



**UNIVERSITY OF SWAZILAND
FINAL EXAMINATION PAPER**

**PROGRAMMES : BSC AGRICULTURAL AND BIOSYSTEMS
ENGINEERING YEAR III**

COURSE CODE : ABE 303

TITLE OF PAPER: SOIL AND FLUID MECHANICS

TIME ALLOWED : TWO (2) HOURS

**INSTRUCTIONS : ANSWER QUESTIONS ONE AND ANY TWO
OTHER QUESTIONS.**

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GRANTED BY THE CHIEF INVIGILATOR.**

FLUID AND SOIL MECHANICS
FINAL EXAMINATION

Question 1 : Compulsory

- (a) An Engineer is given a task of designing a sprinkler irrigation project and select a suitable pump to operate the project, what are the three key issues the engineer would need to consider in order to achieve this? Give as much information to support each point.

[15 marks]

- (b) Given an unlined trapezoidal channel with bed width of 3.0 m side slopes of 1.5:1;

- (ii) Calculate the flow depth for the best hydraulic section i.e.

$$Q = \frac{A^{5/3} S^{1/2}}{n P^{2/3}}$$

[7.5 marks]

- (ii) Owing to weed growth, the roughness coefficient, n, is increased from 0.03 in the winter to 0.05 in summer. For the same discharge, determine the flow depth in summer corresponding to a 1.2 m flow depth in winter. **[7.5 marks]**

- (c) Differentiate between the following terms uniform, steady, unsteady and Turbulent flow. **[10 marks]**

Question 2

A certain farm measuring 150 ha requires an irrigation system to be designed. The evapotranspiration (ET) for the area is 8.00 mm / day, and maximum crop factor (Kc) is 0.8. The area is divided into three blocks as follows; A = 60 ha, B = 55 ha and C = 35 ha.

- (a) Calculate the discharge required for each block given that the irrigation efficiency is 80%. **[10 marks]**

- (b) The distances from the pump station to the blocks are; A = 600 m, B = 450 m and C = 300 m and the friction factor (f) is 1 %, calculate;

- (i) The friction loss for each pipe length. **[10 marks]**

- (ii) Pipe sizes leading to each block given that velocity of flow must not exceed 1.5 m/s. **[10 marks]**

QUESTION 3

- (a) The average velocity in an unlined canal is 1.2m/s with a slope of 3%. Assuming no change in canal bed roughness (n) and in the hydraulic radius (A);
- (i) What is the velocity if the slope is reduced to 2%? [7.5 marks]
- (ii) What is the velocity if the roughness coefficient is reduced from 0.04 to 0.03? [7.5 marks]
- (b) What is pump characteristics curve? [5 marks]
- (c) Distinguish between pipes in series and pipes in parallel. [10 marks]

QUESTION 4

- (a) State Manning's formulas as used for pipes and open channel flow and state what each term mean. [10 marks]
- (b) 30 litres per second of water is pumped through 200 mm pipe over a distance of 300m. The friction factor for the pipe is 2%. The difference in height between the field and the pump statics is 80m. Calculate;
- (i) Total pumping head [10 marks]
- (ii) Power requirement if you use a directly coupled motor. [10 marks]