THE MOMBASA POLYTECHNIC UNIVERSITY COLLEGE

Faculty of Engineering & Technology

DEPARTMENT OF CIVIL AND BUILDING ENGINEERING

DIPLOMA IN CIVIL ENGINEERING AND CAD

END OF COURSE EXAMINATIONS

APRIL/MAY 2010 SERIES

SOIL MECHANICS AND HYDRAULICS

TIME: 3 HOURS

Instructions to Candidates

You should have the following for this examination:

Answer booklet
Pocket Calculator/Mathematical Tables

This paper consists of **EIGHT** Questions in **TWO** sections, **'A'** and **'B'.**
Answer any **FIVE** questions, choosing at least **TWO** Questions from each section.
All questions carry equal marks.
Maximum marks for each part of a question are as shown.

SECTION A : SOIL MECHANICS

(Answer any **TWO** Questions from this Section)

Question ONE

(a). (i). Define each of the following:

- Ultimate bearing capacity
- Safe bearing capacity
- Shallow foundation

(ii). State Terzaghi's formula for strip footings and explain all the terms.

(iii). A square footing of sides 1.5m x 1.5m is founded on sand of density 1760kg/m^3 . The angle of internal friction is 36^o. If $N_\partial = 50$ and $N_q = 43$, determine the ultimate bearing capacity when the footing is:

- On the ground surface
- At a depth of 1.5m below the ground surface. **(12 Marks)**

(b). (i). State **FOUR** factors influencing permeability of a soil.

(ii). A variable head test was made on a soil sample of length 320mm. The water level in a 30mm diameter stand pipe fell from 1590mm to 1005mm after 60seconds. Determine the coefficient of permeability of the soil if the diameter of the sample was 75mm. **(8 Marks)**

Question TWO

(a). State **FOUR** assumptions made in Rankine's theory. **(4 Marks)**

(b). Referning to Figure 1, calculate the total thrust against the wall retaining a soil having an angle of frictional resistance of 35^o. **(12 Marks)**

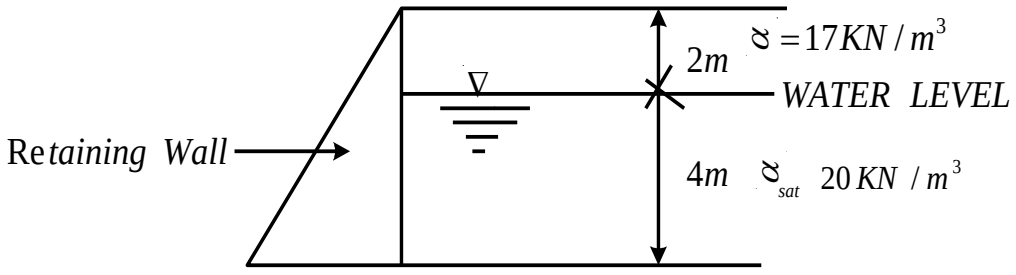

Fig. 1

(c). Determine the degree of saturation of a soil, given:

Bulk density = 1.96g/cc
Specific gravity of soil = 2.75
Moisture content = 16% **(4 Marks)**

Question THREE

(a). Distinguish between the following processes in soils:

(i). Compaction
(ii). Consolidation **(2 Marks)**

(b). (i). State **FOUR** assumptions made in Terzaghi's theory of one-dimensional consolidation in soils.

(ii). Define the following with respect to consolidation of soils:

(I). Coefficient of volume compressibility
(II). Degree of consolidation
(III). Coefficient of consolidation **(5 Marks)**

(c). Table 1 shows results obtained during a standard proctor compaction test on a soil.

Table 1

Bulk Density (kg/m^3)	2060	2100	2160	2130	2040	1890
Water Content (%)	17	15	12	10	9	7

(i). Determine the value of optimum moisture content.

(ii). Plot the zero air voids curve and comment on the effectiveness of the compaction, given that the specific gravity for the soil grains is 2.68. **(13 Marks)**

Question FOUR

(a). State **SIX** objectives of site investigation. **(6 Marks)**

(b). The data in table 2 refers to triaxial tests performed on indisturbed soil samples. The load dial calibration factor is 1.4N per division. Sample size 75mm long and 37.5mm diameter. Determine the value of apparent cohesion and the angle of internal friction for the soil. **(10 Marks)**

Table 2

TEST	CELL PRESSURE (KN/m^3)	AXIAL LOAD DIAL READIG (DIVISIONS) AT FAILURE
1	50	65
2	150	105
3	250	146

(c). Define the following terms:

(i). Liquid limit

(ii). Plastic limit **(4 Marks)**

SECTION B: HYDRAULICS

(Answer any TWO Questions from this Section)

Question FIVE

(a). 4791kg of a certain liquid occupies a volume of 5800 litres. Calculate in SI units:

(i). Its mass density
(ii). Its specific gravity
(iii). Its unit weight
(iv). The mass of $0.4m^3$ of the liquid **(8 Marks)**

(b). A circular plate 200cm diameter is immersed in water as shown in fig. 2.

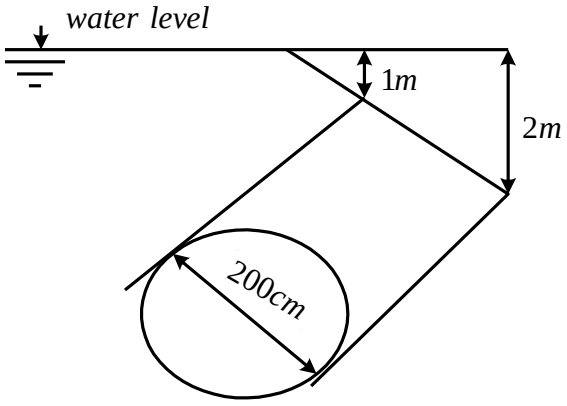

Fig. 2

Calculate:

(i). The total pressure on one side of the plate.
(ii). The position of the centre of pressure. **(6 Marks)**

(c). Define the following terms:

(i). Steady flow
(ii). Uniform flow
(iii). Turbulent flow
(iv). Viscous flow **(4 Marks)**

(d). A right angled v-notch installed in a channel for measuring discharge has a water depth of 250mm above its crest. The coefficient of discharge of the notch cd=0.62. Calculate the discharge over the notch. **(2 Marks)**

Question SIX

(a). A sharp edged notch is in form of a symmetrical trapezium. The horizontal base is 100mm wide, the top is 500mm wide and the depth is 300mm. Estimate the discharge when the upstream water surface is 228mm above the level of the base of the notch. Assume that cd=0.6 and that the velocity of approach has negligible effect. **(6 Marks)**

(b). Two pipes of dia 50mm and 100mm respectively connect two large tanks A & B. The difference in water levels and lengths are shown in fig. 3. If the coefficient of friction f = 0.008 for both pipes, calculate the rate of flow from tank A to tank B. **(7 Marks)**

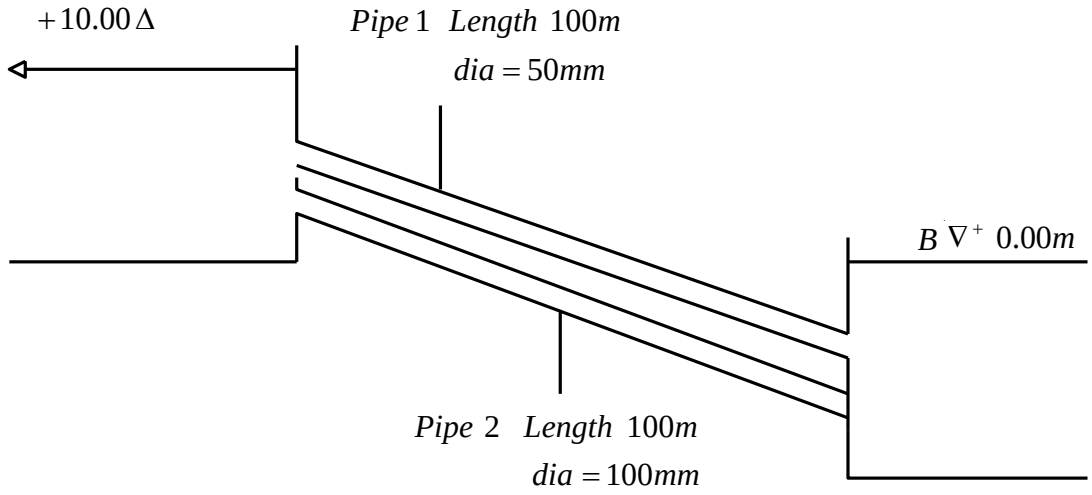

Fig. 3

(c). A rectangular channel is to drain 1.3m^3/s of storm water. Its bed slope is to be 1:900 and Chezy's c = 69 SI units.
(i). Design the channel
(ii). Determine the mean velocity in the channel. **(7 Marks)**

Question SEVEN

(a). Briefly describe the hydrologic cycle. **(7 Marks)**

(b). The data in table 2 was extracted from an isohyetal map showing annual rainfall for a certain catchment. Calculate the mean annual precipitation over the catchment.

Table 3

Isohyets (mm)	600-700	700-800	800-900	900-1000	1000-1100	1100-1200
Area between Isohyets (km^2)	500	3200	3100	950	600	180

(5 Marks)

(c). Explain the meaning of the following precipitation losses.
(i). Infiltration
(ii). Interception
(iii). Evapo-transpiration **(4 Marks)**

(d). Explain the procedure of using a surface float to estimate the mean velocity of a straight stretch of an open channel. **(4 Marks)**

Question EIGHT

(a). A centrifugal pump delivers 0.071m^3/s against a head of 7.6m at 1450 rev/min and requires 6.7kw. If the speed is reduced to 1200rev/min, Calculate:

(i). The flow
(ii). The head
(iii). The power required

Assume efficiency is the same in both cases. **(5 Marks)**

(b). Briefly explain the working principle of a pelton wheel. **(5 Marks)**

(c). Draw a labeled x-section showing salient dimensions of a:
(i). Standard rain gauge
(ii). USWB evaporation pan **(9 Marks)**