1st SEM. 2018

1444

UNIVERSITY OF ESWATINI

RESIT EXAMINATION PAPER
2018/19

PROGRAMME: BSC. ABE

COURSE CODE: ABE405

TITLE OF PAPER: SOILS AND FLUID MECHANICS

TIME ALLOWED: TWO (2) HOURS

SPECIAL MATERIAL REQUIRED: CALCULATOR

INSTRUCTIONS: ANSWER QUESTION ONE AND ANY TWO OTHER QUESTIONS.

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SECTION ONE: COMPULSORY

QUESTION ONE

a) Give one example how clays are used in the following fields. (8 marks)
   i) Oil drilling
   ii) Construction
   iii) Health
   iv) Agriculture

b) List four factors that affect the nature and extent of the diffuse double layer of clays. (8 marks)

c) Define the following terms. (8 marks)
   i) Specific surface
   ii) Cation Exchange Capacity
   iii) Flocculation
   iv) Dispersion

d) Give three distinct differences between a liquid and a gas. (6 marks)

e) Name the three primary thermodynamic variables of any system. (6 marks)

f) A pipeline with an inside diameter of 200 mm and 340 m in length made of new PVC is laid along a horizontal grade. The required flow rate in the pipeline at steady state is 40 l/s and the total head available at the inlet is 330 kPa. Compute the working pressure at the discharge point 340 m from the inlet.
   Use C = 150 for PVC. (4 marks)

SECTION II: ANSWER ANY TWO QUESTIONS

QUESTION TWO

a) A moist soil sample weighs 346 g. After drying at 105oC its weight is 284 g. The specific gravity of the mass and of the solids is 1.86 and 2.70 respectively.

Calculate the following;

i) The water content (3 marks)
ii) The void ratio (5 marks)
iii) The degree of saturation (3 marks)
iv) The porosity (2 marks)

b) Using the physical and index properties of soils, show that the volume of voids V_v can also be written as;

$$V_v = \frac{e}{1+e} * V$$

(7 marks)

c) Water flows in a 10 cm diameter pipe at a mean velocity of 1.5 m/s;

i) Calculate the discharge of the pipe in m^3/s (7 marks)
ii) The mass rate of flow in kg/s (3 marks)

QUESTION THREE

a) Consider a steady flow of water through a nozzle in which the upstream diameter $D_1 = 30$ cm reduces to a downstream diameter of $D_2 = 20$ cm. For a flow rate of 0.08 m^3/s;

i) Compute the mean velocities for the upstream and downstream diameters.

(8 marks)

ii) Assuming the nozzle is horizontal, the flow is steady and neglecting changes in internal energy of the fluid, determine the pressure change through the nozzle between the upstream and downstream end of the nozzle.

(10 marks)

b) Water flows in a very big trapezoidal channel having a bottom width of 15 m and side slopes of 1 vertical to 1.5 horizontal at a rate of 200 m^3/s. Determine whether the flow is subcritical or supercritical given that the depth of flow is 2 m.

(12 marks)

QUESTION FOUR

a) Derive Hooghoudt drain spacing equation for steady state flow to vertically walled open drains reaching an impervious layer. (12 marks)

b) A lake has a maximum depth of 60 m. If the mean atmospheric pressure at the site is 91 kPa, calculate the absolute pressure at the bottom of the lake. (6 marks)

c) A test of the density of soil in place was performed by digging a small hole in t he soil, weighing the extracted soil, and measuring the volume of the hole. The soil (moist) weighed 895 g. The volume of the hole was 426 cm^3. After drying, the sample weighed 779 g. Of the dried soil, 400 g was then vibrated and tampered to a volume of 212 cm^3. Given that G = 2.71; $\gamma_w = 1$ g/cm^3, find the relative density (Dr) of the soil. (12 marks)