M. Tech-I (GTE-CE)

ASM

ADVANCED SOIL MECHANICS

Full Marks: 70
Time: 3 Hours
Answer any **SIX** questions including Q. No.1 which is compulsory
Figures in the right-hand margin indicate marks

1. Answer the following questions 2×10

(a) Draw a map of India and indicate the area of major regional soil deposits?

(b) A plastic bottle contains saturated sand and water reaching into the neck of the bottle, above the sand. When squeezing the bottle, the water level appears to go down. Explain this phenomenon. Is this sand suitable for the foundation of a bridge pier?

(c) Define electrical conductivity and ion activity in relation to the soil solution

(d) How is the Tresca criterion is expressed in terms of the principal stresses?

(e) What is the effect of secondary consolidation on preconsolidation pressure?

(f) How is the FEM different from limit equilibrium method?

(g) What do you mean by the limit state line in soil mechanics?

(h) Give some examples for the long term problem of limiting equilibrium?

(i) Is lime suitable for improving clean sands or gravels? If not then Why?

(j) During cement stabilization of fine grained soils, why lime is preferred to mix in addition

2. (a) A clay layer of 4 m thickness is located below a sand layer of 10 m thickness. The volumetric weights are all 20 kN/m^3, and the groundwater table coincides with the soil surface. The compression constant of the clay is Cc = 0.3. Predict the settlement of the soil by compression of the clay layer due to an additional load of 40 kPa. 5

(b) Explain in detail, how to determine the coefficient of consolidation by square of time fitting method? 5

3. (a) Illustrate by schematic diagrams, how the clay minerals Kaolinite, Illite and Montmorillonite are formed? 5

(b) Illustrate with diagrams, typical soil structures for (i) coarse grained soil and (ii) Fine grained soils. 5

4. (a) Write down the basic principles and the procedures for identification of clay minerals using X-Ray Diffraction and Differential Thermal Analysis? 5

(b) Describe how soil texture and structure influence water movement and water holding capacity. 5

5. (a) What are the model parameters in modified Cam-clay model? Write down the procedure for calculation of the MCC model parameters? 5

(b) Demonstrate the usefulness and power of plastic limit theorems in developing a limit analysis technique in relation to soil mechanics? 5

6. (a) A block of material which yields according to the criterion of Tresca, with yield stress 2c in uniaxial tension, is subjected to an initial principal stress state $(\sigma_1,\sigma_2,\sigma_3)$= (3c/4, 3c/8, 3c/8).The stresses are then changed steadily, with fixed ratios of stress increments. Calculate the ratios of principal plastic strain increments at yield if the stress principal ratios ($\delta\sigma_1$, $\delta\sigma_2$, $\delta\sigma_3$) are (a) (1, $-^1/_2$, $-^1/_2$); (b) ($-^1/_2$, 1, $-^1/_2$); (c) ($-^1/_2$, $-^1/_2$,1); (d) (0,1,-1); (e) (-1,0,1); (f) (1,-1,0). It can be assumed that the normality rule holds for this material. 5

(b) Repeat the previous question assuming that the material yield according to the criterion of von Mises, with yield stress 2c in uniaxial tension. Assume that the normality rule holds for this material. 5

7. (a) A sample of Cam clay is in equilibrium in a triaxial cell under effective stresses δ_r'=200 kPa and δ_a'=300 kPa. The sample was deforming plastically just before this effective stress state was reached. The sample is now subjected to change in effective stresses δ_r'=-1 kPa and δ_a'=+4 kPa. Estimate the increments in axial and radial strain that will result. Assume suitable values for the soil parameters. 5

(b) A sample of Cam clay under an isotropic effective stress p′=200 kPa is found to have specific volume v=2.06. Indicate possible histories of (i) isotropic ompression and unloading, (ii) Conventional drain compression and unloading (iii) Conventional undrain compression and unloading and (iv) constant mean effective stress compression and unloading which would be compatible with the observed state of sample. Take values of soil parameters λ =0.19, κ=0.045, N=3.12 and M = 0.93. 5

8.(a) Write down the basic principles of soil stabilization using (i) Calcium chloride and (ii) Fly ash. How does the soil get improved? 5

(b) Briefly explain about the stabilizing properties of soft and marine clays as well as different waste materials? 5