University of Calcutta

Department of Agricultural Chemistry and Soil Science

Departmental Committee has resolved the following points regarding the implementation of new Ph. D regulation in our department.

1. There are **7** vacancies in the Department for new Ph. D. students. The reservation of candidates will be followed as per the Government Act – The West Bengal State Higher Educational Institutions (Reservation in Admission) Act, 2013 and The West Bengal State Higher Educational Institutions (Reservation in Admission) Rules, 2013.

2. The **Research Eligibility Test (RET)** for the Ph. D programme will be held on 25th August, 2015 at 1 p.m.

3. The **RET** will be of 50 marks objective type test of 1 hr duration.

4. An interview will be held on 28th August, 2015 at 1 p.m. for **RET** qualified as well as NET/ GATE/ SET qualified candidates.

5. Successful candidates will be eligible to register for their Ph.D. programme in the Department of Agricultural Chemistry and Soil Science.

6. The last date for the submission of duly filled in application form alongwith application fees of Rs. 100/- to be submitted to the Head, Department of Agricultural Chemistry and Soil Science on or before 24th August, 2015.

7. **Eligibility** for Application : M.Sc.(Ag.) in Agricultural Chemistry and Soil Science.

8. The following format has been fixed for the coursework of the enrolled candidates for Ph.D. programme after which they will be awarded with a completion certificate.

Course Work : one semester course work of 20 credits

Review of his/ her own research topic:	=> 5 credit point.
Seminar presentation:	=> 5 credit point.
Seminar attendance:	=> 2 credit point.
Methodology, Instrumentation & Techniques Lectures:	=> 5 credit point.
Computation and statistical methods:	=> 3 credit point.

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Ph.D. Entrance Examination (Agricultural Chemistry and Soil Science) : 2015

Procedure and eligibility :

The Ph.D. entrance test of 50 marks for the eligible candidates will be held twice (depending on the availability of candidate) in a year and the qualifying marks will be fixed at 40%. Candidates with at least 50% Marks obtained in M.Sc. (Ag.) in Agricultural Chemistry and Soil Science from any UGC recognized University are eligible to appear in the Examination. Those who have qualified NET/GATE/SET or already obtained M.Phil degree would be exempted from the examination. They may directly submit a statement of purpose or research brief and appear in the interview.

Syllabus :

Scope of soil physics and its relation with other branches of soil science; 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. 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. Water flow in saturated and unsaturated soils, Poiseuille's law, Darcy's law; hydraulic conductivity in saturated 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 & diffusion; measurement of soil 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 soil productivity; nutrient sources – fertilizers and manures; essential plant nutrients – functions and deficiency symptoms. Bulky and concentrated organic manures, their composition, characteristics, transformation in soil and their effect on soil productivity. Role of manures in sustainable agriculture, Enriched compost preparation, Effect of manures on soil properties, Long term effect of FYM, vermin compost and rural as well as urban compost, Bulky and concentrated manures and their effect on soil properties. 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. Sulphur - source, forms, fertilizers and their behaviour in soils; management of sulphur, calcium and magnesium 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; quality – intensity relationships; soil test crop response correlations and response functions. Fertilizer use efficiency; blanket fertilizer recommendations – usefulness and limitations; site –specific nutrient management; plant need based nutrient management. Soil fertility evaluation – biological methods, soil, plant and tissue tests; soil quality in relation to sustainable agriculture.

Chemical (elemental) composition of the earth's crust and soils. 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, zeta potential, stability, coagulation/ flocculation and peptization of soil colloids; soil organic matter – fractionation of soil organic matter and different fractions, clay-organic interactions. Ion exchange processes in soil; cation exchange- theories based on law of mass action (Kerr-Vanselow, Gapon equations, hysteresis, jenny's concept), Silicate clay mineral, types of silicate clay minerals, characteristics and classification and importance in agriculture. AEC, CEC; experimental methods to study ion exchange phenomena and practical implications in plant nutrition. Potassium, phosphate and ammonium fixation in soils covering specific and non-specific sorption; precipitation-dissolution equilibria; step and constant-rate K; management aspects. Chemistry of acid soils; active and potential acidity; lime potential, chemistry of acid soils; sub-soil acidity. 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.

Classification, structure, chemical composition and properties of clay minerals; genesis and transformation of crystalline and non-crystalline clay minerals; identification techniques; amorphous soil constituents and other non-crystalline silicate minerals and their identification; clay minerals in Indian soils. 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 developments and modern systems of soil classification with special emphasis on soil taxonomy; soil classification, soil mineralogy and soil maps – usefulness. Soil survey and its types; soil survey techniques – conventional and modern;; soil series – characterization and procedure for establishing soil series; benchmark soils and soil correlation; soil survey interpretations; soil mapping units, techniques for generation of soil maps. 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.

Soil biota, soil microbial ecology, types of organisms in different soils; soil microbial biomass; microbial interactions; un-culturable 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 nitrogen, phosphorus, sulphur, iron and manganese 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; biotic factors in soil development; microbial toxins in the soil. Preparation and preservation of farmyard manure, animal manures, rural and urban composts and vermicompost. Biofertilizers – definition, scope, classification, specifications, method of production and role in crop production. Constraint in application of biofertilizers.

Soil, water and air pollution problems associated with agriculture, nature and extent. Nature and sources of pollutants – agricultural, industrial, urban wastes, fertilizers and pesticides, acid rains, oil spills etc.; air, water and soil pollutants – their CPC standards and effect on plants, animals and human beings. Sewage and industrial effluents – their composition and effect on soil properties/ health, and plant growth and human beings; soil as sink for waste disposal. Pesticides – their classification, behavior in soils, effect on nutrients availability, effect on plant and human health. Pollution of water resources due to leaching of nutrients and pesticides from soil; emission of green house gases – carbon dioxide, methane and nitrous oxide. Remediation/ amelioration of contaminated soil and water; remote sensing applications in monitoring and management of soil and water pollution.

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 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; monitoring of soil salinity in the field; management principles for sandy, clayey, red lateritic, calcareous 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; salt balance under irrigation; characterization of brackish waters, area and extent; relationship in water use and quality. Agronomic practices in relation to problematic soils; cropping pattern for utilizing poor quality ground waters.

Concept, nomenclature and distribution of pests. History, concept and methods of pest control. Principles of pest control. Pesticide classification based on use, chemistry and target. Mode and mechanisms of action of pesticide. Fate and persistence of pesticides in environment. Pesticide active ingredient, formulation, adjuvant and sefeners. Pesticide application techniques, equipments and accessories. Pest management in important field and horticultural crops and cropping system. Concept and application of Integrated Pest Management.