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

Composed by: Mr. Zulfiqar Ali, HEC, Islamabad
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<td>56</td>
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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
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.

<table>
<thead>
<tr>
<th>Name</th>
<th>Position</th>
</tr>
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<tbody>
<tr>
<td>Prof. Dr. Anwar-ul-Hassan</td>
<td>Convener</td>
</tr>
<tr>
<td>Director, Institute of Soil &amp; Environmental Sciences, University of Agriculture Faisalabad.</td>
<td></td>
</tr>
<tr>
<td>Prof. Dr. Abdulrauf Farooqi</td>
<td>Member</td>
</tr>
<tr>
<td>Department of Environmental Sciences, International Islamic University, Islamabad.</td>
<td></td>
</tr>
<tr>
<td>Prof. Dr. Safdar Ali</td>
<td>Member</td>
</tr>
<tr>
<td>Chairman, Department of Soil Sciences and Soil &amp; Water Conservation, PMAS – Arid Agriculture University, Rawalpindi.</td>
<td></td>
</tr>
<tr>
<td>Prof. Dr. Zahir Shah</td>
<td>Member</td>
</tr>
<tr>
<td>Department of Soil &amp; Environmental Sciences, KPK Agriculture University, Peshawar.</td>
<td></td>
</tr>
<tr>
<td>Dr. Inayatullah Rajpar</td>
<td>Member</td>
</tr>
<tr>
<td>Associate Professor &amp; Chairman, Department of Soil Sciences, Sindh Agriculture University, Tandojam.</td>
<td></td>
</tr>
<tr>
<td>Mr. Nasir Rahim</td>
<td>Member</td>
</tr>
<tr>
<td>Assistant Professor, Chairman, Department of Soil and Environmental Sciences, University of AJ&amp;K, Faculty of Agriculture, Rawalakot.</td>
<td></td>
</tr>
<tr>
<td>Dr. Muhammad Jamil Khan</td>
<td>Member</td>
</tr>
<tr>
<td>Associate Professor &amp; Chairman, Department of Soil &amp; Environmental Sciences, Gomal University, D.I. Khan.</td>
<td></td>
</tr>
<tr>
<td>Name</td>
<td>Position</td>
</tr>
<tr>
<td>-------------------------------------</td>
<td>---------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Dr. Ghulam Sarwar</td>
<td>Assistant Professor</td>
</tr>
<tr>
<td>Dr. Moazzam Jamil</td>
<td>Associate Professor &amp; Principal</td>
</tr>
<tr>
<td>Dr. Muhammad Salim</td>
<td>Chief Scientist</td>
</tr>
<tr>
<td>Mr. Riaz Ahmad</td>
<td>Technical Services Manager</td>
</tr>
<tr>
<td>Mr. Zubair Rehman</td>
<td>Head of Soil Science Department</td>
</tr>
<tr>
<td>Ms. Saima Kalsoom Babar</td>
<td>Assistant Professor</td>
</tr>
<tr>
<td>Prof. Dr. Muhammad Abid</td>
<td>Department of Agronomy &amp; Soil Science</td>
</tr>
</tbody>
</table>

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**

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mathematics / Biology (2 courses)</td>
<td>6</td>
<td>(3-0) (2-1)</td>
</tr>
<tr>
<td>Statistics 1 &amp; 2</td>
<td>6</td>
<td>(3-0) (3-0)</td>
</tr>
<tr>
<td>Computers / IT</td>
<td>3</td>
<td>(2-1)</td>
</tr>
<tr>
<td>Pakistan Studies</td>
<td>2</td>
<td>(2-0)</td>
</tr>
<tr>
<td>Islamic Studies</td>
<td>2</td>
<td>(2-0)</td>
</tr>
<tr>
<td>Communications Skills</td>
<td>3</td>
<td>(3-0)</td>
</tr>
<tr>
<td>English</td>
<td>3</td>
<td>(3-0)</td>
</tr>
<tr>
<td>Basic Agriculture</td>
<td>3</td>
<td>(2-1)</td>
</tr>
</tbody>
</table>

**Sub-Total 28**

2. **Interdisciplinary Foundation Courses**

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agronomy</td>
<td>3</td>
<td>(2-1)</td>
</tr>
<tr>
<td>Plant Breeding &amp; Genetics</td>
<td>3</td>
<td>(2-1)</td>
</tr>
<tr>
<td>Entomology</td>
<td>3</td>
<td>(2-1)</td>
</tr>
<tr>
<td>Plant Pathology</td>
<td>3</td>
<td>(2-1)</td>
</tr>
<tr>
<td>Food Technology</td>
<td>3</td>
<td>(2-1)</td>
</tr>
<tr>
<td>Horticulture</td>
<td>3</td>
<td>(2-1)</td>
</tr>
<tr>
<td>Soil Sciences</td>
<td>3</td>
<td>(2-1)</td>
</tr>
<tr>
<td>Agriculture Economics</td>
<td>3</td>
<td>(2-1)</td>
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</tbody>
</table>

**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**

**Sub-Total during the first four semesters** 70-76

**Semester 5, 6, 7 & 8** 56-60

**Project / Internship** 04

**Grand Total** 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**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>SS-301</td>
<td>Introduction to Soil Science</td>
<td>3(2-1)</td>
</tr>
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</table>

**Major Courses**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>SS-501</td>
<td>Physical Properties of Soil</td>
<td>4(3-1)</td>
</tr>
<tr>
<td>SS-502</td>
<td>Salt-Affected Soils and Water Quality</td>
<td>4(3-1)</td>
</tr>
<tr>
<td>SS-503</td>
<td>Chemical Properties of Soil</td>
<td>4(3-1)</td>
</tr>
<tr>
<td>SS-504</td>
<td>Soil Fertility and Fertilizers</td>
<td>4(3-1)</td>
</tr>
<tr>
<td>SS-505</td>
<td>Analytical Techniques in Soil Science</td>
<td>3(1-2)</td>
</tr>
<tr>
<td>SS-506</td>
<td>Soil Survey and Land Evaluation</td>
<td>3(2-1)</td>
</tr>
<tr>
<td>SS-507</td>
<td>Soil Genesis and Taxonomy</td>
<td>3(2-1)</td>
</tr>
<tr>
<td>SS-508</td>
<td>Soil and Water Conservation</td>
<td>3(2-1)</td>
</tr>
<tr>
<td>SS-601</td>
<td>Soil Microbiology</td>
<td>4(3-1)</td>
</tr>
<tr>
<td>SS-602</td>
<td>Soil Water Plant Relationship</td>
<td>3(3-0)</td>
</tr>
<tr>
<td>SS-603</td>
<td>Environmental Pollution and Management</td>
<td>3(3-0)</td>
</tr>
<tr>
<td>SS-604</td>
<td>Land Degradation and Management</td>
<td>3(3-0)</td>
</tr>
<tr>
<td>SS-605</td>
<td>Research Project and Scientific Writing</td>
<td>3(2-1)</td>
</tr>
<tr>
<td>SS-606</td>
<td>Trace Elements in Agriculture</td>
<td>3(2-1)</td>
</tr>
<tr>
<td>SS-607</td>
<td>Municipal Waste Management</td>
<td>3(3-0)</td>
</tr>
<tr>
<td>SS-608</td>
<td>Internship/ Research Project</td>
<td>6(0-6)</td>
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**Total** 56 (38-18)
<table>
<thead>
<tr>
<th>Course No.</th>
<th>Course Title</th>
<th>Credit Hours</th>
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<tbody>
<tr>
<td><strong>5th Semester</strong></td>
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<tr>
<td>SS-501</td>
<td>Physical Properties of Soil</td>
<td>4(3-1)</td>
</tr>
<tr>
<td>SS-503</td>
<td>Chemical Properties of Soil</td>
<td>4(3-1)</td>
</tr>
<tr>
<td>SS-505</td>
<td>Analytical Techniques in Soil Science</td>
<td>3(1-2)</td>
</tr>
<tr>
<td>SS-507</td>
<td>Soil Genesis and Taxonomy</td>
<td>3(2-1)</td>
</tr>
<tr>
<td>Elective – I</td>
<td>3(3-0)</td>
<td></td>
</tr>
<tr>
<td><strong>Total Credit Hours</strong></td>
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<tr>
<td><strong>6th Semester</strong></td>
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<tr>
<td>SS-502</td>
<td>Salt-Affected Soils and Water Quality</td>
<td>4(3-1)</td>
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<tr>
<td>SS-504</td>
<td>Soil Fertility and Fertilizers</td>
<td>4(3-1)</td>
</tr>
<tr>
<td>SS-506</td>
<td>Soil Survey and Land Evaluation</td>
<td>3(2-1)</td>
</tr>
<tr>
<td>SS-508</td>
<td>Soil and Water Conservation</td>
<td>3(2-1)</td>
</tr>
<tr>
<td>Elective – II</td>
<td>3(3-0)</td>
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<tr>
<td><strong>Total Credit Hours</strong></td>
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<tr>
<td><strong>7th Semester</strong></td>
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<tr>
<td>SS-601</td>
<td>Soil Microbiology</td>
<td>4(3-1)</td>
</tr>
<tr>
<td>SS-603</td>
<td>Environmental Pollution and Management</td>
<td>3(3-0)</td>
</tr>
<tr>
<td>SS-605</td>
<td>Research Project and Scientific Writing</td>
<td>3(2-1)</td>
</tr>
<tr>
<td>SS-607</td>
<td>Municipal Waste Management</td>
<td>3(3-0)</td>
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<tr>
<td>Elective – III</td>
<td>3(3-0)</td>
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<tr>
<td><strong>Total Credit Hours</strong></td>
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<tr>
<td><strong>8th Semester</strong></td>
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<tr>
<td>SS-602</td>
<td>Soil Water Plant Relationship</td>
<td>3(3-0)</td>
</tr>
<tr>
<td>SS-604</td>
<td>Land Degradation and Management</td>
<td>3(3-0)</td>
</tr>
<tr>
<td>SS-606</td>
<td>Trace Elements in Agriculture</td>
<td>3(2-1)</td>
</tr>
<tr>
<td>SS-608</td>
<td>Internship/ Research Project</td>
<td>6(0-6)</td>
</tr>
<tr>
<td><strong>Total Credit Hours</strong></td>
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<tr>
<td><strong>Sub Total</strong></td>
<td>135</td>
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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 undergraduate 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
5. Determination of soil texture and bulk density
6. Fertilizers: Identification, composition and calculation of nutrient percentage
7. Determination of soil pH and EC
8. Determination of soil organic matter

Books Recommended
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

SS-502 SALT-AFFECTED SOILS AND WATER QUALITY

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
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
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

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

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
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

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


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 CO₂
5. Microbial transformations of nitrogen; N\textsubscript{2}-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**

**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**

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
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

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

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

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**


**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

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

**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 ANALYTICAL TECHNIQUES 3(0-3)

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 microanalysis
   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 reflectrometery (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

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

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
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

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 N₂-fixation

Books Recommended
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

3. FAO. 1998. World Reference Base for Soil Resources. FAO, Rome, Italy
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


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, Kostiakov, Green and Ampt, and Philip’s
   8.1 Flow in capillary tubes: Poiseuille’s 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

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

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

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

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


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
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
b) Writing

c) Reading/Comprehension

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**

  b) **Writing**
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

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 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)

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
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,”
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”

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
   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. **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:**


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

3. MATHEMATICS III (GEOMETRY)

Prerequisite(s): Mathematics II (Calculus)

Credit Hours: 3 + 0

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

Course Outline:

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

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

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

**Recommended Books:**

Kaufmann JE, College *Algebra and Trigonometry*, 1987, 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

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 kurtosis

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
Statistics-II

Credit 3 (2-1)

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

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

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)
Computers, Communications & information: A user’s introduction by Sarah E. Hutchinson, Stacey C. Swayer
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

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

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.