under the supervision of respective supervisor and will write a report.

**SCHEME OF STUDIES**  
**Soil Science Courses for**  
**MS/M.Sc.(Hons.)/Ph.D. Program**

<b>Course No.</b>	<b>Title of the course</b>	<b>Credit hours</b>
SS-701	Instrumental Analysis and Analytical Techniques	3(0-3)
SS-702	Soil Chemistry	4(3-1)
SS-703	Soil Fertility and Plant Nutrition	4(3-1)
SS-704	Soil Microbiology and Biochemistry	4(3-1)
SS-705	Soil Classification	4(3-1)
SS-706	Salt-Affected Soils	3(3-0)
SS-707	Soil Physics	4(3-1)
SS-708	Soil Mineralogy	3(3-0)
SS-709	Soil Plant Relationship	3(3-0)
SS-710	Advanced Soil Chemistry	3(3-0)
SS-711	Advanced Soil Fertility	3(3-0)
SS-712	Advanced Soil Microbiology	3(3-0)
SS-713	Advanced Soil Physics	3(3-0)
SS-719	Special Problem	1(1-0)
SS-720	Seminar	1(1-0)

**Note:**

1. *Minimum credit hours for M.Sc. (Hons.) degree are 35 for course work including minor subjects which shall not exceed one-third of the total.*
2. *For the award of degree for M.Sc. (Hons.) Agriculture (Soil Science) thesis carries a weightage of 10 credit hours.*
3. *For the award of Ph.D. degree minimum credit hours for course work are 18 including 6 in minor subjects.*

## DETAIL OF COURSES

**SS-701      INSTRUMENTAL ANALYSIS AND                      3(0-3)**  
**ANALYTICAL TECHNIQUES**

### Objectives

The objective of this course is to equip the students with principle, theory and operation of the specialized instruments used for soil and plant analyses.

### Course Outline

1. Laboratory management and sample handling
2. Use of basic laboratory equipments: Furnace, oven, desiccator, balance. etc.
3. Specialized instruments: Principle, theory and operation
  - 3.1 Spectrophotometer: UV, visible and IR
  - 3.2 Flame photometer
  - 3.3 Atomic absorption spectrophotometer
  - 3.4 Inductively coupled plasma meter and direct current plasma meter
  - 3.5 Chromatography: Paper, thin layer, gas and HPLC
  - 3.6 Microscopy: Scanning and transmission
  - 3.7 X-ray diffractometry and electron probe micro-analysis
  - 3.8 Mass spectrophotometry
  - 3.9 Electro Ultra Filtration
  - 3.10 Ion meter: selective ion electrodes
  - 3.11 EM-38 and EC probe
  - 3.12 Neutron moisture probe/time domain reflectrometry (TDR)
  - 3.13 Oxygen diffusion rate meter
  - 3.14 Thermocycler PCR (polymerase chain reaction)
  - 3.15 Gel electrophoresis apparatus
4. Applications: Data analysis and management

### Books Recommended

1. DeLevie, R. 1997. Quantitative Chemical Analysis. McGraw-Hill Co. Inc. New York, USA.
2. Harris, D.C. 2006. Quantitative Chemical Analysis. 7<sup>th</sup> Ed. W. H. Freeman & Co. NY, USA.
3. Smith, A. K. and M.S. Cresser. 2004. Soil and Environmental Analysis: Modern Instrumental Techniques. 3<sup>rd</sup> Ed., Marcel & Dekker, Inc., USA.
4. Spark, D.L. (ed.) 1996. Methods of Soil Analysis. Part.3.

Chemical Methods. SSSA, ASA Series No.5. Madison, WI, USA.

5. Tandon, H. 2004. Methods of Analysis of Soils, Plants, Waters and Fertilizers. Fertilizer Development and Consultation Organization, New Delhi, India.

## **SS-702      SOIL CHEMISTRY                      4(3-1)**

### **Objectives**

The objective of this course is to understand chemical principles, ion exchange, retention and chemical remediation.

### **Course Outline**

1. Chemical principles
2. Water and solute interactions
3. Soil solution-solid interaction
4. Mineral dissolution: Congruent and incongruent
5. Neo-formation of minerals in soil
6. Thermodynamics and applications in soil
7. Organic matter: Composition and fractionation
8. Surface chemistry of soil matrix
9. Sorption and desorption: Chemical, physical and specific
  - 9.1 Langmuir, Freundlich and Vanselow models
10. Cation exchange: Selectivity coefficients, equivalent fraction concept
  - 10.1 Hysteresis in ion exchange
  - 10.2 Anion exclusion
  - 10.3 Complementation effect.
  - 10.4 Zeta Potential
11. Molecular retention: Specific and non-specific
12. Reactions of metal chelates in soils
13. Chemical behavior of ions / elements in aerated and submerged soils
14. Buffering reactions in soil
15. Chemical remediation of contaminated soils and water

### **Practicals**

1. Determination of exchangeable ions
2. Comparison of Freundlich and Langmuir models
3. Developing titration curves

### **Books Recommended**

1. Bohn, H.L., B.L. McNeal and G.A.O. Connor. 2001. Soil Chemistry. 3<sup>rd</sup> Ed. John Wiley & Sons Inc., NY, USA.
2. Essington, M. E. 2004. Soil and Water Chemistry. CRC Press, Boca Raton, FL, USA.

3. Sparks, D.L. 2003. Environmental Soil Chemistry. 2<sup>nd</sup> Ed. Academic Press, San Diego, CA, USA.
4. Sposito, G. 2008. The Chemistry of Soils. 2<sup>nd</sup> Ed. Oxford University Press, NY, USA.
5. Tan, K.H. 2009. Environmental Soil Science. 3<sup>rd</sup> Ed. CRC Press, Greenwatch Georgia, USA.

## **SS-703 SOIL FERTILITY AND PLANT NUTRITION 4(3-1)**

### **Objectives**

The objective of this course is to comprehend the nutrients behavior and management in soil.

### **Course Outline**

1. Basic soil-plant-relationship in plant nutrition
2. Macro and micro nutrients: Chemical behavior and management
3. Nutrient behavior in submerged soils
4. Soil fertility evaluation: Soil test calibration and plant analysis
  - 4.1 External and internal nutrient requirements
5. Fertilizer management strategies: Nutrient availability and fertilizer use efficiency
  - 5.1 Fertigation and foliar fertilization
  - 5.2 Integrated plant nutrient management (IPNM)
  - 5.3 Variable rate fertilizer technology
6. Nutrient-water and other interactions
7. Specific effects of fertilizers: Plant, human and animal health
8. Environmental implications of fertilizer use

### **Practicals**

1. Soil and Plant analysis for NPK
2. Interpretation of soil and plant analysis results
3. Deficiency Symptoms of macronutrients

### **Books Recommended**

1. Ahmad, N. and M. Rashid. 2003. Fertilizers and their use in Pakistan: An extension guide. Planning Commission, NFDC, Islamabad, Pakistan.
2. Bhatti, A.U. 2005. Spatial Variability & its Management in Agriculture. Higher Education Commission, Islamabad, Pakistan.
3. Havlin, J.L., J.D. H. Beaton, S.L. Tisdale and W.L. Nelson. 2005. Soil Fertility and Fertilizers. 7<sup>th</sup> Ed., Pearson Education, Singapore.
4. Mengel, K. and E.A. Kirkby. 2001. Principles of Plant Nutrition. 5<sup>th</sup> Ed. International Potash Inst., Bern, Switzerland.
5. Elsworth, L. and W.O. Relay (eds.). 2009. Fertilizers: Properties,

Applications and Effects. Nova Science. Publ. Inc., NY, USA.

6. Barker A.V. and D.J. Pilbeam. 2007. Handbook of Plant Nutrition. CRC Press, Boca Raton, FL, USA.

## **SS-704 SOIL MICROBIOLOGY AND BIOCHEMISTRY 4(3-1)**

### **Objectives**

The objective of this course is to equip the students regarding microbial behavior in soil and application in agriculture and the environment.

### **Course Outline**

1. Rhizosphere: Plant-microbes and microbe-microbe interactions
2. Microbial cycling of elements: Macro and micronutrients and heavy metals; Agricultural and environmental significance
3. Biochemistry and biotechnology of BNF; Application in agriculture and environment
4. Mycorrhizal symbiosis
5. Plant growth regulators, phytotoxins and siderophores: Microbiology and biochemistry
6. Composting: Microbiology and biotechnology; agricultural and environmental application
7. Bioremediation of contaminated soils: Biodegradation and detoxification
8. Use of stable isotopes in microbiological research
9. Metabolic and nucleic acid based analysis of soil microbial diversity
10. Bio-fertilizers: Present and future prospects

### **Practicals**

1. Isolation of bacteria, actinomycetes and fungi
2. Enrichment techniques
3. Sulphate reduction
4. Organic matter decomposition
5. Inoculation techniques
6. Techniques used in N<sub>2</sub>-fixation

### **Books Recommended**

1. Sylvia, D.M., J.J. Fuhrmann, P.G. Hartel, and D.V. Zuberer. 2005. Principles and Applications of Soil Microbiology. Prentice Hall International, NJ, USA.
2. Paul, E.A. (ed.). 2007. Soil Microbiology, Ecology and Biochemistry. 3<sup>rd</sup> Ed. Elsevier, Oxford, UK.
3. Maier, R.M., I.L. Pepper and C.P. Gerba. 2009. Environmental Microbiology. 2<sup>nd</sup> Ed. Academic Press Inc., San Diego, CA, USA.
4. Mukerji, K.G., C. Manoharachary and J. Singh. 2006. Microbial Activity in the Rhizosphere. Springer – Verlag, Berlin, Germany.

**Objectives**

The course is aimed to comprehend different soil categories and their importance for particular use.

**Course Outline**

1. Concepts and importance
2. Introduction to soil taxonomy
3. Criteria of classification
4. Properties diagnostic to categories
5. Diagnostic horizons and other diagnostic properties
6. Soil moisture regimes: Classes and importance
7. Soil temperature regimes: Classes and importance
8. Categories and nomenclature
9. Keys to categories: Order, suborder, great group and sub group FAO and other systems of classification
10. Agro ecological zones of Pakistan

**Practicals**

1. Designation of genetic horizons found in Pakistan.
2. Identification of taxonomic names: Orders, suborders, great groups, subgroups, families and series

**Books Recommended**

1. Buol, S.W., M.P. Walker, R.J. Southard and P.A. McDaniel. 2003. Soil Genesis and Classifications. 5<sup>th</sup> Ed. Iowa State University Press, Ames, IA, USA
2. Eswaran, H. et al. 2003. Soil Classification: A Global Desk Reference. CRC Press. Boca Raton, FL, USA
3. FAO. 1998. World Reference Base for Soil Resources. FAO, Rome, Italy
4. Soil Survey Division Staff. 2005. Soil Survey Manual. USDA, Washington DC, USA.
5. Soil Survey Staff. 2006. Keys to Soil Taxonomy. 10<sup>th</sup> Ed. USDA, Washington DC, USA.
6. USDA. 1998. Soil Taxonomy. Krieger Publishing Co., Washington DC, USA.



**Objectives**

Implications of excess salts and water in soil and their mitigation options will be studied in this course.

**Course Outline**

1. Salt-affected soils in Pakistan and global perspective
2. Genesis of saline and sodic soils
3. Classification systems of salt-affected soils
4. Effects of salinity and sodicity on soil characteristics
5. Derivation and applications of Gapon equation
6. Plant responses to saline and sodic conditions
7. Amelioration strategies and economic feasibility for salt-affected soils
8. Water requirements for reclamation
9. Concept of leaching fraction and its applications
10. Waterlogging: Causes and extent
  - 10.1. Soil and plant responses to waterlogging
  - 10.2. Amelioration strategies for waterlogged soils
11. Environmental impacts of salinity and waterlogging

**Books Recommended**

1. Ghafoor, A., M. Qadir and G. Murtaza. 2004. Salt-Affected Soils: Principles of Management. Allied Book Centre, Urdu Bazar, Lahore, Pakistan.
2. Pessarakli, M. (ed.). 2010. Hand Book of Plant and Crop Stress. 3<sup>rd</sup> Ed. Marcel & Dekker Inc., NY, USA.
3. Pierzynski, G.M., J.T. Sims and G.F. Vance. 2000. Soils and Environmental Quality. CRC Press. Boca Raton, FL, USA.
4. Schjonning, P., S. Elmholt and B.T. Christensen. 2004. Managing Soil Quality Challenges in Modern Agriculture. CABI Publisher Cambridge, MA, USA.
5. Singh, N.T. 2005. Irrigation and Soil Salinity in the Indian Subcontinent: Past and Present. Lehigh University Press, Bethlehem, Israel.
6. Tan, K.H. 2009. Environmental Soil Science. 3<sup>rd</sup> Ed. CRC Press, Boca Raton, FL, USA.
7. Viesmen, J., M.J. Hemmar, E.M. Perez and P.A. Chadik. 2009. Water Supply and Pollution Control. 8<sup>th</sup> Ed. Prentice Hall, NY, USA.

**Objectives**

The course is aimed to teach the students regarding movement of water, air, heat and pollutants in soil and their management.

## Course Outline

1. Soil physical properties and inter-relationships
2. Nature and physical behavior of clay and clay minerals
3. Properties of water: Molecular, fluid and colligative
4. Soil water potential and its components
5. Measurement of water in soil
6. Water characteristics curves: Hysteresis
7. Saturated and unsaturated water flow
8. Infiltration models: Horton, Kostiaikov, Green and Ampt, and Philip's
  - 8.1 Flow in capillary tubes: Poiseuilles' law
  - 8.2 Extended Darcy's law and its application
  - 8.3 Richards equations for transient water flow
9. Free and artificial drainage: Drainage design equations
10. Heat flow in soil: Thermal properties; Factor affecting; heat flow equations
11. Transport of gases and water vapors through soil
12. Solute transport in soil; Solute conservation equation, convection-dispersion equation
  - 12.1. Miscible displacement and breakthrough curves
  - 12.2 Transport of inert, non-adsorbing and adsorbing chemicals in soil
  - 12.3 Volatile organic compounds transport in soil
13. Estimation of crop water requirement

## Practicals

1. Measurement of soil water, soil strength, particle density, soil water characteristic curves, infiltration rate and saturated hydraulic conductivity
2. Problem sets

## Books Recommended

1. Hillel, D. 1998. Environmental Soil Physics. Elsevier Academic Press, San Diego, CA, USA.
2. Hillel, D. 2004. Introduction to Environmental Soil Physics. Elsevier Academic Press, San Diego, CA, USA.
3. Jury, W.A. and R. Horton. 2004. Soil Physics. 5<sup>th</sup> Ed. John Wiley & Sons, Inc., NY, USA.
4. Marshall, T.J., J.W. Holmes and C.W. Rose. 1996. Soil Physics. 3<sup>rd</sup> Ed. Cambridge University Press, Cambridge, UK.
5. Hillel, D. 2008. Soil in the Environment: Crucible of Terrestrial Life. Elsevier Inc., Burlington, MA, USA.

**SS-708      SOIL MINERALOGY      3(3-0)**

**Objectives**

The course is designed to understand the origin and formation of different soil minerals and their role in agriculture and environment.

**Course Outline**

1. Concept and significance
2. Chemical and structural classification of soil minerals
3. Carbonate, sulphate, sulphide and phosphate minerals
4. Phyllosilicate, allophane and imogolite in soils
5. Kaolin, halloysite and serpentine minerals: Structural and morphological characteristics
6. Micas: Structures, formulae, and weathering
7. Vermiculite: Structure, composition and properties
8. Smectites: Structure, composition and properties
9. Chlorites: Structure, composition and properties
10. Inter-stratification in layer silicates
11. Oxides and hydroxide of Al, Fe and Mn
12. Significance of soil minerals in plant nutrition, engineering, physics and microbiology
13. Impacts of soil minerals on environment

**Books Recommended**

1. Bashir, E. and R. Bantel. 2001. Soil Science. National Book Foundation, Islamabad.
2. Brindley, G.W. and G. Brown. 1984 Crystal Structures of Clay Minerals and their X-ray Identification. Mineralogical Soc. Monograph No.5. London, U.K.
3. Dixon, J.B. and S.B. Weed (eds.), 1989. Minerals in Soil Environment. 2<sup>nd</sup> Ed., SSSA. Madison, WI, USA.
4. Dixon, J.B. and D.G. Schulze. 2002. Soil Mineralogy with Environmental Applications. Soil Science Society of America, Madison, WI, USA.

**SS-709      SOIL PLANT RELATIONSHIP      3(3-0)**

**Objectives**

The course will address the intricacies of soil and plant relations for crop production.

**Course Outline**

1. Plant root system: Growth distribution, forms and factors affecting; Root hairs and CEC of roots; Shoot-root relationship
2. Rhizosphere: Root exudates and factors affecting; pH, redox potential

and significance

3. Mycorrhizae: Types and mechanisms for water and nutrient uptake
4. Uptake and transport of ions: Movement in soil and plant
5. Mechanisms of ion transport across membranes: Ion release into xylem, xylem and phloem transport; factors affecting ion uptake
6. Water movement from soil to plant root and within plant
7. Water use efficiency and transpiration ratio
8. Water stress, hypoxia and plant growth
9. Mechanisms of salt tolerance; Salinity-hypoxia interaction

### **Books Recommended**

1. Kirkham, M.B. 2005. Principles of Soil and Plant Water Relations. Elsevier Academic Press, San Diego, CA, USA.
2. Marschner, H. 1995. Mineral Nutrition of Higher Plants. 2<sup>nd</sup> Ed. Academic Press. Inc. Boca Raton, FL, USA.
3. Mengel, K. and E.A. Kirkby. 2001. Principles of Plant Nutrition. 5<sup>th</sup> Ed. Kluwer Academic Publishers, Dordrecht, The Netherlands.
4. Rendig, V.V. and H.M. Taylor. 1989. Principles of Soil-Plant Inter-relationships. McGraw Hill Publishing Co., NY, USA.

## **SS-710      ADVANCED SOIL CHEMISTRY      3(3-0)**

### **Course Outline**

1. Chemical thermodynamics of soils: Processes and variables
2. Chemical potentials: Metal oxides, hydroxides and silicates clays
3. Kinetics of soil chemical reactions
4. Precipitation and dissolution in soil environment
5. Surface electro-chemistry of colloids: Sorption of trace metal ions; Selectivity and pH
6. Inter-particles attraction: Solid-solid and solid-liquid interaction
7. Chemistry of submerged soils
8. Chemical transformations of selective elements in soils
9. Contamination of soils with organic and inorganic pollutants
10. Risk assessment of trace metals in soil and water
11. Integrated management of polluted environment
12. Sorption theory: Description and application for decontamination of soils and water
13. Recent developments in soil and environmental chemistry
14. Systems for waste water treatment: Physical, chemical and bio-chemical

### **Books Recommended**

1. Conklin, Jr. A.R. 2005. Introduction to Soil Chemistry Analysis and Instrumentation. John Wiley & Sons, Inc., Hoboken, NY, USA.
2. Kumar, A. 2004. Environmental Contamination and Bio-reclamation. APH Publishing Corporation, New Delhi, India.
3. Schjonning, P., S. Elmholt and B.T. Christensen. 2004. Managing

Soil Quality Challenges in Modern Agriculture. CABI Publisher Cambridge, MA, USA.

4. Sparks, D.L. 2003. Environmental Soil Chemistry. 2<sup>nd</sup> Ed. Academic Press, Inc., San Diego, CA, USA.
5. Sposito, G. 2008. The Chemistry of Soils. Oxford University Press, NY, USA.
6. Viessman, J.W. and M.J. Hammer. 2009. Water Supply and Pollution Control. 8<sup>th</sup> Ed. Prentice Hall NY, USA.

## **SS-711      ADVANCED SOIL FERTILITY      3(3-0)**

### **Course Outline**

1. Growth expression: Mitscherlich and Quadratic equations
2. Plant responses to applied nitrogen: Mathematical description
  - 2.1 Stubble management and N availability
  - 2.2 Effect of forms nitrogen on plant growth: Ammonia absorption, losses and toxicity
3. Phosphate phase equilibria in soils: Dissolution, precipitation, retention reaction at microsities
  - 3.1 Reaction products and changes in applied P
  - 3.2 Soil phosphate buffering capacity and availability
4. Potassium equilibria in soil: Quantity/intensity relationship and availability
5. Modeling nutrient uptake by plants
6. Modeling nutrient losses
7. Nutrition and plant disease interactions
8. Mineral nutrition of horticultural plants
9. Modern concept in soil fertility: Hydroponics, tunnel farming and roof top / pot culture
10. Formulation of fertilizer recommendations
11. Integrated plant nutrient management system
12. Soil variability and its control in field experiments

### **Books Recommended**

1. Havlin, J.L., J.D. Beaton, S.L. Tisdale and W.L. Nelson. 2005. Soil Fertility and Fertilizers. 7<sup>th</sup> Ed. Pearson Education, Singapore.
2. Marschner, H. 1995. Mineral Nutrition of Higher Plants. Academic Press Inc., Orlando, FL, USA.
3. Mengel, K. and E.A. Kirkby. 2001. Principles of Plant Nutrition. 5<sup>th</sup> Ed. International Potash Inst., Bern, Switzerland.
4. Elsworth, L. and W.O. Relay (eds.). 2009. Fertilizers: Properties, Applications and Effects. Nova Science. Publ. Inc., NY, USA.
5. Barker A.V. and D.J. Pilbeam. 2007. Handbook of Plant Nutrition. CRC Press, Boca Raton, FL, USA.

**Course Outline**

1. Advances in soil and environmental microbiology
2. Microbiology of the terrestrial and aquatic environment
3. Organic pollutants: Sources and types, biodegradation and bioremediation
4. Biotransformation of metal pollutants
5. Metabolic and nucleic acid based analysis of soil microbial diversity
  - 5.1 Extraction of bacterial DNA from soil
  - 5.2 Recombinant DNA techniques, PCR, probes and reporter genes used for monitoring soil microbes
6. Recent trends and approaches in soil and environmental microbiology
7. Soil enzymes and their role

**Books Recommended**

1. Burns, R.G. and R.P. Dik. 2002. Enzymes in the Environment. Marcel Dekker, Inc. NY, USA.
2. Harrison, R.M. (ed.). 2001. Pollution: Causes, Effects and Control. 4<sup>th</sup> Ed. Royal Soc. of Chem., Cambridge, UK.
3. Hurst, C.J., R.L. Crawford, G.R. Knudsen, M.J. McInernery, and L.D. Stetzenbach. 2002. Manual of Environmental Microbiology. American Society for Microbiology, Washington DC, USA.
4. Maier, R.M., I.L. Pepper, and C.P. Gerba. 2009. Environmental Microbiology. 2<sup>nd</sup> Ed. Academic Press Inc., San Diego, CA, USA.
5. Paul, E.A. (ed.). 2007. Soil Microbiology, Ecology and Biochemistry. 3<sup>rd</sup> Ed. Elsevier, Oxford, UK.
6. Sylvia, D.M., J.J. Fuhrmann, P.G. Hartel, and D.V. Zuberer. 2005. Principles and Applications of Soil Microbiology. Prentice Hall International, NJ, USA.

**Course Outline**

1. Water flow equations and their applications
2. Thermodynamic potentials and chemical potential of soil water
3. Use of models for artificial drainage
  - 3.1 Factors influencing drainage
4. Heat flow equations: Application and calculations
5. Application of gas flow equations
6. Pollutant transport in soil environment: Analytic solutions of the CDE model
7. Mobile-immobile water flow model for solute transport
8. Behavior assessment model for pesticide and hormones transport
9. Application of soil physics for remediation of hazardous wastes

10. Spatial variability analysis of soil properties and significance
11. Analysis of frequency distribution
12. Techniques for characterizing variability
13. Irrigation water scheduling; Water balance; Old and modern concepts of irrigation
14. Irrigation and water use efficiency
15. Calculation of evapo-transpiration by various methods

### **Books Recommended**

1. Bhatti, A.U. 2005. Spatial Variability and its Management in Agriculture. Higher Education Commission, Islamabad, Pakistan.
2. Hillel, D. 1998. Environmental Soil Physics. Academic Press Inc., San Diego, CA, USA.
3. Hillel, D. 2004. Introduction to Environmental Soil Physics. Elsevier Academic Press. San Diego, CA, USA.
4. Hillel, D. 2008. Soil in the Environment: Crucible of Terrestrial Life. Elsevier Inc., Burlington, MA, USA.
5. Jury, W.A. and R. Horton. 2004. Soil Physics. 5<sup>th</sup> Ed. John Wiley & Sons, Inc., NY, USA.
6. Marshall, T.J., J.W. Holmes and C.W. Rose. 1996. Soil Physics. 3rd Ed., Cambridge University Press, Cambridge, UK.

## DETAILS OF COMPULSORY COURSES

### COMPULSORY COURSES IN ENGLISH FOR Undergraduate Level

#### English I (Functional English)

Credit Hrs. 3

**Objectives:** Enhance language skills and develop critical thinking.

#### Course Contents

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

#### Comprehension

Answers to questions on a given text

#### Discussion

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

#### Listening

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

#### Translation skills

##### Urdu to English

##### Paragraph writing

Topics to be chosen at the discretion of the teacher

#### Presentation skills

Introduction

*Note: Extensive reading is required for vocabulary building*

#### Recommended books:

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



- b) Writing
  1. Writing. Intermediate by Marie-Christine Boutin, Suzanne Brinand and Françoise Grellet. Oxford Supplementary Skills. Fourth Impression 1993. ISBN 0 19 435405 7 Pages 20-27 and 35-41.
- c) Reading/Comprehension
  1. Reading. Upper Intermediate. 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**

**Objectives:** Enable the students to meet their real life communication needs.

### **Course Contents**

#### **Paragraph writing**

Practice in writing a good, unified and coherent paragraph

#### **Essay writing**

Introduction

#### **CV and job application**

Translation skills

Urdu to English

#### **Study skills**

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

#### **Academic skills**

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

#### **Presentation skills**

Personality development (emphasis on content, style and pronunciation)

*Note: documentaries to be shown for discussion and review*

### **Recommended books:**

#### **Communication Skills**

- a) Grammar
  1. Practical English Grammar by A.J. Thomson and A.V. Martinet. Exercises 2. Third edition. Oxford University Press 1986. ISBN 0 19 431350 6.
- b) Writing
  1. Writing. Intermediate by Marie-Christine Boutin, Suzanne Brinand and Françoise Grellet. Oxford Supplementary Skills. Fourth Impression 1993. ISBN 019 435405 7 Pages 45-53 (note taking).
  2. Writing. Upper-Intermediate by Rob Nolasco. Oxford Supplementary Skills. Fourth Impression 1992. ISBN 0 19 435406 5 (particularly good for writing memos, introduction to presentations, descriptive and argumentative writing).

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

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

**Objectives:** Enhance language skills and develop critical thinking

### **Course Contents**

#### **Presentation skills**

#### **Essay writing**

Descriptive, narrative, discursive, argumentative

#### **Academic writing**

How to write a proposal for research paper/term paper

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

#### **Technical Report writing**

#### **Progress report writing**

*Note: Extensive reading is required for vocabulary building*

### **Recommended books:**

#### Technical Writing and Presentation Skills

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

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

**ISLAMIC STUDIES  
(Compulsory)**

**Objectives:**

This course is aimed at:

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

**Detail of Courses**

**Introduction to Quranic Studies**

- 1) Basic Concepts of Quran
- 2) History of Quran
- 3) Uloom-ul -Quran

**Study of Selected Text of Holly Quran**

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

**Study of Selected Text of Holly Quran**

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

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

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

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

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

**Introduction To Sunnah**

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

- 6) Legal Position of Sunnah

## **Selected Study from Text of Hadith**

### **Introduction To Islamic Law & Jurisprudence**

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

### **Islamic Culture & Civilization**

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

### **Islam & Science**

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

### **Islamic Economic System**

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

### **Political System of Islam**

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

### **Islamic History**

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

### **Social System of Islam**

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

### **Reference Books:**

- 1) Hameed ullah Muhammad, "Emergence of Islam", IRI, Islamabad
- 2) Hameed ullah Muhammad, "Muslim Conduct of State"
- 3) Hameed ullah Muhammad, 'Introduction to Islam
- 4) Mulana Muhammad Yousaf Islahi,"
- 5) Hussain Hamid Hassan, "An Introduction to the Study of Islamic Law" leaf Publication Islamabad, Pakistan.
- 6) Ahmad Hasan, "Principles of Islamic Jurisprudence" Islamic Research Institute, International Islamic University, Islamabad (1993)
- 7) Mir Waliullah, "Muslim Jrisprudence and the Quranic Law of Crimes"

- Islamic Book Service (1982)
- 8) H.S. Bhatia, “Studies in Islamic Law, Religion and Society” Deep & Deep Publications New Delhi (1989)
  - 9) Dr. Muhammad Zia-ul-Haq, “Introduction to Al Sharia Al Islamia” Allama Iqbal Open University, Islamabad (2001)

## Pakistan Studies (Compulsory)

### Introduction/Objectives

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

### Course Outline

#### 1. Historical Perspective

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

#### 2. Government and Politics in Pakistan

Political and constitutional phases:

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

#### 3. Contemporary Pakistan

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

### Books Recommended

1. Burki, Shahid Javed. *State & Society in Pakistan*, The Macmillan Press Ltd 1980.
2. Akbar, S. Zaidi. *Issue in Pakistan's Economy*. Karachi: Oxford University Press, 2000.
3. S.M. Burke and Lawrence Ziring. *Pakistan's Foreign policy: An Historical analysis*. Karachi: Oxford University Press, 1993.
4. Mehmood, Safdar. *Pakistan Political Roots & Development*. Lahore, 1994.
5. Wilcox, Wayne. *The Emergence of Banglades.*, Washington: American Enterprise, Institute of Public Policy Research, 1972.
6. Mehmood, Safdar. *Pakistan Kayyun Toota*, Lahore: Idara-e-Saqafat-e-Islamia, Club Road, nd.

7. Amin, Tahir. *Ethno - National Movement in Pakistan*, Islamabad: Institute of Policy Studies, Islamabad.
8. Ziring, Lawrence. *Enigma of Political Development*. Kent England: WmDawson & sons Ltd, 1980.
9. Zahid, Ansar. *History & Culture of Sindh*. Karachi: Royal Book Company, 1980.
10. Afzal, M. Rafique. *Political Parties in Pakistan*, Vol. I, II & III. Islamabad: National Institute of Historical and cultural Research, 1998.
11. Sayeed, Khalid Bin. *The Political System of Pakistan*. Boston: Houghton Mifflin, 1967.
12. Aziz, K.K. *Party, Politics in Pakistan*, Islamabad: National Commission on Historical and Cultural Research, 1976.
13. Muhammad Waseem, *Pakistan Under Martial Law*, Lahore: Vanguard, 1987.
14. Haq, Noor ul. *Making of Pakistan: The Military Perspective*. Islamabad: National Commission on Historical and Cultural Research, 1993.

COMPULSORY MATHEMATICS  
COURSES FOR B.Sc (Hons) AGRICULTURE

## 1. MATHEMATICS I (ALGEBRA)

**Prerequisite(s):** Mathematics at secondary level

**Credit Hours:** 3 + 0

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

### Course Outline:

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

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

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

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

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

*Trigonometry:* Fundamentals of trigonometry, trigonometric identities.

### Recommended Books:

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

Boston (suggested text)

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

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



## 2. MATHEMATICS II (CALCULUS)

**Prerequisite(s):** Mathematics I (Algebra)

**Credit Hours:** 3 + 0

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

### **Course Outline:**

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

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

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

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

### **Recommended Books:**

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

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

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

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

## 3. MATHEMATICS III (GEOMETRY)

**Prerequisite(s):** Mathematics II (Calculus)

**Credit Hours:** 3 + 0

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

### **Course Outline:**

*Geometry in Two Dimensions:* Cartesian-coördinate mesh, slope of a line, equation of a line, parallel and perpendicular lines, various forms of equation of a line, intersection of two lines, angle between two lines, distance between two points, distance between a point and a line.

*Circle:* Equation of a circle, circles determined by various conditions,

intersection of lines and circles, locus of a point in various conditions.  
*Conic Sections*: Parabola, ellipse, hyperbola, the general-second-degree equation

### **Recommended Books:**

Abraham S, *Analytic Geometry*, Scott, Freshman and Company, 1969  
Kaufmann JE, *College Algebra and Trigonometry*, 1987, PWS-Kent Company, Boston  
Swokowski EW, *Fundamentals of Algebra and Trigonometry* (6<sup>th</sup> 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 digram, Graphical representation of data Histogram, frequency polygon, frequency curve.

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

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

**Practicals**

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

**Book Recommended**

1. Introduction to Statistical Theory Part- I by Sher Muhammad and Dr. Shahid Kamal (Latest Edition)
2. Statistical Methods and Data Analysis by Dr. Faquir Muhammad
3. A. Concise Course in A. Level Statistic with world examples by J. Crawshaw and J. Chambers (1994)
4. Basic Statistics an Inferential Approach 2<sup>nd</sup> 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 X<sup>2</sup> (chi-square) Testing hypothesis about variance.

### Practicals

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

### Book Recommended

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

1. All the degree awarding institutions in Soil Science should follow the semester system as per HEC rules and regulations.
2. In the cases where a course is taught / offered by more than one faculty, uniformity may be observed in teaching, paper setting and evaluation.
3. The committee felt seriously about the constraints of the shortage of faculty in the discipline of Soil Science at some campuses. These need to be strengthened and separate departments may be established with adequate facilities for teaching and research.
4. Universities / colleges may prepare their PC-I for strengthening their laboratory and library facilities for submission to HEC for the provision of adequate funds.
5. In every institution, a central repair cell headed by an Electronic Engineer may be established for maintenance/repair of scientific equipment with HEC funding.