

1st SEM. 2020 / 2021



UNIVERSITY OF ESWATINI

**FINAL EXAMINATION PAPER
2021**

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 soils and fluid mechanics

(10marks)

- i) Specific weight
- ii) Specific gravity

b) Choose the correct answer among the given options;

(30marks)

- i) Water transported soils are termed
 - a) Acoline
 - b) Alluvial
 - c) Colluvial
 - d) Dune
- ii) A silty soil gives a positive reaction in
 - a) Toughness test
 - b) Dilatancy test
 - c) Dry strength test
 - d) None of the above
- iii) When consolidation of a saturated soil sample occurs, the degree of saturation
 - a) Increases
 - b) Decreases
 - c) Remains constant
 - d) May increase or decrease
- iv) A soil has a bulk density of 22 kN/m^3 and water content of 10%. The dry density of the soil is
 - a) 18.6 kN/m^3
 - b) 20.0 kN/m^3
 - c) 22.0 kN/m^3
 - d) 23.2 kN/m^3
- v) If the volume of voids is equal to the volume of solids in a soil mass, then the values of porosity and voids ratio respectively are
 - a) 1.0 and 0.0
 - b) 0.0 and 1.0
 - c) 0.5 and 1.0
 - d) 1.0 and 0.5
- vi) Pascal – second is the unit of
 - a) Pressure
 - b) Kinematic viscosity
 - c) Dynamic viscosity

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- d) Surface tension
- vii) An ideal fluid is
- a) One which obeys Newton's law of viscosity
 - b) Frictionless and incompressible
 - c) Very viscous
 - d) Frictionless and compressible
- viii) An open tank contains 1m deep water with 50 cm depth of oil of specific gravity 0.8 above it. The intensity of pressure at the bottom of the tank is
- a) 4 kN/m^2
 - b) 10 kN/m^2
 - c) 12 kN/m^2
 - d) 14 kN/m^2
- ix) If the weight of a body immersed in a fluid exceeds the buoyant force, then the body will
- a) Rise until its weight equals the buoyant force
 - b) Tend to move downwards and it may finally sink
 - c) Float
 - d) None of the above
- x) A rectangular block 2 m long, 1 m wide and 1 m deep floats in water, the depth of immersion being 0.5 m. If water weighs 10 kN/m^3 , then the weight of the block is
- a) 5 kN
 - b) 10 kN
 - c) 15 kN
 - d) 20 kN

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SECTION II: ANSWER ANY TWO QUESTIONS

QUESTION TWO

(30marks)

- a) What is a dimension? (3 marks)
- b) What is a unit? (3 marks)
- c) Name the four primary dimensions in fluid mechanics and give their symbols. (12 marks)
- d) Show that the porosity, n , can be given by the following expression (6 marks)

$$n = \frac{e}{1 + e}$$

- e) A fresh water lake has a maximum depth of 60 m, and the mean atmospheric pressure is 91 kPa. Estimate the mean absolute pressure in kPa at this depth. (6 marks)

QUESTION THREE

(30marks)

- a) Show that the volume of water V_w can also be given by the following expression. (10 marks)

$$V_w = \frac{S.e.V}{1 + e}$$

- b) What is the best dimensions (flow depth y , cross sectional area A , and bottom width, b) for a rectangular brick channel designed to carry $5 \text{ m}^3/\text{s}$ of water in uniform flow with a slope of $S_o = 0.001$? Given that $A = 2y^2$, $R_h = 1/2y$ and $n = 0.015$. (15 marks)

- c) Suppose that SAE30 oil at 20°C with $\mu = 0.29 \text{ kg}/(\text{m}\cdot\text{s})$ is being sheared. Compute (5 marks) the shear stress in the oil if $v = 3 \text{ m/s}$ and $h = 2 \text{ cm}$; note that

$$\tau = \mu \frac{du}{dy}$$

QUESTION FOUR

(30marks)

a) A soil sample has a water content of 8%. $G_m = 1.9$ and $G = 2.66$.

- i) Find the void ratio of the sample. Assume $W_s = 100$ g. (15marks)
- ii) The degree of saturation, S. (5 marks)
- iii) The porosity, n (5 marks)
- iv) How much water (in kilograms) would have to be added to 1 m^3 of this soil in order to bring the water content to 13 %, assuming that the void ratio remains constant. (5 marks)