

AGRICULTURAL CHEMISTRY/ SOIL SCIENCE

(Subject Code-86)

Unit-1: Soil Genesis and Classification

Concept of land, soil and soil science. Composition of earth crust and its relationship with soils; Rocks, minerals and other soil forming materials; Weathering of rocks and minerals; Factors of soil formation; Pedogenic processes and their relationships with soil properties; Soil development; Soil horizons and their nomenclature subsurface horizons and other diagnostic characteristics, soil moisture and temperature regimes.

Assessment of soil profile development by morphological mineralogical and chemical analysis. Concept of Soil individual, Soil classification systems- historical development and modern systems of soil classification with special emphasis on soil taxonomy; application of soil taxonomy.

Unit-2: Soil Physics

Soil physical constraints affecting crop production. Soil texture-textural classes. Soil structure-classification, soil aggregation and significance, soil consistency, soil crusting, bulk density and particle density of soils and porosity, their significance and manipulation.

Soil water- retention and potentials. Soil moisture constants. Movement of soil water - infiltration, percolation, permeability, drainage and methods of determination of soil moisture. Thermal properties of soils, soil temperature, Soil air- composition, gaseous exchange, influence of soil temperature and air on plant growth. **Soil erosion** by water-types, effects, mechanics. Runoff - methods of measurement, factors and management, runoff farming. Soil conservation measures.

Unit-3: Soil Chemistry

Chemical composition of soil; **Soil colloids**-structure, composition, constitution of clay minerals, amorphous clays and other non-crystalline silicate minerals, oxide and hydroxide minerals; Charge development on clays and organic matter; pH-charge relations; Buffer capacity of soils. Chemical equilibria, electrochemistry and chemical kinetics. **Inorganic and organic colloids**- surface charge characteristics, diffuse double layer theories, zeta potential stability, coagulation/ flocculation, peptization, electrometric and sorption properties of soil colloid. **Soil organic** matter- fractionation, clay-organic interactions. **Cation exchange**- theories, adsorption isotherms, Donnan-membrane equilibrium concept, clay-membrane electrodes and ionic activity measurement, thermodynamics, anion and ligand exchange- inner sphere and outer-sphere surface complex formation, fixation of oxyanions, sorption-desorption of oxy-anions and anions. Nitrogen, potassium, phosphate and ammonium fixation in soils and management aspects.

Unit-4: Soil Fertility

Essential elements in plant nutrition; Soil fertility & soil productivity; Nutrient cycles in soil; Transformation and transport of nutrients (Macro and micro nutrients) in soil; Manures and fertilizers; Fate and reactions of fertilizers in soils; Chemistry of different fertilizers; Slow release fertilizers and nitrification retarders; Quality control of fertilizers.

Soil fertility evaluation – soil testing, plant and tissue tests and biological methods; Common soil test methods for fertilizer recommendation; Soil test-crop response correlations; Integrated nutrient management; Use of isotopic tracers in soil research; Nature, properties and development of acid, acid sulphate, saline and alkali and their management; Lime and gypsum requirements of soils; Irrigation water quality - EC, SAR, RSC and specifications. Fertility status of major soil groups of India.

Pollution: types, causes, methods of measurement, standards and management. Heavy metal toxicity and soil pollution; Chemical and bio-remediation of contaminated soils; Soil

factors in emission of greenhouse gases; Carbon sequestration in mitigating greenhouse effect; Radio-active contamination of soil.

Unit-5: Nitrogen fixation in soil. Nitrification, ammonification and transformation. Availability of nitrogen, phosphorus and potassium. Phosphate fixation and solubilization. Microbial fixation of nitrogen.

Unit-6: Soil Microbiology

Soil biota, soil microbial ecology, types of organisms. Soil microbial biomass, microbial interactions, unculturable soil biota. Microbiology and biochemistry of root-soil interface. Phyllosphere. Soil enzymes, origin, activities and importance. Soil characteristics influencing growth and activity of microflora. Microbial transformations of N, P, K, S, Fe and Zn in soil. **Biochemical composition** and biodegradation of soil organic matter and crop residues. Humus formation. Cycles of important organic nutrients. **Biodegradation of pesticides**, organic wastes and their use for production of biogas and manures. **Biofertilizers** – definition, classification, specifications, method of production and role in crop production.

Unit-7: Management of problem Soil and water

Area and distribution of problem soils- acidic, saline and sodic soil; origin of problematic soils, and factors responsible. Morphological features of saline, sodic and saline-sodic soil; characterization of salt-affected soils- soluble salts, ESP, pH; physical, chemical and microbiological properties. Management of salt-affected soils; salt tolerance of crops – mechanism and ratings; monitoring of soil salinity in the field; management principles for sandy, clayey, red lateritic and dry land soils. Acid soils- nature of soil acidity, sources of soil acidity; effect on plant growth, lime requirement of acid soils; management of acid soils; biological sickness of soils and its management. Quality of irrigation water; management of brackish water for irrigation; characterization of brackish waters; relationship in water use and quality. Agronomic practices in relation to problematic soils; cropping pattern for utilizing poor quality ground waters. Chemistry of submerged soil.

Unit-8: Methods of soil analysis

Particle size distribution, bulk and particle density, moisture constants, Modern methods of soil, plant and fertilizer analysis; Flame photometry and inductively coupled plasma optical emission spectroscopy; **Spectrophotometry** - visible, ultra-violet and infrared; Atomic absorption spectrophotometry; Potentiometry and conductimetry; X-ray diffractometry; Mass spectrometry.

Unit-9: Soil health

A concept of soil health and soil quality; causes of deterioration of soil health, chemical, physical and biological parameters of soil health indicators. Methods to improve soil health for sustainable agriculture production. Organic residue management.

Unit-10: Land use planning and watershed management

Concept and techniques of land use planning; factors governing present land use. Land evaluation methods and soil-site suitability evaluation for different crops; land capability classification and constraints in application. Agro-ecological regions/sub-region of India and their characteristics in relation to crop production. Status of LUP in India. Water harvesting – concept, significance, types, methodology; use of harvested water in agriculture to increase water productivity. Watershed development/ management – concept, objectives, characterization, planning, execution, community participation and evaluation; rehabilitation of watershed.