

SYLLABUS SOIL SCIENCE

Topics	Details	Marks
Unit 1: Soil Genesis, Classification, Survey and Land Use Planning	• Concept of land, soil and soil science. • Composition of earth’s 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 relation to soil properties. • Soil development: Pedon, polypedon, soil profile, horizons and nomenclature. • Soil Taxonomy – epipedons, diagnostic subsurface horizons, diagnostic characteristics, soil moisture and temperature regimes, categories and criteria for soil classification. • Soil mineralogy and clay minerals: classification, structure, composition, properties, genesis, transformation and identification techniques. • Role in plant nutrition, interaction with humus, pesticides and heavy metals. • Interpretation of soil survey data for land capability & crop suitability classification. • Macro-morphological study of soils. • Land evaluation and land use type: concepts and applications. • Use of GPS in soil survey. • Soil survey – types, techniques. • Soil series: characterization, procedure for establishing soil series, benchmark soils, major soils of India and soil correlations. • Study of base maps: cadastral maps, toposheets, aerial photos, satellite images. • Use of GIS in preparing thematic maps.	75
Unit 2: Soil Physics	• Soil physical constraints affecting crop production. • Soil texture – textural classes. • Soil structure – classification, aggregation, significance. • Soil consistency, crusting, bulk density, particle density, porosity: significance and manipulation. • Soil water – retention, potentials, constants. • Soil water movement – infiltration, percolation, permeability, drainage; methods of determination. • Darcy’s Law. • Thermal properties of soils; soil temperature. • Soil air – composition, gaseous exchange, influence on plant growth. • Soil erosion – by water and wind: types, effects, mechanics. • Rain erosivity and soil erodibility. • Runoff – measurement, factors, management, runoff farming. • Soil conservation measures, including special problem areas. • Soil and land quality indicators – characterization and evaluation. • Causes of land degradation; management of soil physical properties for prevention/restoration. • Identification, monitoring and management of waste lands. • Land use and land cover mapping with remote sensing. • Watershed concept – characterization and management. • Remote sensing & GIS in precision farming.	
Unit 3: Soil Chemistry	• Chemical composition of soil. • Soil colloids – clay minerals (structure, composition, constitution), amorphous clays, non-crystalline silicates, oxides & hydroxides. • Crystallography, space lattice, coordination theory. • Solubility, ionic products, mineral formation. • Charge development on clays and organic matter; pH and buffer capacity. • Soil organic matter fractions; clay-organic interactions. • Equilibrium thermodynamics, chemical equilibria, electrochemistry, kinetics. • Inorganic & organic colloids – surface charge, diffuse double layer, zeta potential, stability, coagulation/flocculation, peptization, sorption properties. • Cation exchange – theories, adsorption isotherms, Donnan equilibrium, clay electrodes, ionic activity measurement, thermodynamics. • Anion and ligand exchange – inner/outer-sphere complexes, oxyanion fixation, hysteresis, sorption/desorption. • Fixation of N, P, K in soils; nutrient availability. • Chemistry of acid soils, salt-affected soils, submerged soils. • Geochemistry of micronutrients. • Basics of radioisotopes – radioactivity, radiation monitoring, isotopic techniques.	

Unit 4: Soil Fertility	• Essential elements in plant nutrition. • Nutrient cycles in soil. • Transformation & transport of macro and micronutrients. • Manures & fertilizers – chemistry, production, fate and reactions in soils. • Slow-release fertilizers, nitrification retarders. • Fertilizer quality control. • Soil fertility evaluation – soil testing, plant & tissue tests, biological methods. • Soil test methods for fertilizer recommendation. • Soil test-crop response correlation. • Integrated nutrient management. • Isotopic tracers in soil fertility studies. • Problem soils – acid, acid sulfate, saline, alkali: nature, properties, management. • Lime and gypsum requirements; lime potential. • Irrigation water quality – EC, SAR, RSC and standards. • Fertility status of major soil groups of India. • Soil health and soil quality concepts. • Soil pollution – types, causes, measurement, standards, management. • Heavy metal toxicity, remediation (chemical & biological). • Soils and greenhouse gases; carbon sequestration. • Radioactive contamination of soils.
Unit 5: Soil Microbiology	Soil biota and microbial ecology. • Soil microbial biomass, interactions, unculturable microbes. • Rhizosphere and phyllosphere microbiology & biochemistry. • Soil enzymes – origin, activity, importance. • Soil properties influencing microbes. • Microbial transformations of N, P, K, S, Fe, Zn. • Biodegradation of soil organic matter and residues; humus formation. • Nutrient cycles. • Microbial transformation of pollutants. • Soil genomics; xenobiotics. • Biodegradation of pesticides, wastes; biogas and manure production. • Biofertilizers – definition, classification, specifications, production and role.
Unit 6: Analytical Chemistry in Soil	• Concept of chemical analysis. • Solution reactions; titrimetry; standard solutions; indicators. • Soil analysis methods: particle size, bulk/particle density, moisture constants. • Modern methods of analysis: • Flame photometry, ICP-OES • UV-Vis & IR spectrophotometry • Atomic absorption spectrophotometry • Potentiometry, conductimetry • X-ray diffractometry • Mass spectrometry • Radiation monitoring: Geiger Muller, scintillation counters.
Unit 7: Statistics	• Experimental designs – pot culture, field experiments. • ANOVA, ANCOVA. • Measures of central tendency and dispersion. • Correlation & regression. • Significance tests: t, F. • Use of computers in soil research.
<u>Unit 8: Tea Soil</u>	Land soil suitability for tea cultivation, Soil amendment, Role of essential nutrients for tea cultivation, Soil nutrient management practices for tea cultivation, Drainage and irrigation practices for soil and water management in Tea, Regulations of organic tea production
General Studies	General Reasoning / General English / General Awareness / Innovative Knowledge etc