1st SEM. 2018

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UNIVERSITY OF ESWATINI

FINAL EXAMINATION PAPER
2018

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) i) What is meant by fluid mechanics? (4 marks)

ii) Name the states of matter commonly considered in fluid mechanics. (4 marks)

iii) Discuss the technical distinction between the states named in part ii). (6 marks)

iv) Name the four primary dimensions of fluid mechanics. (8 marks)

b) Describe three (3) differences between gases and liquids. (8 marks)

c) A useful theoretical equation for computing the relation between pressure, velocity, and altitude in a steady flow of a nearly invincid, incompressible fluid with negligible heat transfer and shaft work is the Bernoulli relation written as;

$$P_o = P + \frac{1}{2}\rho V^2 + \rho g Z$$

i) Show that this equation satisfies the principle of dimensional homogeneity. (5 marks)

ii) Also show that consistent units result without additional conversion factors. (5 marks)

SECTION II: ANSWER ANY TWO QUESTIONS

QUESTION TWO

a) Discuss three (3) characteristics of clays that make them important in fluid mechanics. (9 marks)

b) Given that an empirical pressure - density relation for a liquid neglecting the temperature effect is given by

$$\frac{P}{P_a} = (B+1)(\frac{\rho}{\rho_a})^n - B$$

where B = 3000 and n = 7, if the pressure at the deepest part of the ocean is 1100 atm, find the density of the sea water. (6 marks)

c) Using the physical and index properties of soils, show that the unit weight of mass γ is given by the following relationship;

$$\gamma = \frac{G+S*e}{1+e} * \gamma_w$$ (10 marks)

d) A tank contains water under pressure at 10 kPa. The depth of water in the tank is 6 m. What is the pressure at the bottom of the tank. (5 marks)

QUESTION THREE

a) Discuss two main reasons for draining a soil. (4 marks)

b) Given that a soil sample L cm long and 7.3 cm in diameter is tested with the following results; The dry weight obtained was 880 g; weight of the water 160 g; n = 0.44, and $G_s = 2.60$

Find

i) the length of the sample L and the degree of Saturation S%. (10 marks)

ii) the seepage velocity if the discharge quantity during a permeability test is 15 g/min. (5 marks)

c) Water flows in a 1000 m long pipeline of diameter 200 mm at a velocity of 5 m/s. Given that the kinetic viscosity is 1.007×10^{-6} m^2/s and the friction factor of 0.021,

i) Calculate the Reynolds Number and classify the flow in the pipeline. (5 marks)

ii) Determine the headloss in the pipeline. (6 marks)

QUESTION FOUR

a) Name three (3) classifications of clays giving one example for each class. (9 marks)

b) A rectangular channel of width 2.438 m and depth of flow 0.610 m is designed to convey water. If the bed slope is 0.0004 m/m and the Manning's roughness coefficient is n = 0.015.

Calculate the discharge in the channel. (9 marks)

c) A well fully penetrates a 25 m thick confined aquifer. After a long period of pumping at a constant rate of 0.05 m^3/s, the drawdown at distance of 50 m and 150 m from the well were observed to be 3 m and 1.2 m, respectively.

Using the equation;

$$Q = 2\pi * K * b * \left(\frac{h - h_1}{\ln\frac{r}{r_1}}\right)$$

i) Determine the hydraulic conductivity. (8 marks)

ii) Determine the transmissivity of the aquifer (4 marks)