Kafrelsheikh University
Faculty of Engineering
Department of Civil Engineering
2nd year, Soil Mechanics
Name: .....

Date: 10- 6 - 2019
Time allowed: (3) hours
Full Mark: 75
Final Exam: 2 pages

Answer all questions; Any missing data to be reasonably assumed
ILOS for this course are A2 ; A3; B2;B11; C1, C5; C7; D1 and D4.

Question 1 (25 Mark)

a) A clay sample containing natural moisture content weighs 3.462 N. The specific gravity of soil particles is 2.70. After oven drying, the soil weighs 2.036 N. If the displaced volume of the wet soil sample is 24.26 cm^3. **Calculate : (i) the water content of the sample, (ii) its void ratio, (iii) wet unit weight, (iv) dry unit weight and (v) degree of saturation.**

b) **Sketch** typical complete grain-size distribution curves for (i) well graded soil and (ii) uniform silty sand. Form the curves, **determine** the uniformity coefficient and effective size in each case.

c) An oven-dried soil weighing 1.89 N is placed in a pycnometer which is then filled with water. The total weight of the pycnometer with water and soil is 15.81 N. The pycnometer filled with water alone weighs 14.62 N. **What is the specific gravity of the soil.**

d) The liquid limit and plastic limit of a soil are 75% and 33% respectively. **Classify** the soil according to casagrand chart and **determine the shrinkage limit. It is required to determine the shrinkage limit,** if the void ratio of the soil on oven-drying was found to be 0.63? Assume grain specific gravity as 2.7.

e) The data obtained from sieve analysis, liquid and plastic limit tests are given in the following table. It is required to **classify** each soil according to the **unified classification system**.

Soil	%pass #200	%pass #4	D_{10}	D_{30}	D_{60}	LL%	PL%	C_U	C_c
A	3	40	0.16	1.2	4.85	-	-	>4	1.86
B	15	78	-	-	-	56	25		
C	8	78	0.1	0.3	0.7	62	27	7	1.29
D	63	100	-	-	-	73	26		

f) A deposit of cohesionless soil with a permeability of 3 × 10–2 cm/s has a depth of 10 m with an impervious ledge below. A sheet pile wall is driven into this deposit to a depth of 7.5 m. The wall extends above the surface of the soil and a 2.5 m depth of water acts on one side. **Sketch the flow net** and **determine** the seepage quantity per meter length of the wall.

Question 2 (25 Mark)

a) A number of assumptions were made in deriving Terzaghi's one-dimensional equation of consolidation. **List four** of these assumptions and discuss one of them in detail.

b) Explain experimentally and analytically, how to determine the critical hydraulic gradient.

c) The following data relate to a pump-out test: Diameter of well = 24 cm. Thickness of confined aquifer = 27 m. Radius of circle of influence = 333m. Draw down during the test = 4.5 m. Discharge = 0.9 m3/s. **What is the permeability of the aquifer** ?

d) The results of the undrained triaxial tests with pore water pressure measurements on compacted soil at failure are shown in the following table. **Determine** the apparent cohesion and angle of shearing resistance referred to both total and effective stresses.

Lateral pressure, KN/m^2	70	350
Total axial pressure, KN/m^2	304	895
Pore water pressure, KN/m^2	-30	95

c) A vane 11.43 cm long and 7.62 cm in diameter was pressed into soft clay at the bottom of a borehole. Torque was applied and gradually increased to 45 N.m when failure took place. **Find** the shear strength of the clay on a horizontal plane.

Question 3 (25 Mark)

a) The results of an Oedometer test on a sample of normally consolidated clay are listed in the following table. It is required to:**(i) plot** the e-logσ curve, **(ii)** determine the maximum past pressure, :**(iii)** calculate the compression index if the field void ratio $e_o = 1.84$, :**(iv)** calculate the swelling index

Pressure (kN/m^2)	**30**	**50**	**100**	**200**	**400**	**800**	**400**	**200**	**100**
Void Ratio, e	**1.80**	**1.76**	**1.68**	**1.48**	**1.16**	**0.84**	**0.88**	**0.96**	**1.04**

b) A footing is to be located 2 m below ground level, as shown in Fig. 2. The base of the square footing is 4 m x 4 m and carrying a load of 4000 kN. Use the data in part b in Question 2. **Compute** the expected primary consolidation settlement for the normally consolidated clay layer. **Calculate** the time required for 90% of settlement to complete in days if the coefficient of consolidation c_v=0.0005 m^2/sec.

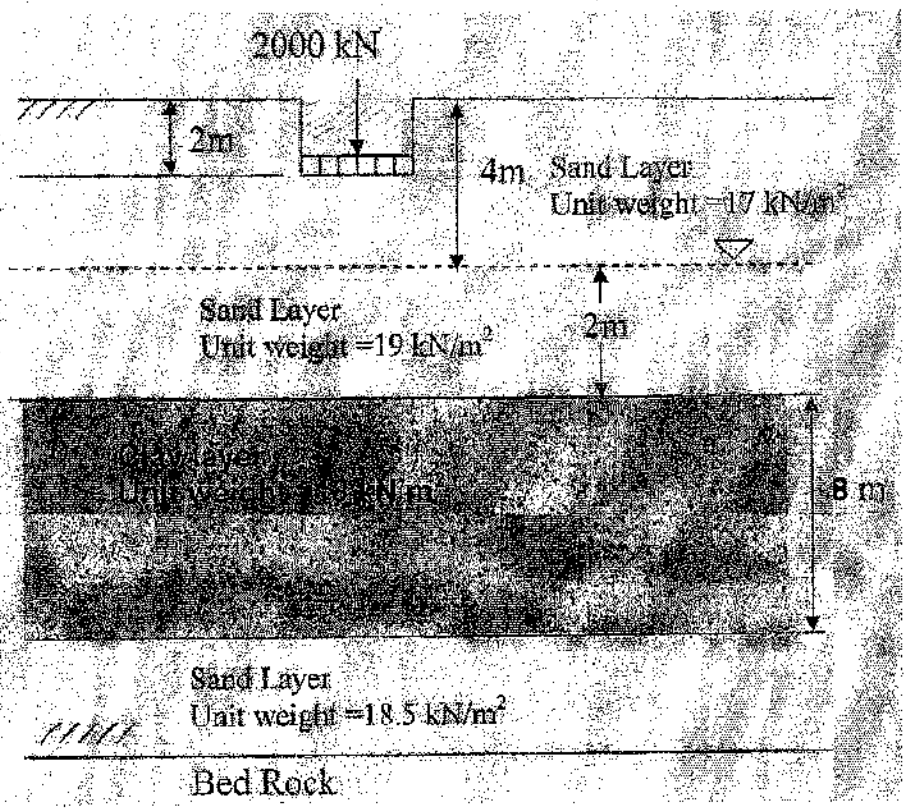

Fig. 1

c) **Construct** a Newmark chart consists of 6 circles and 16 sectors (take z = 4cm)

d) Ring foundation is of 3 m external diameter and 2.00 m internal diameter. It transmits a uniform pressure of 10 kN/m^2. **Calculate** the increase of vertical stress at depths 1.5 and 3.0 m directly beneath the centre of the loaded area **by three different method and compare between them**.

Best Wishes ***Dr Ali Basha***