B.E.(C.E.) Part III Examinations 2011

5 th Semester Civil Engineering

Soil Mechanics-I

(CE 502)

FIRST HALF

Q. No. 1 is compulsory. Answer *two* more questions from the rest.

1. (a) Distinguish, with sketches, between single-grained structure and honeycombed structure of soils.

(b) Draw the three-phase diagram of a partly saturated soil specimen. Hence deduce, from first principles, the relation between the dry density and bulk density of the soil.

(c) The liquid limit and plastic limit of a given clay specimen are 44% and 23% respectively. Draw a neat sketch of the plasticity chart and classify the given soil with the help of it.

(d) Define: (i) Isobar (ii) Zone of influence. [2+3+4+2=11]

2. (a) The mass of a moist soil specimen reduced from 360 gm to 322 gm on oven drying. The initial volume of the specimen was 210 cc. The specific gravity of solids was found to be 2.68. Assuming there was no change in the void ratio, determine the initial water content and degree of saturation of the specimen.

(b) Draw a typical free-hand sketch of the particle size distribution curve for a well-graded soil. Hence define the following terms:

(i) uniformity coefficient (ii) coefficient of curvature.

(c) State and explain Stokes' law, clearly defining all the terms used therein. State three major limitations of Stokes' law regarding its application in the hydrometer test. [4+3+5=12]

3.(a) 'The porosity of a given soil can never be greater than its void ratio." State, giving reasons, whether the above statement is true or false.

(b) Define any three of the following:

(i) Residual soil (ii) Alluvial soil (iii) Marine clay (iv) Black cotton soil (v) Lacustrine soil.

(c) An embankment was constructed by compacting soil at a water content of 12%. The degree of saturation of the finished embankment was found to be 55%. The soil absorbed some water during the rainy season and its degree of saturation increased to 90%. Determine the water content of the soil at this stage. What will be the degree of saturation if the water content reduces to 8% in the dry season? Given, specific gravity of solids = 2.71. [2+6+4=12]

4. (a) What do you understand by 'excess pore water pressure?' How is it related to the total stress and effective stress?

(b) Derive an expression for the effective stress at any point in a soil mass when there is a steady downward flow of water through the soil.

(c) Define 'critical hydraulic gradient.' A sand deposit is 50% saturated and its bulk density is 17.5 kN/m^3. If the water content of the sand be 18%, then determine the critical hydraulic gradient. [3+5+4=12]

5. (a) State Boussinesq's equation of stress distribution and define the notations used therein. What, in your opinion, is the limitation of this equation with reference to the determination of stress increment at any point in a soil due to an external concentrated force?

(a) A concentrated vertical force of 100 kN is applied at a point on the ground surface. Draw an isobar for a stress intensity of 10 kN/m^2 due to the load.

(b) An area measuring 2 m x 3 m on the ground surface is loaded with a stress intensity of 50 kN/m^2. Plot the distribution of vertical stress intensity due to this load on a horizontal plane at a depth of 3 m below the ground level using:

(i) The 2 : 1 dispersion method

(ii) Boussinesq's equation, assuming the load is concentrated at the center of the area. [3+3+6=12]

SECOND HALF

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

6. (a) A 6 m thick clay stratum is overlain by an 8 m thick stratum of coarse sand and is underlain by an impermeable shale. A raft footing, supporting the columns of a building, is to be founded at a depth of 1.2 m below ground level. The size of the raft is 8.5 m × 13.6 m, and it is loaded uniformly with a stress intensity of 9.2 t / m^2. The water table is located at 2 m below the ground level. The unit weight of sand above and below the water table are 1.90- and 2.10 t / m^3. The properties of the clay are as follows: Initial void ratio = 0.72, specific gravity of solids = 2.71, liquid limit = 42 %, Co-efficient of consolidation = 2.2×10^{-3} cm^2 / sec.

Determine: (i) Probable consolidation settlement of the raft. (ii) The time required to undergo a consolidation settlement of 5 cm.

(b) An unconfined compression test was performed on an undisturbed sample of clay. The sample had a diameter of 3.8 cm and was 7.6 cm high. The load at failure measured by proving ring was 28 N and the axial deformation of the sample at failure was 13 mm. Determine the unconfined compressive strength and the undrained shear strength of the clay. [7+4=11]

7. (a) Explain in sequence the events that take place when a saturated clay deposit undergoes consolidation.

(b) A 2.5cm thick sample of clay was taken from the field for predicting the time of settlement for a proposed building which exerts a uniform pressure of 100 kN / m^2 over the clay stratum. The sample was loaded to 100 kN/m^2 and proper drainage was allowed from top and bottom. It was seen that 50% of the total settlement occurred in 3 minutes. Find the time required for 50% of the total settlement of the building, if it is to be constructed on a 6 m thick layer of clay, which extends from the ground surface and is underlain by sand.

(c) Establish the relationship: $m_v = \frac{a_v}{1+e_0}$, the notations having their usual meanings. [3+4+5=12]

8. (a) Classify triaxial tests on the basis of their drainage characteristics.

(b) A cylindrical sample of soil having unit cohesion of 80 kN/m^2 and angle of internal friction of 20^0 is subjected to a cell pressure of 100 kN/m^2. Determine: (i) the deviator stress at which the sample will fail, and (ii) the angle made by the failure plane with the axis of the sample

(c) The results of a direct shear test performed on a sample of silty sand in a shear box of 6 cm x 6 cm are given below:

Normal load (N)	100	200	300
Shear force (N)	99.5	156.3	210.7

Draw the failure envelop and determine the shear strength parameters of the soil. [3+5+4=12]

9.(a) Develop an expression for the rise of water in a capillary tube.

(b)Explain with a neat diagram a method for determining coefficient of permeability of sandy soil in the laboratory.

(c) A falling head permeability test is carried out on a 15 cm long sample of silty clay. The diameters of the sample and the stand-pipe are 9.8 cm and 0.75 cm respectively. The water level in the stand-pipe falls from 60 cm to 45 cm in 12 min. Determine:

(i) the co-efficient of permeability of the soil in m/day

(ii) height of water level in the stand-pipe after 20 min

(iii) time required for the water level to drop to 10 cm. [3+4+5=12]