2ND SEM.2015/2016

109

UNIVERSITY OF SWAZILAND
FINAL EXAMINATION PAPER

PROGRAMME: BSC ABE. III

COURSE CODE: ABE 303

TITLE OF PAPER: FLUID AND SOIL MECHANICS

TIME ALLOWED: TWO (2) HOURS

SPECIAL MATERIAL REQUIRED: NONE

INSTRUCTIONS: ANSWER QUESTION ONE AND ANY TWO OTHER QUESTIONS.

DO NOT OPEN THIS PAPER UNTIL PERMISSION HAS BEEN GRANTED BY THE CHIEF INVIGILATOR

SECTION I   COMPULSORY

QUESTION 1

a)   Define the following terms as used in fluid mechanics:
   (i)   Turbulent flow;
   (ii)   Uniform flow;
   (iii)   Viscosity;
   (iv)   Hydrostatic pressure.
   (v)   Capillarity

[20 marks]

b)   A soil sample is taken with a soil probe and is placed in a container for soil water determination in the laboratory. The sample volume is 100 cm^3, the total wet mass of the soil including the container is 188g, the total oven dried mass including container is 155 g, and the container weighs 21 g. Assuming a soil particle density of 2.65 g/cm^3. Calculate:

   (i)   Soil (dry) bulk density
   (ii)   Soil water content (mass basis)
   (iii)   Soil water content (volume basis)
   (iv)   Estimated porosity

[20 marks]

SECTION II   ANSWER ANY TWO QUESTIONS

QUESTION 2

a)   Discuss the Bernoulli Equation (also known as the energy equation), outlining the assumptions that allow us to use it.

[10 marks]

b)   The diameter of a water pipe gradually changes from 5 cm at the entrance, Point A, to 15 cm at the exit, Point B. The exit is 5 m higher than the entrance. The pressure is 700 kPa at the entrance and 664 kPa at the exit. Friction between the water and the pipe walls is negligible. The water density is 1000 kg/m^3. Calculate the rate of discharge (in m^3/s) at the exit.

[10 marks]

c)   Explain how these devices are used to measure flow properties:
   - Venturi meter
   - Pitot tube

[10 marks]

QUESTION 3

a)   Water flows through an open concrete channel, with the area of flow being an equilateral triangle, 2 m on each side as shown below. Assuming a Manning roughness coefficient of 0.013 for concrete, what is the minimum slope needed to maintain a steady flow of 3 m/s?
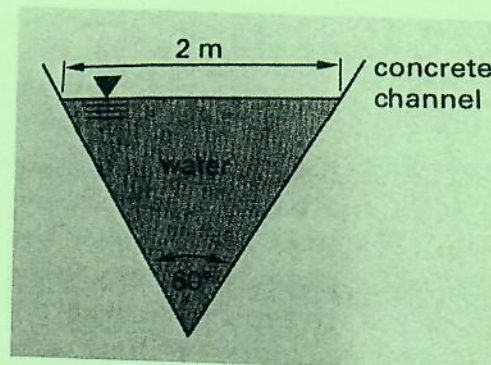
[15 marks]

b)   What is a pump used for in hydraulics? How does one decide whether to connect pumps in series or in parallel? Use graphs to illustrate your answer.

[15 marks]

QUESTION 4

a)   Darcy's Law is explained by the equation below:

$$Q = -KA \ (dh/dx)$$

Explain all the components as given in the equation above.

[10 marks]

b)   Give two (2) examples of where (soil) compaction could be used in real life.

[4 marks]

c)   Explain what a proctor test is, and how it is carried out in the laboratory.

[6 marks]

d)   Discuss the sieve test and the hydrometer test as used in determining the particle size distribution.

[10 marks]