

1st SEM. 2019 / 2020



UNIVERSITY OF ESWATINI
FINAL EXAMINATION PAPER
2019

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

(40marks)

- a) Discuss the following terms as used in fluid mechanics (10marks)
 - i) Specific weight
 - ii) Specific gravity
 - iii) Viscosity
 - iv) Surface tension
 - v) Dimensional homogeneity

- b) Discuss the following terms as used in soils mechanics (10marks)
 - i) Dilatancy
 - ii) Creep
 - iii) Groundwater
 - iv) Unknown initial stresses
 - v) variability

- c) Explain what is meant by the fact that soils do not exhibit the stress – strain relationship as in most engineering materials. (3marks)

- d) Discuss the main possible causes of the following deformations; (6marks)
 - i) Appearance of Pot holes along tarred roads
 - ii) Water breaks on earth dams
 - iii) Tilting of some high rise buildings

- e) A truck loaded with 2 m^3 dry sand appears to weigh "3 tons" more than the weight of the empty truck.
 - i) What is the meaning of the term "3 tons"? (1mark)
 - ii) What is the volumetric weight of the sand? (2marks)
 - iii) If it is known that the density of the sand particles in the material of the previous problem is 2600 kg/m^3 , then what is the porosity n ? and the void ratio e ? (4marks)
 - iv) It would be possible to fill the pores of the dry sand of the previous problems with water. What is the volume of the water that the sand could contain, and then what is the volumetric weight of the saturated sand? (4marks)

SECTION II: ANSWER ANY TWO QUESTIONS

QUESTION TWO

(30marks)

- a) Compute the discharge for uniform flow in a rectangular channel made of unfinished concrete ($n = 0.017$) which has a bed slope of 0.0101 m/m, width of 1.80 m, and depth of flow equal to 0.541 m. (9 marks)
- b) Given that an empirical pressure - density relation for a liquid neglecting the temperature effect is given by

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

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 metal block weighs 400 N in air, but when completely submerged in water it weighs 250 N. Calculate the volume of the metal block. (5 marks)

QUESTION THREE

(30marks)

- 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} m²/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)

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QUESTION FOUR

(30marks)

- 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 $0.05 \text{ m}^3/\text{s}$, 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)