INDIAN INSTITUTE OF TECHNOLOGY, KHARAGPUR

Date: xx/11/13 (AN)	Time: 3 Hrs Full Marks: 50	No. of Students: 13
Autumn Semester	Deptt: Agril. and Food Engineering	Sub No. AG60063
1st Yr. M. Tech. (ASM)	Sub. Name: Soil Systems	

1. (a) Describe the type of rocks, their origin with examples and the resultant soil properties.
   (b) State the soil forming factors. Describe any two in detail.
   (c) Provide schematic of Inceptisol, Vertisol and Oxisol profiles.
   (d) How hydrolysis, hydration and carbonation of minerals help in soil formation?
   (3x4)
2. (a) What is the importance of clay and humus in soils.
   (b) Show the structural differences between Kaolinite, montmorrilonite and illite minerals.
   (c) Explain how the charges are originated on organic, allophones and inorganic colloids.
   (d) Explain soil C: N ratio.
   (3x4)
3. What do you mean by matric potential head? How would you measure this quantity is soil?
   (4)
4. Define hydraulic conductivity for the saturated and unsaturated soil. Schematically show how hydraulic conductivity and soil water contents depend on matric potential heads in a sandy and clayey soils.
   (6)
5. What are the main transport processes responsible for solute movement in soil? Provide relationships that best describe these processes. Explain how these processes may be useful for fertilizer application both in terms of quantity and the frequency of application.
   (6)
6. Urea fertilizer was applied at the rate of 80 kg/ha to a lowland rice crop grown in 1000 m^2 area. Five centimeter of ponded water was steadily maintained at the soil surface at all times. The rice root zone was limited to 30 cm deep and was fully saturated. Assume that the top 30 cm soil is homogenous with a soil bulk density of 1.4 g/cm^3 and saturated hydraulic conductivity of 10 cm/day. It was further observed that the applied urea was instantly hydrolyzed and got uniformly mixed with the ponded water forming soluble ammoniacal nitrogen (NH_4-N). Ammonium ion has a distribution coefficient of 0.1 L/kg. Assuming that soil remains always saturated with water,
   a. Estimate the mean retention time of NH_4-N within the rice root zone
   b. Estimate the concentration of NH_4-N in ponded water immediately after the urea hydrolysis.
   c. Estimate the concentration NH_4-N in soil solution if there is no ponded water at the soil surface, but the top 30 cm soil is fully saturated. (Assume no water flow taking through the root zone.)
   d. Estimate the concentration of NH_4-N if the transformation of NH_4-N to nitrates proceed at a rate of 0.1 d-1 after 5 days of the application of this fertilizer. Assume that the conditions stated in part c of this problem are also prevalent.
   (10)