U.P. HIGHER EDUCATION SERVICES COMMISSION, PRAYAGRAJ

Syllabus

Agricultural Chemistry/Soil Science

(Assistant Professor-Higher Education)

(Subject Code- 86)

Unit-1 : Soil Mineralogy, Genesis and classification

Classification, structure, chemical composition and properties of clay minerals; genesis and transformation of crystal line and non-crystal line clay minerals; identification techniques; amorphous soil constituents and other non-crystalline silicate minerals and their identification; clay minerals in Indian soils, role of clay minerals in plant nutrition and interaction of clay with humus, Factors of soil formation, soil formation models; soil forming processes; weathering of rocks and mineral transformations; soil profile; weathering sequences of minerals with special reference to Indian soils. Concept of soil individual; soil classification system-historical developments and modern systems of soil classification with special emphasis on soil taxonomy; soil classification, soil mineralogy and soil maps – usefulness.

Unit-2 : Soil physics

Basic principles of physics applied to soils, soil as a three phase system. Soil texture, textural classes, mechanical analysis, specific surface. Soil consistence; dispersion and workability of soils; soil compaction and consolidation; soil strength; swelling and shrinkage-basic concepts. Alleviation of soil physical constraints for crop production. Soil erosion and erodbility. Soil structure-genesis, types, characterization and management soil structure; soil aggregation, aggregate stability; soil tilth, characteristics of good soil tilth; soil crusting-mechanism, factors affecting and evaluation; soil conditioners; puddling, its effect on soil physical properties; clod formation. Soil water: content and potential, soil water retention, soil-water constants, measurement of soil water content, energy state of soil water, soil water potential, soil-moisture characteristic curve; hysteresis, measurement of soil-moisture potential.

Unit-3 : Soil Chemistry

Chemical (elemental) composition of the earth's crust, soils, rocks and menerals Elements of equilibrium the rmodynamics, chemical equilibria, electrochemistry and chemical kinetics. Soil colloids: inorganic an d organic colloids – origin of charge, concept of point of zero-charge (PZC) and its dependence on veriable-charge soil components, surface charge characteristics of soils; diffuse double layer theories of soil colloids, zeta potential, stability, coagulation/flocculation and peptization of soil colloids; electrometric properties of soil colloids; sorption properties of soil colloids; soil organic

matter – fractionation of soil organic matter and different fractions, Characterization of OM; clay-organic interactions. lon exchange processes in soil; cation exchange-theories adsorption isotherms, Donnan-membrane equilibrium concept, clay-membrance electrodes and ionic activity measurement, thermodynamics, statistical mechanics; anion and ligand exchange-inner sphere and outer-sphere surface complex formation, fixation of oxyanions, hysteres is in sorption-desorption of oxy-anions and anions, shift of PZC on ligand exchange, AEC and CEC.

Unit-4: Soil Fertility and Fertilizer Use

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. Soil fertility and soil productivity; fertility status of major soils group of india; nutrients-source fertilizers and manures; Criteria of essentiality, classification, law of minimum and maximum, essential plant nutrients-functions and deficiency symptoms, Nutrient uptake, mutrient interactions in soils and plants; long term effect of manures and fertilizers on soil fertility and crop productivity. Soil and fertilizer nitrogen-sources, forms, immobilization and mineralization, nitrification, denitrification; biological nitrogen fixation –types, mechanism, microorganisms and factors affecting; nitrogenous fertilizers and their fate in soils; management of fertilizer nitrogen in lowland and upland conditions for high fertilizer use efficiency. Soil and fertilizer phosphorus-forms, immobilization, mineralization, reactions in acid and alkali soils; factors affecting phosphorus availability in soils; phosphatic fertilizers-behavior in soil sand management under field conditions. Potassium-forms, equilibrium in soils and its agricultural significance; mechanism of potassium fixation; management of potassium fertilizers under field conditions. Sulphur-Source, forms, fertilizers and their behavior in soils; role in crops and human health; calcium and magnesium-factors affecting their availability in soils; management of sulphur, calcium and magnesium fertilizers in the soils.

Unit-5: Soil Biology and Biochemistry

Soil biota, soil microbial ecology, types of organisms in different soils; soil microbial biomass; microbial interactions; un-culturable soil biota. Micro biology and bio chemistry of root-soil interface; phyllosphere; soil enzymes, origin, activities and importance; soil characteristics influencing growth and activity of microflora; Root rhizosphere and PGPR. Microbial transformations of nitrogen, phosphours, sulphur, iron and manganese in soil; biochemical composition and biodegradation of soil organic matter and crop residues, microbiology and biochemistry of decomposition of carbonaceous and protenaceous materials, cycles of important organic nutrients. Organic wastes and their use for production of biogas and manures; biotic factors in soil

development; microbial toxins in the soil. Preparation and preservation of farmyard manure, animal manures, rural and urban composts and vermicompost. Bio fertilizers-definition, classification, specifications, method of production and role in crop production; FCO specifications and quality control of bio fertilizers.

Unit-6 : Management of Problematic Soils and Water

Area and distribution of problem soils-acidic, saline, sodic and physically degraded soils; origin and basic concept of problematic soils, and factors responsible. Morphological features of saline, sodic and saline-sodic soils; 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; salt stress meaning and its effect on crop growth, monitoring of soils alinity in the field; management principles for sandy, clayey, red lateritic and dryland soils. Acid soils-nature of soil sources of soil acidity; effect on plant growth, lime requirement of acid soils; management of acid soils; biological sickness of soils and its management.

Unit-7 : Methods of soil and plant analysis

Preparation of solutions for standard curves, indicators and standard solutions for acid-oxidation reduction and complexometric titration; soil, water and plant sampling techniques, their processing and handing. Estimation of phosphorus, ammonium and potassium fixation capacities of soils. Principles of visible, ultra violet and infrared spectrophotometery, atomic absorption, flame-photometry, inductively coupled plasma spectrometry; chromatographic techniques, mass spectrometry. Electrochemical titration of clays; estimation of exchangeable cations (Na,Ca,Mg,K); estimation of root caption exchange capacity. Wet digestion/fusion/extraction of soil with aquaregia with soil for elemental analysis; triacid/di-acid digestion of plant samples; determination of available and total nutrients (N, P, K,S, Ca, Mg, Zn, Cu, Fe, Mn, B, Mo) in soils; determination of total nutrients (N, P, K, S, Ca, Mg, Zn, Cu, Fe, Mn, B, Mo) in plants

Unit-8: Soil Survery and Land Use Planning

Soil survey and its type s; soil survey techniques-conventional and modern; soil series-characterization and procedure for establishing soil series; benchmark soils and soil correlations; soil survey interpretations; thematic soil maps, cartography, mapping units, techniqyes for gene ration of soil maps, application of remote sensing and GIS in soil survey and mapping of major soil group of India. Landform-soil relationship; major soil groups of India with special reference to respective states; land capability classification and land irrigability classification; land evaluation and land use type(LUT)-concept and application; approaches for managing soils and landscapes in the framework of agro-ecosystem. Concept and techniques of land use planning; factors

governing present land use; Land evaluation method sand soil-site suitability evaluation for different crops; land capability classification and constraints in application. Agro-ecological regions/sub-regions of India and their characteristics in relation to crop production. Status of LUP in India.

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