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3.
  - a) What is isomorphous substitution? Explain briefly the isomorphous substitution that takes place in various clay minerals. (12)
  - b) Explain about hydrogen bond and vanderwaals bonding in soils. (8)
4.
  - a) Explain the principle of X-ray diffraction and how it is used for identification of clay mineral. Discuss with the help of an example. (10)
  - b) What do you mean by differential thermal analysis ? How it is done? What are its uses in clay mineralogy? (10)
5. Discuss in detail the effect of clay minerals on following properties of soil :
  - a) compressibility
  - b) plasticity characteristics
  - c) swelling and shrinkage potential
  - d) Shear strength
  - e) sensitivity. (5×4=20)
6.
  - a) What is the effect of addition of lime in soils? Explain the design procedure of soil-lime stabilization. (10)
  - b) Explain the types of soil cements. Explain the factors affecting the cement stabilized soils (10)
7.
  - a) What do you mean by diffuse double layer? How it is formed? What is its effect on various properties of soil? (10)
  - b) How do you calculate the percentage base saturation of colloid? What is its relation with soil pH value? (10)
8. Write short notes on :
  - a) Zonal, azonal and intra-zonal soils
  - b) Mineralogy of cohesionless soils
  - c) Flocculent and dispersive structure in clays
  - d) Adsorbed water in soil
  - e) Colloids zeta potential (5×4=20)