CSA Institute

Patuakhali Science and Technology University

Dumki, Patuakhali

Course Curricula

Course Code: CSA 6104
Course Title: Soil, water and environment management
Credit Hour: 2
Student Level: MS, Semester – 1

Rationale:
Sustainable farming under changing climate is one of the stressing needs for ensuring food security of the people across the globe. For successful production of crops requires an in-depth understanding of agricultural resources and its efficient uses. The basic natural resources are soil, water and environment (light, air etc.). Therefore, students intended to follow MS in CSA should get sufficient theoretical and practical background on soil processes, nutrient dynamics in soils and nutrient budget while a comprehensive understanding on water management at crop level is equally important. In addition, CSA students need to study the efficient harvesting of environmental resources including solar radiation.

Course logistics: The course consists of 18 hours of classroom lectures, workshops, supervised practical assignments and a final exam. The remaining hours are for self-study and online testing. Course material will be made available on the digital learning platform.

Objectives:

After completion of the course, the students should be able to

(i) Understand, discuss and synthesize the soil processes and functions for successful crop production.
(ii) Understand water uptake and its uses by plants, and calculate the crop water requirement.
(iii) Understand, synthesize and apply the theories related to solar radiation harvesting by plants.
(iv) Discuss the impacts of agricultural activities on soil, water and environment.
(v) Design crops or cropping for a particular situation through applying theoretical and practical knowledge of crop-soil-environment interactions.

Learning Outcomes	Course Content	Teaching-Learning Strategy	Assessment Strategy
Understanding soil properties, particles and their interactions in soils	**1. Soil processes and interactions** • Physical, chemical and biological properties of soils • Soil minerals and its role in nutrient cycling • Soil texture, structure and density • Soil water and its availability to plants, soil moisture content, retention (pF curve) and flow • Soil pH, cation exchange capacity and base saturation • Soil organic matter, mineralization and its role in nutrient cycling • Soil biology- soil microorganisms and nutrient cycling • Soil salinity aspects	Lecture Reading Assignment Presentation QA	
Understanding nutrient dynamics and pesticides in soils	**2. Nutrient cycling and budget in soils** • Speciation of nutrients in soil • Nutrient adsorption models (Langmuir and Freundlich) • Nutrient uptake processes (Mass flow, root interception and diffusion) and models • N, P and K cycles • Nutrient budgeting/Nutrient use efficiency Calculations for different crops • Nutrient stoichiometry • Diagnosis of nutrient deficiency and toxicity in plants • Pesticide soil processes • Leaching of nutrients and pesticides	Lecture Reading Assignment Presentation QA Practical: A short experiment to examine nutrient dynamics in soil	
Understanding plant water relationships	**3. Plant water relationship** • Water in soils and its uptake in plants • Water use efficiency in relation to plant/canopy architecture and weather conditions (evapotranspiration)		

	• Crop water requirement and crop factors • Role of groundwater, capillary rise, unsaturated zone • Fresh water sources • Irrigation scheduling		
Understanding plant-environment interactions	**4. Plant-environment interactions** • Solar radiation and its interception by plants • Soil temperature • Efficiency of solar radiation harvesting in relation to crop/canopy architecture, soil resources, water resource • Crop performance/management under different wind/air supply/flow • Crop scheduling using heat unit calculation		
Increasing the synthesizing capacity of students for designing of crops/cropping	**5. Crop-environment interactions** • Designing crops/cropping under different resources conditions • Using the FAO AquaCrop model to model crop water demands and crop yields	Computer workshop	

Recommended Books and Periodicals

1. Ali, H., 2011. Practices of Irrigation & On-farm Water Management: Volume 2. Springer Science & Business Media.
2. Allen, R.G., Pereira, L.S., Raes, D., Smith, M., 2000. Crop Evapotranspiration (guidelines for computing crop water requirements). FAO - Food and Agriculture Organization of the United Nations, Rome, Italy.
3. Bal et al. 2018. Advances in Crop Environment Interactions. Springer Nature.
4. Brammer H. 1996. The Geography of the Soils of Bangladesh. University Press
5. FAO, 2018. AquaCrop training handbooks: Book II: Running AquaCrop. Food & Agriculture Org.
6. Kirkham MB.2014. Principles of Soil and Plant Water Relations. Elsevier Academic Press.
7. Marschner H. 2012. Marschner's Mineral Nutrition of Higher Plants. Elsevier Academic Press.
8. Mejias, P., Piraux, M., 2017. AquaCrop, the crop water productivity model. FAO, Rome, Italy.
9. Steduto, P., C. Hsiao, T., Fereres, E., Raes, D., Land and Water Division, 2012. Crop Yield Response to Water, FAO Irrigation and Drainage Paper. FAO, Rome, Italy.
10. Tan, K.H., 2009. Environmental Soil Science. CRC Press.

11. Theivasigamani, P., Velu, G., Jeyakumar, P., 2013. Impact of Crop Heat Units on Growth and Developmental Physiology of Future Crop Production: A Review. Research & Review: Journal of Crop Science & Technology 2, 2319–3395
12. Weil R. R. and Brady N. C. 2021. The Nature and Properties of Soil. 15th Edition, Pearson publishers