Department of Soil Science

Ph.D Programme

Course No.	Title of the Course	Credits
1st semester		
ACSS-701	Radioisotopes in Soil & Plant Studies	1+1
ACSS-702	Soil Genesis & Micropedology	2+0
ACSS-703	Biochemistry of Soil Organic Matter	2+0
ACSS -704	Advance in Soil Microbial Ecology	2+1
2nd semester		
ACSs -751	Geomorphology & Geochemistry	2+0
ACSS -752	Remote Sensing & GIS Techniques for Soil & Crop Studies	2+0
ACSS-753	Advances in Soil Physics	2+0
ACSS-754	Advances in Soil Fertility	2+0
ACSS -799	Seminar-I	1+0
3rd semester		
ACSS-849	Seminar-II	1+0
4th semester		
	Nil	
5th semester		
	Nil	
6th semester		
ACSS -999	Seminar-III	1+0
ACSS-1000	Doctoral Research	0+45

1st semester

ACSS-701 Radioisotopes in Soil Plant Studies 1+1

Theory

UNIT I: Atomic structure, radioactivity and units; radioisotopes - properties and decay principles; nature and properties of nuclear radiations; interaction of nuclear radiations with matter

UNIT II: Principles and use of radiation monitoring instruments - proportional, Geiger Muller counter, solid and liquid scintillation counters; neutron moisture meter, mass spectrometry, auto radiography

UNIT III: Isotopic dilution techniques used in soil and plant research; use of stable isotopes; application of isotopes in studies on organic matter, nutrient transformations, ion transport, rooting pattern and fertilizer use efficiency; carbon dating

UNIT IV: Doses of radiation exposure, radiation safety aspects regulatory aspects, collection, storage and disposal of radioactive wastes

Practical

- Storage and handling of radioactive materials
- Determination of half-life and decay constant

• Preparation of soil and plant samples for radioactive measurements

• Setting up of experiment on fertilizer use efficiency and cation exchange equilibria using radioisotopes

• Determination of A, E and L values of soil using ^{32}P/ ^{65}Zn

• Use of neutron probe for moisture determination

• Sample preparation and measurement of ^{15}N enrichment by mass spectrophotometry/ emission spectrometry

ACSS-702 Soil Genesis & Micropedology 2+0

Theory

UNIT I: Pedogenic evolution of soils; soil composition and characterization.

UNIT II: Weathering and soil formation – factors and pedogenic processes; stability and weathering sequences of minerals.

UNIT III: Assessment of soil profile development by mineralogical and chemical analysis.

UNIT IV: Micro-pedological features of soils – their structure, fabric analysis, role in genesis and classification.

ACSS-703 Biochemistries of Soil Organic Matter 2+0

Theory

UNIT I: Organic matter pools in soil; composition and distribution of organic matter in soil and its functions; environmental significance of humic substances; decomposition of organic residues in soil in relation to organic matter pools.

UNIT II: Biochemistry of the humus formation; different pathways for humus synthesis in soil; soil carbohydrates and lipids.

UNIT III: Nutrient transformation – N, P, S; trace metal interaction with humic substances, significance of chelation reactions in soils.

UNIT IV: Reactive functional groups of humic substances, adsorption of organic compounds by clay and role of organic substances in pedogenic soil aggregation processes; clay-organic matter complexes.

UNIT V: Humus - pesticide interactions in soil, mechanisms.

ACSS-704 Advances in Soil Microbial Ecology 2+1

Ecological interrelationships- Biological, equilibrium, Microbiology of rhizosphere and phyllosphere, Microbial synthesis of polysaccharides and their effect on soil structure. Interaction between soil particles and microorganisms at colloidal and aggregate level. Soil enzyme and their significance. Microbes in geochemical changes. Introduction, systematic position of algae, classification of algae-their distinguishing characters, occurrence and economic importance. Procaryotic algae-cyanophytes-general morphology and structure, cellular and thallus organization. Movement of blue green algae; gas vacuoles; cell differentiation, reproduction and life cycle of BGA. Classification of cyanophyte with their characteristics, abundance. Evolution and phyllogamy-relationship of BGA with bacteria.

2nd Semester

ACSS- 751 Geomorphology & Geochemistry 2+0

Theory

UNIT I: General introduction to geology and geochemistry, major and minor morphogenic and genetic landforms, study of schematic landforms and their elements with special reference to India.

UNIT II: Methodology of geomorphology, its agencies, erosion and weathering; soil and physiography relationships; erosion surface of soil landscape.

UNIT III: Geochemical classification of elements; geo-chemical aspects of weathering and migration of elements; geochemistry of major and micronutrients and trace elements.

ACSS- 752 Remote Sensing & GIS Techniques for Soil & Crop Studies 2+1

Theory

UNIT I: Introduction and history of remote sensing; sources, propagation of radiations in atmosphere; interactions with matter.

UNIT II: Sensor systems - camera, microwave radiometers and scanners; fundamentals of aerial photographs and image processing and interpretations.

UNIT III: Application of remote sensing techniques - land use soil surveys, crop stress and yield forecasting, prioritization in watershed and drought management, wasteland identification and management.

UNIT IV: Significance and sources of the spatial and temporal variability in soils; variability in relation to size of sampling; classical and geo-statistical techniques of evolution of soil variability.

UNIT V: Introduction to GIS and its application for spatial and non-spatial soil and land attributes.

Practical

• Familiarization with different remote sensing equipment and data products

• Interpretation of aerial photographs and satellite data for mapping of land resources

• Analysis of variability of different soil properties with classical and geostatistical techniques

• Creation of data files in a database programme

• Use of GIS for soil spatial simulation and analysis

• To enable the students to conduct soil survey and interpret soil survey reports in terms of land use planning

ACSS- 753 Advances in Soil Physics 2+0

Theory

UNIT I: Soil-water interactions, soil water potential, free energy and thermodynamic basis of potential concept, chemical potential of soil water and entropy of the system.

UNIT II: Fundamentals of fluid flow, Poiseuilles law, Laplace's equation, Darcy's law in saturated and unsaturated flows; development of differential equations in saturated and unsaturated water flow,

capillary conductivity and diffusivity; limitations of Darcy's law; numerical solution for one dimensional water flow.

UNIT III: Theories of horizontal and vertical infiltration under different boundary conditions.

UNIT IV: Movement of salts in soils, models for miscible-immiscible displacement, diffusion, mass flow and dispersion of solutes and their solutions through differential equations; break-through curves.

UNIT V: Soil air and aeration, mass flow and diffusion processes; thermal properties of soil, heat transfer in soils, differential equation of heat flow, measurement of thermal conductivity of soil.

UNIT VI: Soil crust and clod formation; structural management of puddled rice soils; soil conditioning-concept, soils conditioners - types, characteristics, working principles, significance in agriculture.

UNIT VII: Solar and terrestrial radiation measurement, dissipation and distribution in soil-crop systems; prediction of evapotranspiration using aerodynamic and canopy temperature-based models; canopy temperature and leaf diffusion resistance in relation to plant water deficit; evaluation of soil and plant water status using infra-red thermometer.

ACSS-754 Advances in Soil Fertility 2+0

Theory

UNIT I: Modern concepts of nutrient availability; soil solution and plant growth; nutrient response functions and availability indices.

UNIT II: Nutrient movement in soils; nutrient absorption by plants; mechanistic approach to nutrient supply and uptake by plants; models for transformation and movement of major micronutrients in soils.

UNIT III: Chemical equilibria (including solid-solution equilibria) involving nutrient ions in soils, particularly in submerged soils.

UNIT IV: Modern concepts of fertilizer evaluation, nutrient use efficiency and nutrient budgeting.

UNIT V: Modern concepts in fertilizer application; soil fertility evaluation techniques; role of soil tests in fertilizer uses recommendations; site-specific nutrient management for precision agriculture.

UNIT VI: Monitoring physical, chemical and biological changes in soils; permanent manurial trials and long-term fertilizer experiments; soil productivity under long-term intensive cropping; direct, residual and cumulative effect of fertilizer use.

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