BACHELOR OF SCIENCE IN SOIL SCIENCE

1.0 INTRODUCTION

Fundamental knowledge of soil science is imperative not only in agriculture, but also in natural resources management, environmental policy, and environmental engineering. Soil is the ultimate natural resource for growing plants. It is crucial for raising livestock and the ever-increasing world population could not possibly be sustained without soils. The Bachelor of Science in Soil Science is designed to provide fundamental knowledge of soils for sustainable agricultural production, forestry, and environmental protection. The program puts emphasis on practical application of knowledge of soil as a basic resource upon which other natural resources and agriculture depend on. This program will give students the knowledge they need to supply vital advice and services to agricultural and land management issues. Much of the emphasis in our situation will be improvement of soil quality for different crops and sustainability.

2.0 OBJECTIVES

The overall objective of the programme is to produce skilled, motivated and internationally competitive graduates with knowledge to provide vital advice and services in soil management issues. The specific objectives of the programme are:

a) To impart knowledge and skills to students in sustainable use and management of soil resource.
b) To provide students with the technical know-how that will address problems related to agriculture and management of natural resources so as to alleviate food insecurity and improve livelihood.
c) To provide students with knowledge in basic and applied research in soils resource management.
d) To develop frontier actors in advancement of knowledge and innovations in soil science and improved agricultural productivity.

3.0 ADMISSION REQUIREMENTS

a) Candidates must satisfy the minimum university requirements of mean grade of C+. In addition to (a) above, candidates should offer passes at C or above in Biology, Physics, Chemistry and Mathematics; and satisfy the Joint Admission Board's subject cluster requirements.

or

b) Holders of KACE with two principal passes in science subjects and at least a credit in mathematics at Ordinary level

or

c) Holders of diploma in agricultural or business related subjects from a recognized institution.

or

d) Holders of a related degree from a recognized university.

or

e) Holders of a Higher Diploma in related field from a recognized institution.

4.0 COURSE STRUCTURE AND DURATION

4.1 The degree shall normally take four academic years of 8 semesters.

4.2 Courses shall be offered in units. A course unit is defined as that part of a subject described by a coherent syllabus and taught normally over a period of a semester. It is designated as a total of 42 hours of study in a semester. For this purpose one 1-hour lecture is equivalent to one 2-hour tutorial or 3-hour practical or any combination as may be approved by the Board of the School of Agriculture, Food Security and Biodiversity.

4.3 Part-time students shall be allowed to take not less than 50% of the courses prescribed for the year.

4.4 All courses will be taught for a total of 42 contact hours, including examinations except industrial attachment which will take 480 hours of practical work in a relevant industry.

4.5. Students shall be required to undergo an Industrial Attachment of three (3) months at the end of 2nd semester of the third year of study.

5.0 EXEMPTION FROM COURSES

Students may be exempted from some courses by Senate on recommendation of the University College Academic Board.

6.0 EXAMINATION REGULATIONS

University Senate examination rules and regulations shall apply.

7.0 COURSE LISTING

One semester shall comprise of minimum courses of seven (7) units and maximum of nine (9) units.

8.0 COURSE DISTRIBUTION

YEAR 1 SEMESTER 1					
Course Code	**Course Title**	**Contact Hours**			**Weight (Unit)**
		Lecture	**Practical**	**Total**	
APT 3111	Agricultural Botany	28	14	42	1R
SCH 3111	Physical and Inorganic Chemistry	28	14	42	1R
SMA 3111	Mathematics I	42	0	42	1R
SPH 3111	Physics	28	14	42	1R
EEL 3113	Communication Skills	42	0	42	1R
AAE 3113	Farming Systems and Rural Livelihood	42	0	42	1R
SCS 3111	Computer Organization and Applications	28	14	42	1R
SB1 3114	HIV and AIDS	42	0	42	1R
	Total	**280**	**56**	**336**	**8**

YEAR 1: SEMESTER 2

Course Code	Course Title	Contact Hours			Weight (Unit)
		Lecture	Practical	Total	
ALS 3121	World of Water	42	0	42	1C
ALS 3122	Land and Life	42	0	42	1C
ALS 3123	Introduction to Soil Science	28	14	42	1C
SCH 3122	Organic Chemistry	28	14	42	1R
SMA3122	Mathematics II	42	0	42	1R
ESD 3120	Social Ethics and Integrity	42	0	42	1R
APT 3125	Principles of Crop Production	28	14	42	1R
SLB 3121	Development Studies	42	0	42	1R
	Total	**294**	**42**	**336**	**8**

YEAR 2: SEMESTER 1					
Course Code	**Course Title**	**Contact Hours**			**Weight (Unit)**
		Lecture	**Practical**	**Total**	
ALS 3211	Agriculture and Environmental Quality	42	0	42	1C
ALS 3212	Soil Genesis and Morphology	28	14	42	1C
ALS 3213	Soil survey, Classification and Land Evaluation	28	14	42	1C
ALS 3214	Soil Chemistry	28	14	42	1C
ALS 3215	Quantitative Methods in Soil Science	42	0	42	1C
ALS 3216	Soils and Civilization	42	0	42	1C
AAE 3212	Biodiversity and Agricultural	28	14	42	1R

	Biotechnology				
	Total	**238**	**56**	**294**	**7**

YEAR 2: SEMESTER 2					
Course Code	**Course Title**	**Contact Hours**			**Weight (Unit)**
		Lecture	**Practical**	**Total**	
ALS 3221	Soil and Water Conservation	28	14	42	1C
ALS 3222	Introductory Soil Microbiology	28	14	42	1C
ALS 3223	Soil Physics	28	14	42	1C
ALS 3224	Tropical Soil Management	42	0	42	1C
ALS 3225	Instrumentation in Soil and Water Analysis	42	0	42	1C
ALS 3226	Soil Physical Conditions and Plant growth	28	14	42	1C
ALS 3227	Soil Salinity and Management	28	14	42	1C
	Total	**224**	**70**	**294**	**7**

YEAR 3: SEMESTER 1					
Course Code	**Course Title**	**Contact Hours**			**Weight (Unit)**
		Lecture	**Practical**	**Total**	
ALS 3311	Research Methodology	42	0	42	1R
ALS 3312	Soil Microbial Ecology	28	14	42	1C
ALS 3313	Environmental Biogeochemistry	42	0	42	1C
ALS 3314	Principles of Surveying	28	14	42	1R
ALS 3315	Crop Eco-Physiology	42	0	42	1C
ALS 3316	Soil Fertility and Plant Nutrition	28	14	42	1C
ALS 3317	Soil and Water Engineering	28	14	42	1C

BEP 3315	Entrepreneurship	42	0	42	1R
	Total	**280**	**56**	**336**	**8**

YEAR 3: SEMESTER 2

Course Code	**Course Title**	**Contact Hours**			**Weight (Unit)**
		Lecture	**Practical**	**Total**	
ALS 3321	Soil, Water and Public Health	42	0	42	1C
ALS 3322	Wetland Soils Management	28	14	42	1C
ALS 3323	Nutrient Management and Research in Agro-ecosystems	42	0	42	1C
ALS 3324	Soil Chemical Analysis	28	14	42	1C
ALS 3325	Soil Contamination and Remediation	42	0	42	1C
ALS 3326	Principles of Irrigation and Drainage	28	14	42	1C
ALS 3327	Soil- Water Nutrient Relationship	28	14	42	1C
ALS 3328	Biometrics for Soil Science	28	14	42	1C
	Total	**266**	**70**	**336**	**8**

YEAR 3: SEMESTER 3

ALS 3331: Three (3) Months Industrial Attachment

YEAR 4: SEMESTER 1					
Course Code	**Course Title**	**Contact Hours**			**Weight (Unit)**
		Lecture	**Practical**	**Total**	
ALS 3411	Irrigation and Drainage Technology	28	14	42	1C
ALS 3412	Soil Mineralogy and Surface Chemistry	28	14	42	1C
ALS 3413	Forest Soils Ecosystems	28	14	42	1C
ALS 3414	Rhizosphere Biochemistry	28	14	42	1C
ALS 3415	Soil landscape Modeling	28	14	42	1C
ALS 3416	Highland Soils Management	28	14	42	1C
ALS 3417	Soil Quality and Food Security	42	0	42	1C
ALS 3418	Research Project I and II	28	56	84	2C
	Total	**238**	**140**	**378**	**9**

YEAR 4: SEMESTER 2

Course Code	**Course Title**	**Contact Hours**			**Weight (Unit)**
		Lecture	**Practical**	**Total**	
ALS 3421	Soils and Plant Nutrient Bioavailability	28	14	42	1C
ALS 3422	Soil Quality Assessment and Management	28	14	42	1C
ALS 3423	GIS in Soil land Water Science	42	0	42	1C
ALS 3424	Climate change and soil-Plant Relationships	42	0	42	1C
ALS 3425	Land Degradation and Management of Problematic Soils	28	14	42	1C
AAE 3422	Agricultural Policy Analysis	42	0	42	1R

AAE 3425	Environmental and Natural Resources Economics	42	0	42	1R
AAE 3427	Farm Management	42	0	42	1R
	Total	**294**	**42**	**336**	**8**

C: Core course, which is central to the discipline of study.

R: required course, which is supportive or beneficial to the programme.

9.0 DESCRIPTION OF THE COURSES

YEAR 1: SEMESTER 1

APT 3111: Agricultural Botany **42 Hours**

Plant cells, tissues, organs; Morphology and anatomy of angiosperms root, stem, leaf, flower, fruit, seed and seedling; Primary and secondary growth of plants; Persistent and successive cambia; Morphogenesis and differentiation; Plasticity of plant organs; Relationship between plant structure, function, and ecological adaptation; Evolutionary trends in anatomy and morphology of crop plants; Totipotency, sectioning and staining; Preparation of main botanical agents; The concept of artificial and natural plant classification; Role of fossil angiosperm and gymnosperms in taxonomy; Taxonomic hierarchy; Specific variation and isolation; Nomenclature; Herbarium and its relevance/role in plant taxonomy.

SCH 3111: Physical and Inorganic Chemistry

The structure and properties of matter, origin of elements, evolution of living organisms from chemical systems, bond formation and molecules. Laws of thermodynamics, Steady state kinetics, Reaction kinetics, various functional groups of organic molecules and their biological roles. Carbohydrates ;Structure and properties of mono-, di- and polysaccharides.

SMA 3111: Mathematics I **42 Hours**

Elementary set theory. Mappings and functions: Definitions, domains, codomains, range and inverses and composition of functions**.** Trigonometry: Functions, their graphs, inverses, degree and radian measure, sine and cosine formulae, trigonometric identities and equations. Algebra: Quadratic equations. Surds, logarithms and indices. Series: Arithmetic and geometric progressions, Permutation and combinations. Binomial theorem and applications such as approximations, simple and compound interest. Remainder theorem applications to solutions of factorials polynomials. Statistics: Collection and representation of data. Measures of central tendencies and variability. Graphical and axiomatic approaches to probabilities. Tree diagrams. Probability: Definition, axioms, tree diagram.

SPH 3111: Physics **42 Hours**

Physical units and dimensions, rectilinear motion with constant acceleration; Displacement velocity time graphs; Basic dynamic equations of motion. Reflection and refraction of waves at plane and spherical surfaces; The prism and dispersion, lenses and aberrations, optical instruments, diffraction gratings. Electricity and magnetism; Charge and current Coulombs law, electrostatic and electric potential capacitors, magnetic flux density along asolenoid, principles of electromagnetic induction, transformers, cathode ray oscilloscope and its functions.

EEL 3113: **Communication Skills** **42 Hours**

Study Skills; Planning study time, making references, filing notes, preparing for examinations. Library Skills; Organization, classification, shelving, using reference books. Listening Skills; Asking and answering questions in lectures and seminars, making and defending arguments, agreeing and disagreeing, explaining points clearly. Academic reading skills; Skimming and scanning, notes making, understanding footnotes and bibliographical references.

AAE 3113: Farming Systems and Rural Livelihood **42 Hours**

Processes of environmental, economic and social change from the global, regional and local perspectives; Emergence of new forms of production, exchange, consumption, and governance; Impacts of global and regional production and consumption trends and changes on food and agriculture; Structure and dynamics of agri-food systems; Trade liberalization; Deregulation of foreign investment; Government divesture in the agricultural sector; Privatization and globalization of agricultural commodity chains; Ascendance of regional and global retailers in poor economies; Governance restrictions and operation of agri-business supplies; Agricultural commodity value chains; Consolidation of food processing and manufacturing; Farming system determinants; Pro-poor farming systems approaches and methodologies.

SCS 3111: Computer Organization and Applications 42 Hours

Organization: Introduction to the computer and the notion of a programmable machine. The basic organization based on the von Neumann model. Functional components (CPU, memory, I/O) and their logical organization. Number systems and internal data representation. Concept software and types of software. Components of contemporary personal computer systems from end-user perspective; Application: Classical and contemporary applications of computers. Proficiency in basic computer usage and productivity/office automation applications including word-processing, spreadsheets, e-mail, web, etc. Basic first year security and maintenance issues. Ethical and societal issues.

SBI 3114: HIV and AIDS 42 Hours

Introduction; Historical background and magnitude of HIV and AIDS; General organization of the human body; Reproduction, immune system (human physiology) and other factors; Sex and sexuality; The biology of the human immunodeficiency virus and viral transmission; Stages of infection and the development of HIV and AIDS; Opportunistic infections; HIV and AIDS prevention and infection control; Peer education for HIV; Treatment options and vaccine development; Blood transfusion and HIV and AIDS; Management of HIV and related infections; Legal and Ethical Issues in HIV AND AIDS; Factors that influence the spread of HIV and AIDS in Africa; Case studies in

selected countries in Africa; HIV and AIDS as a national disaster and its impacts; Myths and emerging issues on HIV and AIDS.

YEAR 1: SEMESTER 2

ALS 3121: World of Water **42 Hours**

Introduction to the world of water; Policies and guidelines, earth and water, total and distribution of water on earth and origin of Earth's water. Water and the evolution of life on earth. Water and heat; Global climate, the atmosphere and thermal regulation on earth. Weather; Patterns and precipitation. Ocean fundamentals. Groundwater; Fresh water and aquifers: Sustainability and vulnerability. Major lakes, rivers, watersheds, origin, types and civilization. Wetlands. Water quality; Review of parameters and sources, biological, organic and chemical Pollutants.

ALS 3122: Land and Life **42 Hours**

Relationships between human activities and soil and environmental sustainability and quality. Fundamentals of soil and environmental science; Basic principles throughout human history; Causes and effects of environmental degradation and strategies for remediation of degraded environments.

ALS 3123: Introduction to Soil Science **42 Hours**

Fundamental concepts: The pedosphere, hydrosphere, atmosphere, soil, edaphology; soil phases and components; Soil as a living body; Soil as part of the environment; Factors of soil formation: Parent material, climate, organisms, topography; and time; Soil – forming processes: Physical, chemical and biological; Properties of soil: Soil profile, horizon, pedon, epipedon, endopedon, physical, chemical, and biological. Perfectly and imperfectly drained soils

SCH 3122: Organic Chemistry **42 Hours**

Introduction to amino acids: Proteins- primary, secondary, tertiary and quaternary structures. Protein denaturation, introduction to lipids, neutral lipids, polar lipids. Fatty

acids: structure, properties and nomenclature. Steroids and terpenes. Chemistry of bacterial and plant cell walls.

SMA 3122: Mathematics II **42 Hours**

Coordinate geometry and equations of straight lines. Matrices: definitions, matrix algebra, determinants, transpose, adjoints, inverses and solutions of systems of linear equations using matrix method. Limit continuity. Differentiation and integration of algebraic, trigonometric, exponential functions. Applications of differentiation and integration to rates of change, maxima, minima. Area under curve. 1^{st} order D.E and their application.

ESD 3120: Social Ethics and Integrity **42 Hours**

Definitions and concepts; Categories of ethics; national cohesion; integrity; Unity; Structural injustices; ethnicity: Positive ethnicity, negative ethnicity; Peace: Peace making, peace building, peace transformation; Stake holders in national cohesion.

APT 3125: Principles of Crop Production **42 Hours**

Concept of crop production, energy/biomes transfer systems; Environmental factors determining crop performance; Cultural practices: seedbed preparation, cultivation, plant seed and seed rates, plant population; Crop protection; Maintenance of soil fertility: organic and inorganic fertilizers; soil and water conservation; Cropping systems including crop rotation; Intercropping and agro-forestry.

SLB 3121: Development Studies **42 Hours**

Development Studies as an autonomous discipline; The concept of development; An overview of the theories and paradigms of development; The relationship between economic growth and development; Science and technology in development; Developed and developing countries; Issues in development: Social, economic and political; Actors in development: The state, national and international NGOs, bilateral and multilateral institutions, multinational corporations (MNCs), and social movements.

YEAR 2: SEMESTER 1

ALS 3211: Agriculture and Environmental Quality 42 Hours

Effect of agriculture on environmental quality; Agricultural practices, treatment and utilization of organic wastes. Minimization of agricultural pollution. Sustainable food production and soil quality.

ALS 3212: Soil Genesis and Morphology 42 Hours

Soil morphology; Properties used in describing soil layers, soil horizon designations; Concepts relating to the description, sampling, and mapping of soils; Genetic and interpretive significance of soil morphology. Introduction to soil components; Organics and minerals. Weathering and soil formation; Physical and chemical weathering processes, mineral weathering reactions and sequences. Processes of horizon development; Surface horizons, translocation of Fe, Al, and organic carbon, colloidal translocation, densification and induration; Al and Fe oxide and hydrous oxide accumulation, carbonate and salt accumulation, redox influences. Environmental factors of soil formation; Parent material, time, relief, climate and organisms.

ALS 3213: Soil survey, Classification and Land Evaluation 42 Hours

Soil survey; Aims and importance of soil surveys, types of soil survey. Soil classification; Types and merits of soil classification, fundamental taxonomic classifications, practical evaluation for soils in relation to rain fed and irrigated agriculture, land rating and compiling soil suitability maps for specific purposes or crops. Some important Kenya soils; Properties, occurrence, distribution and use.

ALS 3214: Soil Chemistry 42 Hours

Detailed examination of the structure and surface chemistry of colloidal particles important to the function of soils. Emphasizes ion exchange; Mineral-solution equilibria; and adsorption reactions of silicate clays, oxides, and organic matter. Describes the sorption behavior of environmental contaminants in soils, particularly metals and xenobiotics.

ALS 3215: Quantitative Methods in Soil Science 42 Hours

Definition of statistics; Importance of statistics; Population; Sample; Methods of data collection and presentation; Measures of central tendency and dispersion; Probability, some probability distributions; Sampling distribution; Estimation and testing of probability; Estimation and testing of difference of two expectations; Goodness of fit tests; Contingency tables; Simple linear regression and correlations.

ALS 3216: Soils and Civilization 42 Hours

Effects of soil physical, chemical, and biological properties on civilization throughout history. Influence of soils on settlement patterns, land use/management, and civilization decline. Case studies focus on current soil and land use issues in Kenya.

AAE 3212: Biodiversity and Agricultural Biotechnology 42 Hours

Ecosystem structure and functions; Definitions of biodiversity and biotechnology; Importance of biodiversity in Africa; Biodiversity and bio-prospecting; Conservation of biodiversity; Agro-biodiversity; Importance of biotechnology; Industrial and environmental biotechnology; Agricultural and food biotechnology; Health-related biotechnology; Food and nutrition related biotechnology; Emerging trends in biotechnology; Case studies in North America; Implications of agricultural biotechnology for developing countries; Biosafety and Intellectual Property Rights (IPRs); Product development, quality control and legislation.

YEAR 2: SEMESTER 2

ALS 3221: Soil and Water Conservation 42 Hours

Soil/water resources, historical erosions and sediment problems, geologic vs. accelerated erosion, erosion prediction equations, government conservation programs and water conservation; Water harvesting techniques; Irrigation, drainage and salinity; Storm-water management; Case studies in erosion and sedimentation.

ALS 3222: Introductory Soil Microbiology **42 Hours**

History and economic importance of microbiology; Definitions, diversity and habitats of micro-organisms; Biology of micro-organisms: Structure, taxonomy, ecology, physiology and culturing of algae, fungi and bacteria with specific discussion to include mushrooms and yeasts; Structure, physiological and biochemical properties of viruses and mycoplasmas.

ALS 3223: Soil Physics **42 Hours**

The solid phase; Inorganic and organic; Characterization of primary particles in bulk soil; Liquid phase; Properties of water, water retention in soil, soil water content, energy status of water in soil, analysis of systems at equilibration, measurement of components of water potential, water characteristic function, water movement in soil, field water regimes; Field water balance; Soil-water-plant relationships, soil erosion, soil and water conservation and management, drainage, irrigation; The soil thermal regime, atmospheric energy balance, soil surface energy balance, heat flow; Soil aeration: Composition of soil air, gas reaction in soil, gas transport through soil, gas transport through soil, measurement of oxygen diffusion on consumption in soil; Solute transport in soil: Solute conservation equation, convection - dispersion equation, transfer function module of solute transport through soil, solute management in field soil.

ALS 3224: Tropical Soil Management **42 Hours**

The future for tropical soils management. Energy and tropical land use systems; Soil forming factors with tropical Examples, climate and microclimate, nutrient recycling and plant indicators; Biotic effects on the soil, parent material and weathering. Tropical soils; Soil color, classification systems, soil orders and management characteristics, geographic distribution of soils. Nutrient aspects of tropical soil fertility; Organic matter and the use of organic amendments, biological fixation by tropical plants and organisms, mycorrhiza, potassium and phosphorus, Al and pH, soil charge, micronutrients. Plant deficiency symptoms; Tests for determining fertilizer requirement. Management Practices; Land clearing and burning, irrigation and drainage, tillage and mechanization; Use of fertilizers, cover crops and green manures, soil conservation practices.

ALS 3225: Instrumentation in Soil and Water Analysis 42 Hours

Techniques for field appraisal of the status of water in plants and soil, including methods used in physiological studies, such as the psychrometer, pressure chamber, gas exchange analyzer, and abscisic acid analysis with ELISA.

ALS 3226: Soil Physical Conditions and Plant growth 42 Hours

Relationships of soil physical properties to plant growth and development; Use of water by plants and availability of soil water for plants; Soil management for plant production based on soil structure, temperature and water.

ALS 3227: Soil Salinity and Management

Concepts and defininations in soil salinity. Basic chemical, physical and biological principles of salinity management; Basic chemistry of salt affected soils, Clay colloidal properties in saline and sodic solution, Hydraulic soil properties under saline and sodic conditions, Soil Structure and crusting in saline and sodic conditions, Movement and accumulation of salts in soils, Soil fertility under salinity, Plant response to saline and sodic conditions, Plant nutrition in saline and sodic environments, Salt tolerance of crops, Approaches to developing salt tolerance in crops. Diagnosis of salinity and sodicity; Principles and criteria of monitoring soil salinity, Field sampling and monitoring of soil, water, and plants, field and laboratory measurements

YEAR 3: SEMESTER 1

ALS 3311: Research Methodology 42 Hours

Introduction to research; Meaning and purpose, basic terms; Deductive and inductive approaches. Planning research project; Identifying problem, objectives, hypothesis, literature review, research instruments, budgeting and planning. Logistical and ethical issues in research. Data collection and data analysis; Sampling, classification of variables, preanalysis of data, coding and entering. Research and project development; Writing research proposal, writing project proposal. Writing a research report; Components of research report.

ALS 3312: Soil Microbial Ecology **42 Hours**

The soil as a habitat for organisms, the taxonomy and biology of the soil organisms, the fundamentals of nutrient cycles, symbiotic associations, and bioremediation.

ALS 3313: Environmental Biogeochemistry **42 Hours**

Biogeochemistry and its history. Analysis of cycles and processes; lithosphere, atmosphere, hydrosphere, ecosphere. Carbon cycle, nitrogen cycle, phosphorous cycle, sulphur cycle. Environmental change; land use change, soil loss/erosion, eutrophication, acid rain and climate change.

ALS 3314: Principles of Surveying

Measurement of distance and angles, triangulation; chain surveying; leveling, plane table survey, contour survey; measurement of slope; compass surveying; air photo survey, scale, parallax, use of stereo pairs; plans and maps. Application in soil and water conservation practices.

ALS 3315: Crop Eco-Physiology **42 Hours**

Definition and development of plant eco-physiology; plant productivity; Photosynthesis-single leaf and canopy; Assimilate partitioning and crop/harvest index; Plant population ecology: Implication on cropping systems, cropping densities and crop-weed competition; Biophysical plant ecology: Solar radiation, radiation and energy balances; Management of excess and limiting light levels: heat fluxes in soil, air, crop canopies; Plant response to temperature (air and soil); Plant water relations: Hydrological balance; Water potential of soil, air, and tissue/cells; crop water balance: Absorption, transpiration, vapour pressure deficits (VPD); Plant responses to environmental stress: Causes, effects, symptoms and adaptations to common stress (water deficit, anaerobiosis, salinity, mineral deficiency/toxicity, temperature, wind, gaseous pollutants etc.); Beneficial effects of environmental stress.

ALS 3316: Soil Fertility and Plant Nutrition **42 Hours**

Concepts: Soil fertility, productivity, nutrient essentiality, toxicity, plant nutrition, nutrient availability; Essential nutrients: Macronutrients, micronutrients; Nutrient uptake and translocation; Functions of plant nutrients; Nutrient interactions: Synergism and antagonism; Fertilizers: Inorganic, organic, and bio-fertilizers; Inorganic fertilizers; Types, formulations, manufacture; nutrient requirement determination and fertilizer applications; Organic fertilizers: Types, characterization, handling, applications; Bio-fertilizers: Types, use; Lime, liming, lime requirement of soils; Economics of fertilizer and lime use; Fertilizer and water use relationships; Soil and plant sample analyses.

ALS 3317: Soil and Water Engineering **42 Hours**

Introduction to hydrology; Hydrological cycle; Effective rainfall: Measurements of precipitation, infiltration and runoff; Introduction to hydraulics; Types of flow; Continuity and Bernoullis equation; Water conveyance and distribution in pipes and channels; Sedimentation and scouring; water lifting devices: Types of pumps and their characteristics curves; Construction of dams and tanks; Development of groundwater; Soil erosion and conservation; Irrigation and drainage methods including micro-irrigation techniques; Soil-plant water relationships: Crop water requirement, irrigation intervals, soil water retention availability; dry land farming methods.

BEP 3315: Entrepreneurship **42 Hours**

Definition of Small and Medium Enterprise (SME); Theory and philosophy of entrepreneurship; Production efficiency: Factor resource intensity, large vs. small enterprises, and justification for small enterprises; Understanding entrepreneurship: Starting a SME, creating and managing the venture; Sources of capital in venture creation; Consumer-entrepreneur relationship: Role of product quality, innovation and skill in product quality; Marketing of SME product; Competitiveness; Scaling up; Institutional arrangements; Standards and quality; Barriers to SME development; Role of SME in economic development; Case studies of successful SME; Indicators and s vertical integration.

YEAR 3: SEMESTER 2

ALS 3321: Soil, Water and Public Health 42 Hours

Public health; Environmental health regulations, risk assessment, approaches to the study of public health, health in environmental impact assessments. Soil and water Science; Soil functions, general soil properties: Physical, chemical, biological, relationship between soil properties and environmental health, contaminant retention/release, microbial degradation, leaching and runoff, soil degradation and public health, soil remediation; Water quality and public health; Water quantity and public health. Application of soil and water science principles to public health promotion and protection; Trace element contamination of soils and waters, organic chemical contamination of soils and waters, land degradation, dust storms, and respiratory distress. Soil and waterborne pathogens, industrial development and land degradation; Human sanitation, water quality and disease; Land application of waster, acid rain and effect on mobilization of soil contaminants/components, soil quality, food availability and crop nutritional value.

ALS 3322: Wetland Soils Management 42 Hours

Definition of basic terms relating to wetlands. Hydrology; Hydrologic cycle and wetland water budget, precipitation, evaporation and transpiration, infiltration; Groundwater water budget calculations; Rainfall runoff; Hydrologic indicators. Biogeochemistry: upland vs. wetland soil characteristics; Reduction/oxidation, microbial activity, oxygen availability, carbon cycling , nitrogen cycling, phosphorus cycling. Hydric soils; Legal definition of hydric soils, soil orders/morphology, hydric soil delineation; Field indicators. Wetlands vegetation; Environmental stressors; Biological adaptations; Vegetative succession. Wetlands ecology. Natural wetland systems. Constructed wetlands

ALS 3323: Nutrient Management and Research in Agroecosystems 42 Hours

Basic concepts of soil fertility and biogeochemistry and how soil and environmental properties affect nutrient availability and cycling. Organic farming and soil conservation

impact on the fate of nutrients in agro-ecosystems. Nutrients management improvement without creating environmental hazards.

ALS 3324: Soil Chemical Analysis **42 Hours**

Practical and theoretical aspects of instrumentation and methodology used in the chemical analysis of soil and water samples. Lab safety; General rules. Some chemistry basics, definitions, SI units, non SI units in common usage, significant figures, glassware safety cleaning glassware, volumetric glassware. Accuracy and precision, blanks, replicates, standards, external check samples, sample preservation. Instrumentation used in soil and water analyses; UV-VIS Spectrophotometry, Atomic absorption spectrophotometry, ICP, HPLC/ion chromatography.

ALS 3325: Soil Contamination and Remediation **42 Hours**

Soil contamination and remediation; Environmental contaminants and their sources in the environment, pathways to contaminate soils, impacts on the environment, fates in soils, and remediation. Development and application of new remediation technologies; Thermal remediation, biological, chemical and physical remediation.

ALS 3326: Principles of Irrigation and Drainage **42 Hours**

Irrigation water sources and methods of storage, water and soil relationship; Water flow through the soil, the quantity and quality of water used in irrigation systems, surface and underground irrigation, drainage, wells and its use for irrigation, water measurements, laws and legislation for irrigation.

ALS 3327: Soil-Water Nutrient Relationship. **42 Hours**

Physics of irrigated soils; Water infiltration, redistribution and drainage; Monitoring content and transport of water and solute chemistry of irrigated soils; evaluation of water quality; Cation exchange and precipitation reactions; Chemical and physical properties of soil due to irrigation; Nutrient availability and monitoring; Reclamation of sodic and saline soils; Behaviour of organic compounds in soil.

ALS 3328: Biometrics for Soil Science 42 Hours

Need for Agricultural experiments, contribution of statistics to experimentation; Planning experiments: Replication, randomisation sampling, the concepts of variance, error and error reduction; Statistical designs: Completely randomised, completely randomised block, split plot, latin square; Factorial experiments, nested structures; Analysis of Experiments: Partition of treatment of effects; Comparison of means in each experimental design and structure. Field research methods, research project preparation, funding, implementation and reporting

YEAR 3: SEMESTER 3

ALS 3331: Industrial Attachment 480 Hours

An Industrial Attachment will be undertaken at the end of the 2nd Semester of the 3rdYear of study for twelve (12) weeks. Students will be examined in three stages as follows: Field supervision by academic staff of work undertaken by the student while on the industrial attachment (25%); oral presentation by the student upon return to the college on completion of the attachment (25%); and a written Report on the operation of the firm following the standard university report writing format (50%). The report should cover a theoretical background and identify a problem, causes, effects, and possible solutions and opportunities created on implementation of the intervention(s).

YEAR 4: SEMESTER 1

ALS 3411: Irrigation and Drainage Technology 42 Hours

Irrigation equipment; irrigation water supply, filtration and metering; Efficiency and conformity of water distribution: The problems and their significance; Measurement in sprinkler sets and drip lines; Sprinkler and drip irrigation system design - principles, design and layout; Irrigation scheduling, plant and soil aspects; Farm irrigation planning; Pumps and pumping; Types, selection, installation, maintenance and operation; The change from open to closed irrigation systems; Economic use of energy in irrigation.

ALS 3412: Soil Mineralogy and Surface Chemistry 42 Hours

Mineralogical composition of various size classes of soil particles; Genesis and important properties of soil minerals with emphasis on clay minerals; X-ray diffraction, DTA, and polarizing microscope techniques in mineralogical analysis of soil materials.

ALS 3413: Forest Soils Ecosystems 42 Hours

Defination of ecosystems sevices; Forests and soils ecosystem services. Ecosystem servicess as used in the concepts of sustainability and conservation, economic values of ESs. Economic valuation of forest ecosystem services. Production services; Lumber and pulp, bioenergy, chemical extractives, charcoal, pine straw. Physically related forest and Soil ESs; Soil conservation and stability, water yield, flood mitigation. Chemically related forest and soil ESs; Water quality (filtering, water treatment, biological filtering, plant remediation), Air quality; Nutrient cycling, carbon Sequestration. Biologically related forest and soil ESs. Biodiversity (plant and chemical), wildlife habitat and diversity, pollination, seed dispersal.

ALS 3414: Rhizosphere Biochemistry 42 Hours

Macronutrients in the rhizosphere: Their sources and roles in promoting rhizosphere communities. Communications in the rhizosphere. Detection and response; Major classes of the rhizosphere signals and their origin; Chemical techniques and bioassays to separate, purify and identify rhizosphere signals; Signal perception and signal transduction pathways in prokaryotes and eukaryotes; Plant defense compounds. Root-root interactions; Allelopathy. Root-fungal interactions; Plant signals and their recognition by pathogenic and beneficial fungi. Root-bacterial interactions. Molecular determinants of rhizosphere colonization. Evolution of rhizosphere signaling. Rhizosphere communities and their role in biocontrol, micronutrient acquisition, and bioremediation

ALS 3415: Soil Landscape Modelling 42 Hours

History and trends in environmental soil-landscape modeling; The space-time continuum/spatial and temporal scales; Historic, current and future perspectives; Digital

soil mapping and modeling (pedometrics); Quantitative assessment of environmental quality (environmetrics). Collection of soil and ancillary environmental datasets; Emerging geographic information technologies, proximal soil sensing techniques and remote sensing, topographic mapping. Quantitative Methods to assess soil and environmental patterns across landscapes; Crisp and fuzzy classifications, Global and local deterministic methods, Geostatistical methods, Multi-scale/multi-dimensional modeling of soil and environmental properties.

ALS 3416: Highland Soils Management **42 Hours**

Types and genesis of soils in highland and highly sloping areas; Classification, prominent physical, chemical and mineralogical properties of hillslope soils; Relationship of soils to vegetation and topographic position; Basic concept on uses and conservation of highland soils based on soil properties and limitation for plant production.

ALS 3417: Soil Quality and Food Security **42 Hours**

Soil degradation and crop production. The influence of global environmental change on soil quality and food production. Impacts of global warming on food security. Analysis of world commodity market, food distribution, and globalization

ALS 3418: Research Project I and II **84 Hours**

Each student will undertake problem solving research project in an area of his/her choice in Soil Science; The project will be conducted under supervision of teaching and technical staff; the students will prepare a research proposal guided by an appointed supervisor and continue to conduct the experiment, write a report and give an oral presentation; The project and oral presentation will be presented in the second semester of the same year.

YEAR 4: SEMESTER 2

ALS 3421: Soils and Plant Nutrient Bioavailability 42 Hours

Description of forms, transformations, and movement of plant nutrients in soils. Discussion of factors affecting nutrient supply, both qualitatively and quantitatively, for nutrient elements essential for plant growth.

ALS 3422: Soil Quality Assessment and Management 42 Hours

Definition of basic concepts. Soil quality indicators. Soil quality assessment. Measurements of soil quality indicators; Physical parameters, chemical parameters, microbiological and biochemical parameters. Soil quality management for plant production. Management of soil quality for the environment. Soil quality management for air quality. Soil quality management for plant health. Soil quality management for animal health. Soil quality management for food security.

ALS 3423: GIS in Soil land Water Science 42 Hours

Basic concepts of geographic information systems in soil and water management. Utility of GIS in decision-making. Fundamentals of cartography, geo-referencing, data structures, database design, project planning, and basic spatial data analysis. Elements of aerial photographs and remote sensing; Principles on interpretation of aerial photographs and remote sensing information; Methods in aerial-photo interpretation for soil survey, land use mapping and other related natural resources; Uses of basic materials and instruments in aerial-photo interpretation.

ALS 3424: Climate Change and Soil- Plant Relationships 42 Hours

Effects of higher CO_2 on soil fertility, physical conditions and productivity. Effects of rainfall and temperature changes in different climates; Processes in soils and clay surfaces. Resilience against physical and chemical soil degradation and soil redox reactions. Effects of a rising sea level on soils in coastal areas.

ALS 3425: Land Degradation and Management of Problematic Soils 42 Hours

Definition of to land degradation; human influence on the environment, concepts of soil quality, soil resilience and sustainable use; nature, processes and factors of different types of physical, chemical and biological soil degradation including compaction, hardsetting, fertility depletion, acidification, salinization and alkalization; management aspects of soils associated with these problems; desertification: causes, processes and indicators; soil-induced mass movements; problems resulting from quarrying, mining and their environmental impact; detection and monitoring of different kinds of soil-related land degradation using multi-temporal remote sensing techniques; assessing, modelling and predicting land degradation using GIS; reclamation and management of degraded soils.

AAE 3422: Agricultural Policy Analysis 42 Hours

Agricultural policy and economic development; Role of agriculture in developing countries; Economic planning paradigms; Agricultural policy analysis framework; Methods of policy analysis; Domestic policy environment (factor, product, marketing, land reform and agricultural research policy); International policy environment (diversification, international credit, regional integration, globalization, international conventions and protocols, role of WTO).

AAE 3425: Environmental and Natural Resources Economics 42 Hours

Economics of the environment: Environmental quality as an economic good; Environmental pollution: global problems, air borne residuals, water borne residuals, solid waste residuals; Market system and pollution: Market failures, property rights, tragedy of the commons; Economics of pollution control: Optimum level of pollution control, remedies for externalities, the bargaining solution, emissions fees, emissions standards and enforcement, transferable emissions permits; Examples of market efficiency; Allocation of specific types of resources: Replenishable but depletable resources, renewable common property resources, storable renewable resources; Economic rationale of the public sector in environmental management; Need and functions of the public sector; Conflicts and limitation in correcting market failure.

AAE 3427: Farm Management **42 Hours**

Definition and scope of management; Unique characteristics of farm management: Planning, implementation and control; Basic economic principles in the context of farm management; Returns to capital, labour, management and owners' equity; Personnel management; Labour laws and regulation; Motivation and group dynamics; Measures of risk: Criteria for decision making under risk and uncertainty; Farm planning techniques; Farm enterprise studies; Performance analysis of the farm business; Value chain and value addition of agricultural products; Market driven agricultural production; Access to markets and market information; Theories of production/expansion path; Cost of production and cost curves.