Bengal Engineering and Science University, Shibpur
B.E. (Civil) Part – III, 6th Semester Examination, 2013
Soil Mechanics II
(CE 603)

(i) Use separate answer script for each half
(ii) Assume reasonable data if not supplied

Full Marks: 70 Time: 3 Hours

FIRST HALF

Attempt Q. No. 1 and any two from the rest

Q.1.(a) Explain Coulomb's earth pressure theory with reference to the active state. Mention the assumptions on which the theory is based.

(b) A retaining wall with a smooth, vertical back face has to retain a sand backfill up to a height of 4.5 m. A uniform surcharge of 50 kN/m^2 is placed over the backfill. The ground water table is at 2 m below GL. The specific gravity of solids and the void ratio of the backfill are 2.68 and 0.82 respectively. The soil above water table has a degree of saturation of 10%. The angle of internal friction of the soil, both below and above the water table, is 30°.

Plot the distribution of active earth pressure on the wall using Rankine's theory. Hence determine the magnitude and point of application of the resultant active thrust on the wall.

[4 + 7 = 11]

Q.2. A gravity retaining wall has to retain a 6 m high backfill of dry, cohesionless soil (γ = 19.0 kN/m^3 and ϕ = 33°). The backfill has a surcharge angle of 8° while the back face of the wall has a batter angle of 10°. A line load of 50 kN/m runs parallel to the wall at a distance of 3 m from its top corner, the distance being measured along the surface of the backfill. Determine graphically the magnitude of the resultant active thrust. Also find its direction and the point of application. Assume reasonable value for any data not supplied.

[12]

Q.3. The section of a masonry retaining wall, founded at 1.4 m below GL, is shown in Figure Q.3. The wall has to retain a cohesionless backfill (γ = 16 kN/m^3, ϕ = 32°) up to 3.5 m above GL. The backfill has a surcharge angle of 12°. The soil below the ground level is a normally consolidated clay deposit (γ = 16.8 kN/m^3, q_u = 50 kPa). Check the stability of the wall against base tension, sliding and overturning. Assume that 50% of passive pressure will be mobilsed. Use Rankine's theory for the computation of earth pressures.

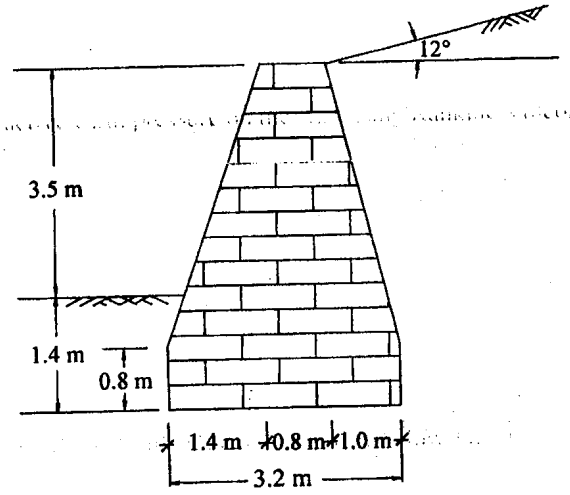

Fig.Q.3

[12]

Q.4. A cantilever sheet pile has to retain a soil mass up to 4.5 m above the dredge line. The water table has been located at 1.2 m below the surface of the soil. The properties of the soils are as follows:

Above dredge level:

$$\gamma = 17.5 \text{ kN/m}^3,\ \gamma_{sat} = 18.6 \text{ kN/m}^3,\ \phi = 32°,\ \phi' = 28°$$

Below dredge level:

$$\gamma_{sat} = 20.3 \text{ kN/m}^3,\ q_u = 63 \text{ kPa}$$

Find out the required depth of embedment with respect to a factor of safety of 2.0.

[12]

Contd....

Q.5. An anchored bulkhead has to retain a backfill of cohesionless soil up to 6 m above the dredge level. The water table is at 2.0 m below the top of the backfill, while the anchor rod is provided at 1.2 m below this level. The properties of the soil, which are identical above and below the dredge level, are as follows:

$\gamma = 16.5$ kN/m^3, $\gamma_{sat} = 19.7$ kN/m^3, $\phi = 33°$, $\phi' = 29°$

Find out the required depth of embedment with respect to a factor of safety of 2.0. Also find the force in the anchor rod considering unit length of the sheet pile wall. Use the equivalent beam method. Given, for $\phi' = 29°$, $x = 0.053H$.

[12]

SECOND HALF

(Answer Q.**No.6** and any **Two** from the rest)

Q.6.(a) Write short notes on: (i) Reinforced earth retaining wall; (ii) Depth of exploration.

(b) An infinite slope 6 m height and 35^0 inclination is made in a layer of dense sand having the following properties :

$c = 45$ kN /m^2, $\phi = 5^0$, $G = 2.70$, $e = 0.85$, and $w = 0\%$.

(i) Determine the factor of safety of the slope against sliding

(ii) How will the factor of safety change if the slope gets fully submerged ?

$[(3+3)+4=10]$

Q.7. A 12m deep cut is made in a silty clay with side slopes of 30°. The soil has the following properties:

$\gamma = 19$ kN / m^3, c = 25 kPa, $\phi = 8°$.

Locate the centre of the critical slip circle by Fellenius' method and determine the factor of safety of the slope against sliding failure by the Swedish circle method.

The values of α_1, α_2 for slope angle, β are shown below.

Slope angle, β	Values of angle	
	α_1	α_2
30°	25°	35°

$\left[12\frac{1}{2}\right]$

Q.8. (a) What is stabilized soil?

(b) Describe cement stabilized soil.

(c) Discuss the five major functions of geotextile.

(d) Discuss with neat sketches different applications of reinforced earth in the civil engineering field.

$\left[\frac{1}{2}+4+3+5=12\frac{1}{2}\right]$

Q.9. (a) What do you understand by compaction?

(b) Discuss the factors that influence the compaction characteristics of soil.

(c) The optimum moisture content of a soil is 16.5 % and its maximum dry density is 15.7 kN / m^3. The specific gravity of solid is 2.65.

(i) The degree of saturation and percentage of air voids of the soil at OMC.

(ii) the theoretical dry density at OMC corresponding to zero air voids.

(d) What types of soils are best compacted by the use of the following compacting equipment?

(i) Smooth wheel rollers; (ii) Rubber tyred rollers; (iii) Pneumatic rollers; (iv) Sheepsfoot roller; and (v) Vibratory rollers.

$\left[1+6+3+2\frac{1}{2}=12\frac{1}{2}\right]$

Q.10.(a) Discuss the various steps in the planning of sub-surface exploration programme.

(b) What kind of improvement of the engineering properties of a soil mass can be brought about through compaction?

(c) A borrow material has a water content of 8 %. Assuming that 6 kg of wet soil is required for a laboratory compaction test, estimate the amount of water required to be added to other 6 kg samples to bring their water content up to 10-, 15-, 18-, 20-, and 25%.

$\left[3+6+3\frac{1}{2}=12\frac{1}{2}\right]$

.....End.....