

COURSE CAPSULES

First Semester

SS 5101. Fundamentals of Soil Science (2)

Soil formation. Physical, chemical and biological properties of soil, Soil as a medium for plant growth, Soil as a sink and source of environmental pollutants.

SS 5102. Physical Properties and Processes in Soils (2)

Physical properties of soils. Mass volume relationships. Soil rheology and trafficability. Soil water. Measurements of water status in soil. Flow of water in soil. Water and energy balance. Tillage and soil structure management. Soil strength. Soil temperature. Heat and gas flow.

SS 5103. Mineralogical and Chemical Properties of Soils (3)

Basic chemical, structural and crystallographic concepts. Classification, structure, surface chemistry, genesis, weathering, identification and distribution of soil minerals. Influence of minerals on soil properties. Mineralogy of Sri Lankan soils. Nature and properties of organic constituents, chelates and clay humus complexes. Ionic distribution on colloids. Flocculation and dispersion of soil colloids. Adsorption / Desorption of ions and ion exchange in soils. Soil acidity, alkalinity, salinity and sodicity. Reactions of submerged soils and redox phenomena. Kinetics of soil chemical reactions.

SS 5104. Plant Nutrition (2)

Occurrence and availability of plant nutrients and beneficial elements in soil. Mechanisms of nutrient absorption, translocation and excretion. Functions of nutrients in plants. Deficiencies and toxicities of nutrients in plants and their diagnosis. Managing nutrient imbalances.

SS 5105. Introduction to Tropical Soils (1)

Tropical environment; climates and moisture regimes, Characterization of highly weathered soils, Soils of tropics; fertility, productivity, and sustainability. Compare and contrast tropical and temperate soils.

SS 5106. Environmental Pollution and Control (2)

(Offered for non- Environmental Soil Science Degree students)

Sources of pollutants and contaminants; fertilizers, pesticides, solid wastes, sewage sludge, toxic metals, metalloids, soluble salts, radio-nuclides, soil sediments and atmospheric depositions. Transformation, mobility and persistence of pesticides, toxic metals, metalloids and other organic and inorganic pollutants in soil environment. Impact of pollutants on ecosystem health; eutrophication, siltation of reservoirs, pollution of groundwater, soil and air, narrowing of soil biodiversity. Remediation of contaminated soil and water bodies. Regulatory measures and policies to control pollution.

SS 5107. Formation and Characteristics of Topical Soils (2)

Tropical environment and the soils of the tropical belt. Management of tropical soils. Differences between tropical and temperate soils. Sustainability and productivity of tropical soils.

SS 5108. Soil Ecosystems and their functions (2)

(Offered only under Soil and Environmental Microbiology Program)

Population ecology, structure, dynamics and interactions. Food webs, Biogeochemical cycles and flow of energy. Primary production. Community succession and disturbances. Biodiversity and soil productivity. Soil quality and sustainability. Ecosystem conservation.

SS 5109. Microbial Ecology (3)

(Offered only under Soil and Environmental Microbiology Program)

Microbial Evolution. Microorganisms in their natural habitats-air, water and soil. Spatial heterogeneity and temporal variability of microorganisms in aquatic and terrestrial habitats. Respond of soil and aquatic

microorganisms to environmental perturbations. Adaptations to extreme environmental conditions and to host. Microbial interactions, communities and ecosystems. Techniques in microbial ecology, enrichment, isolation and characterization. Ecological theories in microbial ecology - Neo Darwinism vs. Communities, Diversity vs. Stability.

SS 5110. Environmental Soil Physics (3)

Soil as a product of environment, Environmental Significance of Soil Texture, Structure, Density and Porosity, Field water cycle. Infiltration, sorptivity, redistribution including saturated and unsaturated flow of water and their effects on the environment. Solute movement with special emphasis on transport of contaminants. Relationship of soil orders with the Environment. Spatial and temporal variability of soils and their environmental impact. Application of geo-statistics in studying the spatial structure.

SS 5111. Environmental Soil Chemistry (3)

Review of chemical principles. Application of thermodynamics to soil systems; mineral/solid phase solubility, precipitation, sorption, complexation, ion exchange equilibria. Activity-ratio diagrams for describing chemical equilibria in soil systems. Advanced techniques used for solid and solution phase speciation including hands-on experience with geochemical speciation models. Application of chemical kinetics to soil reactions. Oxidation-Reduction reactions and their environmental significance. Sources, reactions, transport, fate and bioavailability of chemical species in soils. Predicting fate of contaminants and pollutants using mathematical modeling.

SS 5112. Soil-Plant-Water Systems (3)

(Offered only for non-soil science M.Sc. degree programs)

Soil, their properties and functions. Soil resources of Sri Lanka. Nutritional aspects of plants. Fertilizers, organic manures, crop residues, their uses and effects on environment. Soil management and conservation. Soil degradation and desertification. Pollution of natural resources soil, water and air.

SS 5113. Environmental Microbiology (2)

Microbial bioenergetics. Microbiology of biogeochemical cycles. Microorganisms as a sink and source of environmental pollutants in terrestrial and aquatic ecosystems. Biotransformation of environmental pollutants. Use of microorganisms as bio-indicator and biosensor. Principles of biological treatments. Enzymes in the soil environment; interactions with colloids, inhibition and kinetics.

SS 5114. Digital Soil Mapping (2)

Theory, Introduction to digital Soil Mapping, Fundamentals of Digital Soil Mapping, GIS tools for Digital Soil Mapping, Basic GIS functions, Soil Sampling using spatial statistical methods, Statistical spatial data analysis techniques, Sources of Ancillary information for digital soil mapping Following laboratory sessions will be conducted; dereferencing and navigation, GIS functions, Construction of DEM, Construction of apparent electrical conductivity data base

SS 5151. Management of Soil Organic Matter (2)

Organic and inorganic phases of soil: Chemical composition and characterization of soil organic matter. Role of soil organic matter in improving soil fertility. Composting techniques. Use of organic materials in agriculture; compost, green manure, crop residues, farm yard manure etc. Concepts of organic and biodynamic farming systems.

SS 5152. Techniques in Soil, Plant, Water and Fertilizer analysis (3)

Principles of volumetry, gravimetry, colorimetry, turbidimetry, nephelometry, fluorometry, flame photometry, atomic absorption spectrometry and potentiometry analytical techniques. Sampling and sample preparation for analysis. Errors in analysis. Quality assurance and quality control. Determination of basic soil properties. Extraction of soil nutrients. Analysis of soil, plant, water and fertilizers for elements.

SS 5153. Soil Morphology and Classification (2)

Soil forming processes. Soil morphology. Soil profile description. Soil survey. Historical background of soil classification. Systems of soil classification; FAO classification and soil taxonomy. Soils of Sri Lanka and their classification. Classification of rice growing soils.

SS 5154. Plant-Microbe Interactions (2)

(Offered only under Soil and Environmental Microbiology Program)

Nature of phyllosphere and rhizosphere. Diversity of phyllosphere and rhizosphere microorganisms. Signal transduction and host specificity. Di-nitrogen fixation. Mycorrhizae. Plant Growth Promoting Rhizobacteria. Plant growth regulators, phytotoxins and allelo-chemicals. Plant-microbe interactions and ecosystem stability.

SS 5155. Management of Tropical Soils (3)

Soils of the tropical belt, their formation, characteristics and classification; Differences between tropical and temperate-zone soils; Soil development and land use in the tropics; Sustainability and productivity of tropical soils; Management of tropical soils; Problem soils of the tropics, their properties and management; Soil degradation under tropical conditions; Soil conservation and rehabilitation of degraded soils in the tropics.

SS 5156. Water Quality and Environment (2)

Significance of water for global sustainability, Properties of water and forms in nature, Global water availability in qualitative and quantitative terms, Water cycle, Uses (common and specific) and quality requirements, Measurements and monitoring water quality parameters, Sources and causes of water pollution, Ground water quality, Influence of land management on water quality, Social and economic dimensions of water pollution, Mitigation of water pollution, Purification methods, Responsibilities and ignorance of water users.

SS 5198. Directed Study (5)

Candidate should carry out an independent research project on a topic related to degree program as recommended by the advisor.

SS 5199. Seminar (1)

Communication of science. Assessment of research articles, Preparation of extended abstracts, Techniques to effectively present data, handling of audio visuals.

SS 6101. Tracer Techniques in Soil and Plant Studies (2)

Basic principles of radioactivity, its detection and measurement. Hazards of radioactivity and safety measures. Radioactive waste management. Atomic energy regulations. Tracer methodology; mass spectrometry, photo spectrometry and autoradiography. Use of tracers in ion uptake, root activity, root distribution and soil organic matter dynamics, fertilizer use efficiency, C and N dynamics in soils, microbial growth and activity measurements, soil erosion and fate of nutrients and pesticides in soils.

Second Semester

SS 5201. Soil Fertility and Fertilizers (3)

Factors affecting plant growth. Historical background of fertility management. Soil fertility parameters and interpretations. Assessment of soil fertility. Sustainable management of soil fertility. Fertility based crop selection. Basic aspects of fertilizers, manure and amendments. Manufacture and standards of chemical fertilizers. Types of fertilizers. Formulation of fertilizer mixtures. Composting. Biofertilisers. Amendments to improve soil fertility. Efficient use of fertilizers. Organic farming. Fertilizer recommendations.

SS 5202. Advanced Plant Nutrition (2)

Status of nutrients in plant tissues. Plant water relationship. Physiological pathways of nutrients. Nutrient interactions in plant and soil. Relationships between nutrients and pest and diseases. Nutrition and yield responses and yield quality. Nutrient stressed conditions in plants and adaptations.

SS 5203. Degradation and Conservation of Tropical Soils (2)

Types and nature of soil degradation. Soil degradation under tropical conditions. Soil erosion. Mystification, Salinization, nutrient depletion and imbalance in agricultural soils. Soil subsidence, compaction, desertification etc. Rehabilitation of degraded soils. Mechanical and agronomic conservation measures with special reference to Sri Lanka. Legal aspects of soil conservation.

SS 5204. Management of Tropical Uplands (1)

Land classification. Land suitability evaluation for upland agriculture. Land development. Productivity management of soils under rainfed agriculture, grasslands and forests. Tillage, moisture and organic matter conservation in the uplands. Some aspects of irrigation. Fertility management of upland agricultural soils in the tropics.

SS 5205. Management of Tropical Wetlands (1)

Characteristics and processes in wetland environment. Role of wetlands in global nutrient cycles. Fertility and water management in lowland rice. Problem rice soils with special reference to Sri Lanka. Environmental issues associated with wetlands, including swamp and marshy lands. Legal aspects on conservation of wetlands.

SS 5206. Social and Legal Aspects of Land Management (2)

Population pressure on land. Resource poor land users in developing countries. Land tenure. International conventions and environment laws. World soil charters. Global and local investment on soil conservation. Past and present Sri Lankan legislation, their success and failures. Law enforcement and policies for the future.

SS 5207. Reclamation and Management of Problem soils in Sri Lanka (2)

Types, distributions and description of problem soils in Sri Lanka. Natural and anthropic causes leading to problems. Impact on the productivity and environment. Socioeconomic issues, reclamation challenges. Law and policy requirements. Integrated approaches for rehabilitation and better management. Importance of on-farm solutions.

SS 5208. Field Characterization of Soils (2)

Site / location description. Identification and relevance of soil horizons / layers,. Estimation of mottles, stones, organic matter, particle size classes, soil water. Determination of carbonates, soil reaction, salinity and nutrient status. Sampling equipment, commercial and self prepared field soil kits, indicator plants. Overall fertility assessment.

SS 5209. Land Use Planning (2)

Basic concepts of land use planning. Land suitability evaluation. Land classification. Present and past land use planning in Sri Lanka. Present land use and land cover mapping. Remote sensing and GIS. Economic and social aspects related to land use. Crop requirements. Watershed approach in land use planning. Land suitability for different crops, pasture and forestry sector. Implementing land use plans.

SS 5211. Soil Enzymology (1)***(Offered only under Soil and Environmental Microbiology Program)***

Fundamental properties of enzymes. Characterization and quantification of enzymes in soil. Interactions of enzymes with organic and inorganic colloids. Inhibition of enzymes in soils. Kinetics of enzymes and their applications. Enzymes as an indicator of soil quality.

SS 5212. Soils of Sri Lanka (1)

Agro-ecological regions, Soil and their distribution, Potentials and limitations for agriculture, Environmental concerns.

SS 5251. Organic Pollutants and Environment (2)

Nature of organic pollutants. Fate of organic pollutants in soil and water: retention, transformation, catabolic pathways: metabolites, enzymes and genes, leaching and volatilization. Fate of hydrocarbons in soil and water. Toxicity of organic pollutants with an emphasis on pesticides. Impact of organic pollutants on ecosystem. Risk Assessment.

SS 5252. Environmental Impact of Inorganic Pollutants and Radio-nuclides (3)

Soil and air pollution by fertilizers. Sources of toxic metals and metalloids. Contamination of water sources use for domestic purposes and irrigation. Eutrophication. Speciation of metals in soil and water. Biogeochemical behaviour of inorganic pollutants. Impact of toxic metals and metalloids on plants, microorganisms and animals. Decontamination of groundwater. Radionuclides; Sources of radionuclides: Fallout radionuclides deposited on soils. Transfer to crops and migration to groundwater.

SS 5253. Solid Waste and Environment (2)

Common types and composition of solid wastes. Contamination of soil and water with waste. Immediate impacts on physical, biological and chemical properties of soils. Transformation of wastes. Accumulation and residual effects on soils. Risks of translocation. Capacity of soils to buffer adverse impacts. Overall effects on soil health. Appropriate application methods, rates and environmental law. Social responsibility and attitudes.

SS 5254. Environmental Biotechnology (2)

Trends in the development of soil biotechnology, Technology and ecology of genetically engineered soil microorganisms for environmental processes. Ecological concerns of introducing genetically engineered organisms as biofertilizers, biopesticides and agents of waste decomposition and bioremediation. Commercialization of genetically engineered organisms and relevant legal aspects. Case Studies.

SS 5255. Special Topics Related to Microbiology (2)***(Offered only under Soil and Environmental Microbiology Program)***

Use of stable radio-active isotopes in mineralogical studies, Statistical methods for microbiological data analysis, Modeling of microbial growth and activity, Environmental policies and laws with special reference to Sri Lanka. Current issues related to environmental microbiology.

SS 6201. Techniques for Efficient Plant Nutrient Management (2)

Land preparation, Fertilizer/amendments application techniques including fertigation. Integrated plant nutrient management in agriculture. Crop specific nutrient supply with special emphasis on horticulture and floriculture crops. Media preparation and nutrient management in protected agriculture; soil less cultures/ hydroponics.

SS 6202. Environmental Soil Mineralogy (2)

Minerals in soil environments, Geochemical-biological cycle of toxic elements, Bedrock geochemistry and stability of secondary phases, Soil-solution-mineral and organo-mineral interactions, Properties of soil mineral surfaces.

SS 6203. Land Use and Environment (1)

Land use. Land use systems in Sri Lanka. Impact of urbanization on land use. Assessment of land use. Measures to control misuse of lands.

SS 6204. Remediation of Contaminated Soil and Water (2)

Sources and environmental consequences of hazardous inorganic and organic toxicants. Remediation of soil and water. In-situ, and ex-situ methods of remediation of contaminated soils. Physical, chemical and biological remediation techniques; their potentials and limitations. Some case studies describing use of these different techniques to solve real world, soil/water pollution problems, and their success and failures. Application of different remediation techniques under Sri Lankan conditions.

SS 6205. Advanced Instrumentation in Environmental Research (2)

Electron microprobe analysis, Infrared spectrometry, X-ray diffraction techniques, X-ray fluorescence spectrometry, Chromatography, GC-MS, Isotopic analytical techniques, Electro-chemical techniques, Techniques used for solid- and solution-phase chemical speciations with sample studies, ICP-AFS / MS.

SS 6206. Soil Environmental Modeling (2)

Concepts of modeling, soil water interactions, formulation of models and solution techniques, verification and calibration, chemical speciation models, redox and adsorption models, application of water flow and solute transport models, simulation models for biochemical processes and bacterial growth, Graphic programs for chemical and mineral structure plotting.

SS 6207 Applications of Digital Soil Mapping (2)

Theory, Upgrading and Updating soil maps, Digital Terrain Analysis, Field measurements and analysis of apparent electrical conductivity data, Spatial prediction techniques, Geostatistical predictions, Data reduction techniques, Unsupervised classification, Spatial modeling of soil variation, Laboratory sessions: Exploratory analysis of exhaustive data sets, Geostatistical analysis Univariate and Multivariate, Proximal sensing and data analysis,