Comprehensive Examination (3-5-2018, FN)   Duration: 3 hours
Course: CE F243 (Soil Mechanics)   Closed Book   Max. Marks: 105
Use both sides of answer sheet. Each part of one question to be answered at one place. Formula sheet in three A4 size pages is allowed.

1. Fig. 1 shows completed flow net for seepage through pervious layer below concrete dam.
(i) Estimate seepage quantity in cu m/day/m width. Permeability of pervious layer = 0.005 cm/s.
(ii) Uplift pressure (kPa) along base of dam at points B, C & D. Unit weight of water = 9.8 kN/m^3.   [4+6 = 10]
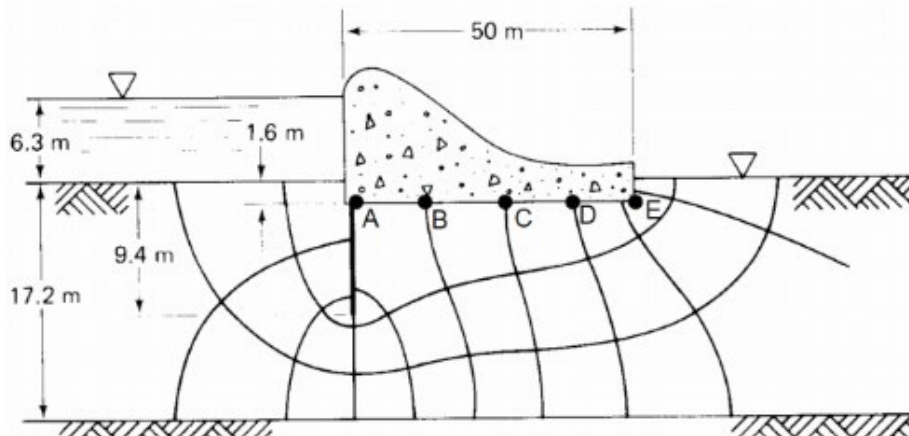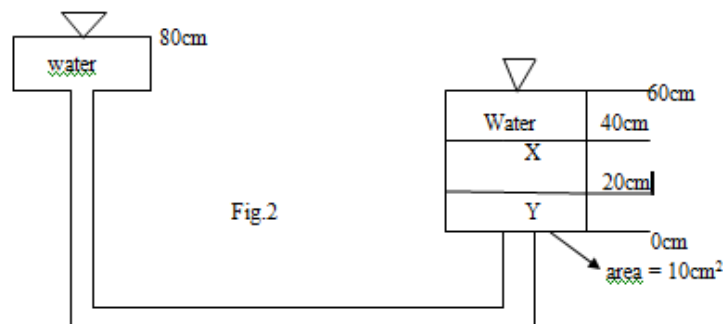

Fig. 1

2. In Fig. 2 the head lost in Soil Y is 24 times the head lost in soil X and the permeability of soil X is 4 x 10^{-3} cm/s.
i. What is permeability of soil Y?
ii. What is quantity of water flowing per minute?
iii.To what elevation (above datum) would water rise in a piezometer inserted in soil Y at El.15cm.   [3+2+5=10]

Fig.2

3. A strip footing 2m wide is loaded with a pressure of 100 kN/m^2. A 4m thick soft clay layer exists at a depth of 10m below the foundation. Find the increase in vertical stress at the centre of the clay layer under the centre line and edge of the footing.   [4+6=10]

4. A clay deposit is 15m thick and is draining on both faces. The coefficient of consolidation of clay was found to be 0.0009 m^2/day. The ultimate settlement of clay was estimated to be 1.5m. How long would it take for settlements of 400 and 1000mm to occur? How much settlement would occur in 10 years? [10]

5. Compute the shear strength of a soil along a horizontal plane at a depth of 5m in a deposit of sand having the following properties: Angle of internal friction = 34deg, dry unit weight = 19 kN/m^3 and specific gravity of solids = 2.5. Assume the water table to be at a depth of 2.5m from ground level. Also determine the change in the shear strength, if the water table rises upto the ground level. γ_w = 9.81kN/m^3. [10]

6. (a) During secondary consolidation, decrease in void ratio for one log cycle of time is 0.056. Final void ratio at the end of primary consolidation is 1.5. Primary consolidation is completed after 27years for the compressible layer at site 9m thick. Compute the amount of secondary consolidation from 27 to 100 years in meters.
(b) The time for a clay layer to achieve 85% consolidation is 10 years. If the layer was half as thick, 10 times more permeable, and four times more compressible, then what is time that would be required to achieve same degree of consolidation? γ_w = 1gm/cc [5+10=15]

7. (a) A square footing 3m x 3m in plan, transmits a pressure of 150kN/m^2 on a cohesive soil having E = 50000kN/m^2 and μ = 0.5. Determine immediate settlement of the footing at the centre assuming it to be flexible and rigid. Influence factor = 1.12 for flexible and = 0.82 for rigid foundation.
(b) In Fig. 3, determine normal and shear stress on plane ab inclined 25deg. with respect to major principal plane. [4+6=10]

$$\sigma_1 = 100 \, kNm^2$$

b

a

$$\sigma_3 = 25 \, kN/m^2$$

Fig. 3
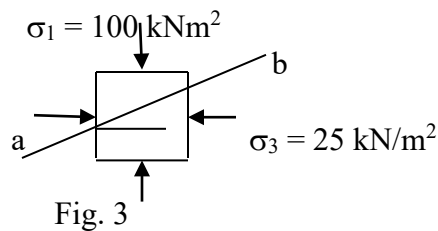
8. A sample of sand has 20% water content and 1.93 gm/cc bulk density. Its void ratios in loosest and densest possible states was found as 0.9 & 0.5. Calculate relative density and degree of saturation of sample assuming G = 2.65. Unit weight of water = 1gm/cc. [7+3=10]

9. A site consists of sand upto 5m depth below ground surface (G=2.67, e=0.6). Below sand, there is 4m thick clay layer (saturated unit weight = 20kN/m^3). Water table is 2m below ground surface and degree of saturation is 50% above water table. Calculate total stress, pore water pressure and effective stress at mid clay layer. If water table is lowered by 2m from its present position due to pumping, what is the change in effective stress at mid clay layer? γ_w = 9.81kN/m^3. [4+6=10]

10. Fill in the blanks:

(i) In boulders and rocks, --------------------- (auger/percussion) boring is suitable.

(ii) In subsurface sounding, resistance to penetration of ------------------------------ (only sampling spoon/only cone/sampling spoon as well as cone) under dynamic or static loading is measured.

(iii) If the effective overburden pressure at the depth at which SPT 'N' is determined is 0.33 kg/cm^2, C_N will be ------------- (0.37/1.37/2.37).

(iv) Sample can be obtained in -------------- (SPT/DCPT).

(v) ------------ (SPT/DCPT/CPT) measures static resistance of soil.

(vi) CPT is unsuitable in ----------------- (dense sand/soft clay).

(vii) Geophone is used in ---------------------------------- (seismic refraction/electrical resistivity) method.

(viii) As distance between shock source and geophone increases -------------------------- (direct/refracted) waves reach geophone first.

(ix) Apparent resistivity and true resistivity in soil are ---------------------- (same/different).

(x) Soil resistivity variation with depth is studied in ---------------------- (sounding/profiling).
[1x10=10]