PONDICHERRY UNIVERSITY
SYLLABUS FOR ENTRANCE EXAMINATION
(Ph. D in Soil Science)

SOIL PHYSICS

- Basic principles of physics related to soil, soil as a three-phase system. Soil texture, textural classes, mechanical analysis, specific surface area. Soil consistence; dispersion and workability of soils; soil compaction and consolidation; soil strength; swelling and shrinkage-basic concepts. Alleviation of soil physical constraints for improving crop production. Soil erosion and erodibility.

- Soil structure-genesis, types, characterization and management of 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.
- Water flow in saturated and unsaturated soils, Poiseuille's law, Darcy's law; hydraulic conductivity, permeability and fluidity, hydraulic diffusivity; measurement of hydraulic conductivity unsaturated and unsaturated soils. Infiltration; internal drainage and redistribution; evaporation; hydrologic cycle, field water balance; soil-plant-atmosphere continuum.
- Composition of soil air; renewal of soil air - convective flow and diffusion; measurement of soil aeration; aeration requirement for plant growth; soil air management. Modes of energy transfer in soils; energy balance; thermal properties of soil; measurement of soil temperature; soil temperature in relation to plant growth; soil temperature management.

SOIL FERTILITY AND FERTILIZER USE

- Soil fertility and soil productivity; fertility status of major soils group of India; nutrient sources - fertilizers and manures; Criteria of essentiality, classification, law of minimum and maximum, essential plant nutrients - functions and deficiency symptoms, Nutrient uptake, nutrient interactions in soils and plants.
- 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 - behaviour in soils and management under field conditions. Potassium forms, equilibrium in soils and its agricultural significance; mechanism of potassium fixation; management of potassium fertilizers under field conditions**;** quantity–intensity relationships

- Calcium, magnesium and sulphur - source, forms, fertilizers and their behaviour in soils; factors affecting their availability in soils; role in crops and human health; management of calcium, magnesium and sulphur fertilizers. Micronutrients – critical limits in soils and plants; factors affecting their availability and correction of their deficiencies in plants; role of chelates in nutrient availability.

- Common soil test methods for fertilizer recommendations; soil test crop response correlations and response functions. Fertilizer use efficiency; site-specific nutrient management; plant need based nutrient management; integrated nutrient management. Soil fertility evaluation - biological methods, soil, plant and tissue tests; Determination of critical limit, DRIS. Specialty fertilizers concept, Need and category. Current status of specialty fertilizers uses in soils and crops of India. Definition and concepts of soil health and soil quality. Soil quality in relation to sustainable agriculture; Long term effects of fertilizers and soil quality.

SOIL CHEMISTRY

- Chemical (elemental) composition of the earth's crust, soils, rocks and minerals. Elements of equilibrium thermodynamics, chemical equilibria, electro chemistry and chemical kinetics. Soil colloids: inorganic and organic colloids - origin of charge, concept of point of zero-charge (PZC) and its dependence on variable-charge soil components, surface charge characteristics of soils; diffuse double layer theories of soil colloids

- 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**.** on exchange processes in soil; cation exchange- theories based on law of mass action (Kerr-Vanselow, Gapon equations, hysteresis, Jenny's concept).

- Adsorption isotherms, Donnan-membrane equilibrium concept, clay-membrane electrodes and ionic activity measurement, thermodynamics, statistical mechanics; anion and lig and exchange–inner sphere and outer-sphere surface complex

formation, fixation of oxyanions, hysteresis in sorption-desorption of oxy-anions and anions, shift of PZC on lig and exchange, AEC, CEC; experimental methods to study on exchange phenomena and practical implications in plant nutrition

- Potassium, phosphate and ammonium fixation in soils covering specific and nonspecific sorption; precipitation-dissolution equilibria; Concept of quantity/intensity (Q/I relationship; step and constant-rate K); Chemistry of acid soils; active and potential acidity; lime potential, sub-soil acidity, chemistry of acid sulphate soils; management aspects

- Chemistry of salt-affected soils and amendments; soil pH, ECe, ESP, SAR and important relations; soil management and amendments. Chemistry and electrochemistry of submerged soils, geochemistry of micronutrients, environmental soil chemistry

SOIL MINERALOGY, GENESIS AND CLASSIFICATION

- Fundamentals of crystallography, Importance of crystal chemistry, crystal lattice, space lattice, Types of crystal systems, Isomorphism and polymorphism, Comparison of crystal structures, Coordination number, Coordination and Pauling's rules, coordination theory, Silicate structures and structural formula, Stability of minerals and bond strength. Clay minerals: classification, structure, chemical composition and properties, genesis and transformation of crystalline and non-crystalline clay minerals

- 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, interaction of clay with humus, pesticides and heavy metals.

- 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 systems–historical development

- Modern systems of soil classification with special emphasis on soil taxonomy; soil classification, soil mineralogy and soil maps–usefulness.

SOIL BIOLOGY AND BIOCHEMISTRY

- Soil biota, soil microbial ecology, types of organisms in different soils; soil Microbial biomass; microbial interactions; un-culturable soil biota. Microbial communities in agricultural systems. Role of soil organisms in pedogenesis. Microbiology of root-soil interface

- Biochemistry of root-soil interface; phyllosphere; soil Enzymes, origin, activities and importance; soil characteristics influencing growth and activity of microflora; Root rhizosphere and PGPR. Antibiotic production in soil. Microbial transformations of nitrogen, phosphorus, sulphur in soil

- Microbial transformations of 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 nutrient. Humus formation theories.

- Organic wastes and their use for production of biogas and manures; microbial toxins in the soil. Bioremediation of contaminated soils; Bio degradation of pesticide. Preparation and preservation of farm yard manure.

- Preparation and preservation of animal manures, rural and Urban composts and vermicompost. Biofertilizers – definition, classification, specifications, method of production and role in crop production; FCO specifications and quality control of organic manures and biofertilizers.

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, 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. Effects of salinity on plant growth.

- Management of salt-affected soils; Amendments/water/nutrient management; salt tolerance of crops mechanism and ratings; salt stress meaning and its effect on crop growth, 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; Acid sulphate soils definition,

causes for formation of acid sulphate soil and its management. Biological sickness of soils and its management Quality of irrigation water; Toxicity of specific ions.

- Salt balance under irrigation, management of brackish water for irrigation; characterization of brackish waters, area and extent; relationship in water use and quality. Management and effective use of poor-quality irrigation water and cropping pattern for utilizing poor quality ground waters. Agronomic practices in relation to problematic soils;