

32. SYLLABUS FOR COMPETITIVE EXAMINATION FOR THE POST OF TEACHING ASSOCIATE IN SOIL SCIENCE & AGRICULTURAL CHEMISTRY

Unit1: 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 and wind, their types, effects, mechanics. Runoff - methods of measurement, factors and management, runoff farming. Soil conservation measures.

Unit 3: 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; Fertility status of major soil groups of India. 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 4: 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. Bio-fertilizers –definition, classification, specifications, method of production and role in crop production.

Unit 5: Soil Pollution-

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 6: Statistics-

Experimental designs for pot culture and field experiments; Statistical measures of central tendency and dispersion; Correlation and regression; Tests of significance– t and F tests; Computer use in soil research.

Unit 7: 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 oxyanions and anions. Nitrogen, potassium, phosphate and ammonium fixation in soils and management aspects.

Unit 8: Management of Problem of 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 dryland 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 9: Methods of Soil Analysis-

Particle size distribution, bulk and particle density, moisture constants, Modern methods of soil, plant and water 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 10: Remote Sensing and Land Use Planning-

Remote sensing and its application in agriculture; GIS and GPS- basic features and uses in agriculture, Elementary concepts of radio isotopes and uses in agriculture. Application of Remote Sensing in Soil fertility mapping. Remote Sensing and GIS in Carbon sequestration studies. 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.

Unit 11: Nano-Technology –

General introduction: Basics of quantum mechanics, harmonic oscillator, magnetic phenomena, band structure in solids, Mössbauer effect and spectroscopy, optical phenomena, bond in solids, an isotropy. Nanostructures: growth of compound semiconductors, super lattices, self-assembled quantum dots, Nano-particles, Nano tubes and nanowires, fullerenes (buck balls, graphene). Nanofabrication and Nano-patterning: Optical, X-ray, and electron beam lithography, self-assembled organic layers, process of synthesis of Nano-powders, electrode position, important Nano-materials. Mechanical properties, magnetic properties, electrical properties, electronic conduction with nanoparticles, investigating and manipulating materials in the nanoscale: Electron microscopy. Nano-biology: Interaction between biomolecules and Nano-particle surface, different types of inorganic materials used for the synthesis of hybrid Nano-bio-assemblies, application of Nano- in agriculture, current status of Nano-biotechnology, future perspectives of Nano-biology and Nano-sensors.

बोर्ड द्वारा आयोजित की जाने वाली सभी वस्तुनिष्ठ परीक्षाओं में किसी प्रश्न का उत्तर नहीं दिये जाने के संबंध में अभ्यर्थी से पुष्टि करवाये जाने हेतु ओ.ए. म.आर. उत्तरपत्रक में पाँचवा विकल्प के संबंध में निम्नलिखित विशेष निर्देश लागू किये गये हैं :-

1. प्रत्येक प्रश्न के 05 विकल्प A, B, C, D, E. अंकित रहेंगे। उनमें से अभ्यर्थी को केवल एक विकल्प को नीले बॉल पेन से गहरा गोल उत्तरपुस्तिका में सही उत्तर दर्शाने हेतु करना होगा।
Each question has five options marked as A, B, C, D, E. You have to darken only one circle (bubble) indicating the correct answer on the Answer Sheet using BLUE BALL POINT PEN.
2. प्रत्येक प्रश्न के लिये विकल्पों में से केवल एक विकल्प को भरना आवश्यक होगा।
It is mandatory to fill only one of the options for each question.
3. यदि अभ्यर्थी द्वारा किसी प्रश्न को हल नहीं किया है तो उसके लिये पाँचवा विकल्प E को गोला गहरा करना होगा। यदि पाँचों विकल्पों में से किसी को भी गहरा नहीं किया जाता है तो ए' से 10 प्रतिशत प्रश्नों तक प्रत्येक प्रश्न के 1/3 अंक घटाये जावेंगे।
If you are not attempting a question then you have to darken the circle 'E'. If none of the five circles is darkened, one third (1/3) part of the marks of question shall be deducted.
4. प्रश्न पत्र हल करने के बाद अभ्यर्थी को यह सुनिश्चित करना होगा कि उसने प्रत्येक प्रश्न का एक गोला गहरा भर दिया है। इस हेतु निर्धारित समय के बाद अभ्यर्थी को 10 मिनट अतिरिक्त समय दिया जावेगा। ताकि वह प्रत्येक अनुत्तरित प्रश्न का 'E' गोला गहरा भर सकें।
After solving question paper, candidate must ascertain that he/she has darkened one of the circles (bubbles) for each of the question. Extra time of 10 minutes beyond scheduled time, is provided for darkening the circle of option "E" for all unanswered questions.
5. जिस अभ्यर्थी द्वारा 10 प्रतिशत से अधिक प्रश्नों को किन्हीं पाँच गोलों में से गहरा नहीं भरने पर उसे अयोग्य किया जावेगा।
A candidate who has not darkened any of the five circles in more than 10% question shall be disqualified.