Course Title: Soil Mechanics (1)	Course Code: CSE2208	Year: 2nd Civil Eng.
Date: June 2013 (Second term)	Allowed time: 3 hrs	No. of Pages: (4)

- **Assume any missing data**
- **Answers should be supported by sketches as possible as can be**

Question Number (1) ***(15 Marks)***

a) Draw the grain size distribution curve for the following cases of soil:
- Well-graded soil.
- Gap-graded soil.
- Uniformly graded soil. (1 Point)

b) What are the different states that a dry cohesive soil can go through after slowly increasing its water content until reaching the liquid state? Define the three limits that separate each of these states. (2 Points)

c) Describe how determine the liquid limit in the laboratory. (2 Points)

d) The following index properties were determined for two soils A and B:

Proprty	A	B
Liquid Limit	62%	34%
Plastic Limit	26%	19%
Water content	38%	25%
Specific gravity of solids	2.72	2.67
Degree of saturation	100%	98%

i. Classify both soils using the A-line chart. [Equation of A-line on the plasticity chart is: Plasticity Index = 0.73 (Liquid Limit – 20)] (2 Points)

ii. Determine with calculations which of these soils:
1. Has a greater wet density;
2. Has a greater dry density;
3. Has a greater voids ratio. (3 Points)

e) A sandy soil has a natural water content of 25% and total unit weight of 19 kN/m3. The void ratios corresponding to the densest and loosest state of this soil are 0.55 and 0.91. The specific gravity of the soil is 2.7. It is required to find the relative density and the degree of saturation. (5 Points)

Question Number (2) ***(15 Marks)***

a) Define the permeability of soils. (عرف نفاذية التربة) (1 Point)

b) Briefly explain the factors influence permeability of soils. (2 Points)
(إشرح بإختصار ماهي العوامل التي تؤثر في معامل النفاذية للتربة)

c) A sily sand sample is prepared for a falling head permeability test. Given the following parameters of the test:
Area of the soil sample = 1400 mm^2,
Length of the soil sample = 70 mm,

Area of the stand pipe = 50 mm^2,

At time t = 0, the head difference = 400 mm, and

At time t = 150 minutes, the head difference = 200 mm

i. Compute the coefficient of permeability of the tested soil in m/sec (2 Points)

(إحسب معامل النفاذية للتربة بالوحدات الموضحة أعلاه)

ii. Estimate the total seepage force in the sample after 1 hour . (2 Points)

(إحسب قوة السريان الكلية في عينة التربة بعد مضي ساعة واحدة من بداية التجربة)

d) A silty sand layer has the same permeability as in (c) is shown in Figure (1). Consider a steady state flow from the canal to the drain. Consider the flow in the silty sand layer and neglect the flow in the clay. (إعتبر السريان من البحيرة إلى النهر في طبقة الرمل الطميي و إهمل السريان في الطين)

Calculate (i) The hydraulic gradient, and (إحسب الميل الهيدروليكي)

(ii) The flow rate in m^3/day/m.(إحسب معدل السريان بالوحدات الموضحة)

(iii)The total seepage force in the silty sand layer per linear meter of the canal

(إحسب قوة السريان الكلية في طبقة الرمل الطميي لكل متر طولي من القناة) (8 Points)

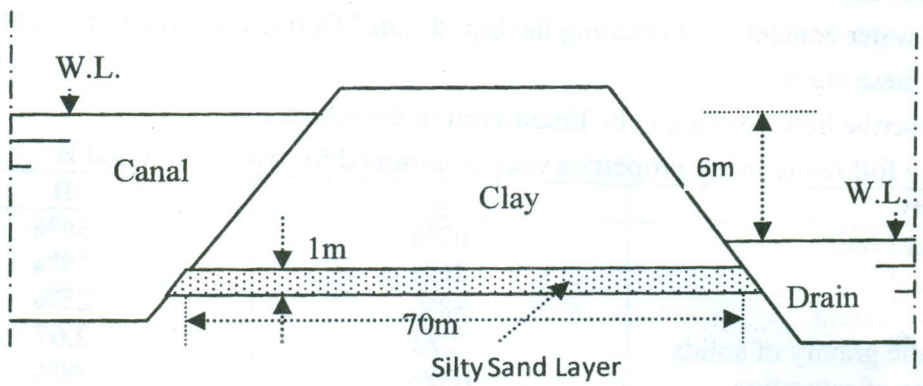

Fig. (1)

Question Number (3) ***(10 Marks)***

a) Define the pressure bulb for vertical stress under a foundation, then show, using clear sketches, the effect of foundation size and the effect of closely placed footings on the bulb size and depth. (1 Point)

b) Using only clear sketches draw the shape of the expected contact pressure distribution under a rigid foundation as well as under a flexible foundation. (2 Points)

c) A and B are two footings of size 1.5 x 1.5 m each placed in position as shown in Fig. (2). Each of the footings carries a column load of 400 kN. Determine by the Boussinesq method, the excess load that footing B shall carry due to the effect of the load on A. Assume the loads at the centers of footings act as point loads. (7 Points)