UNIVERSITY OF SWAZILAND

SUPPLEMENTARY EXAMINATION PAPER

PROGRAMMES: BSc. ABE 3, and BSc LWM 3 OLD (T)

COURSE CODE: ABE 303

TITLE OF PAPER: FLUID AND SOIL MECHANICS

TIME ALLOWED: TWO (2) HOURS

INSTRUCTIONS: ANSWER QUESTION ONE AND ANY TWO OTHER QUESTIONS

DO NOT OPEN THIS PAPER UNTIL PERMISSION HAS BEEN GRANTED BY THE CHIEF INVIGILATOR

QUESTION 1

a. At the end of a channel is a sharp edged rectangular weir with a width of 400mm and a coefficient of discharge of 0.65. The water is flowing at a depth 0.16m above the base of the weir.

i. Calculate the actual discharge from the rectangular weir. **[5marks]**

ii. If this weir is replaced by a 90° *V*-notch weir with the same coefficient of discharge, what will be the necessary upstream depth of water to achieve the same discharge as the rectangular weir? **[15marks]**

b. Define the following terms and outline their significance with regard to soil mechanics;

i. Shear strength **[10 marks]**

ii. Mohr-Coulomb failure criterion **[10 marks]**

QUESTION 2

a. Oil flows through a 25.0 *mm* diameter pipe with mean velocity of 0.3 m/s. Given that the viscosity $\mu = 4.8\times10^{-2}$ *kg/ms* and the density $\rho = 800.0$ *kg/m*^{3}, calculate:

i. The friction head loss and resultant pressure drop in a 45.0 *m* length of pipe, and; **[15 marks]**

ii. The maximum velocity and the velocity 5.0 *mm* from the pipe wall. **[15 marks]**

QUESTION 3

A laboratory test carried out on an undisturbed sample of soil weighing 1.74 *kg* and having a volume of 1/1000 *m*^{3} determined the specific gravity of the solids to be 2.6 and the dry density of the solids to be 1500.0 *kg/m*^{3}. Calculate;

i. The moisture content **[5 marks]**

ii. The void ratio and porosity **[10 marks]**

iii. The saturated and submerged densities **[10 marks]**

iv. The degree of saturation of the soil **[5 marks]**

QUESTION 4

a. Measurements carried out on the uniform flow of water in a long rectangular channel 3.0 m wide and with a bed slope of 0.001, revealed that at a depth of flow of 0.8 m the discharge of water was 3.6 m^3/s. Estimate the discharge of water using;

i. The Manning equation **[10 marks]**

ii. The Darcy equation **[10 marks]**

b. What do 'total strength parameters' and 'effective strength parameters' designate? **[5 marks]**

c. Define and outline the relevance of permeability in soil mechanics. **[5 marks]**

APPENDIX

$$h_L = K'\left(\mathrm{Re}^{e-2}\right)\left(\frac{L}{d}\right)\left(\frac{v^2}{2g}\right) = f\left(\frac{L}{d}\right)\left(\frac{v^2}{2g}\right)$$

$$t = \frac{A_1 A_2}{(A_1 + A_2)C_d A_o \sqrt{2g}}\left[\sqrt{h_{initial}} - \sqrt{h_{final}}\right]$$

$$Q_{actual} = C_d A_1 A_2 \sqrt{\frac{2g\left[\frac{p_1 - p_2}{\rho g} + z_1 - z_2\right]}{A_1^{\,2} - A_2^{\,2}}}$$

$$u_1 = \sqrt{\frac{2gh(\rho_{man} - \rho)}{\rho}}$$

$$Q_{actual} = C_d \frac{2}{3} B\sqrt{2gH^{3/2}}$$

$$\mathrm{Re} = \frac{vL\rho}{\mu}$$

$$T = c_V(\pi dh)\frac{d}{2} + c_H\left(\pi\frac{d^2}{4}\right)\frac{2}{3}$$

$$Q_{actual} = C_d \frac{8}{15}\sqrt{2g}\tan\left(\frac{\theta}{2}\right)H^{5/2}$$

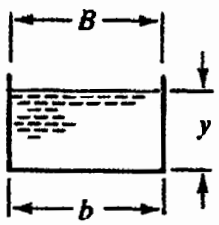
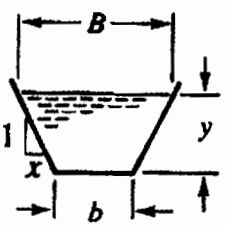
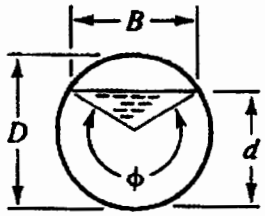
$$h_f = \frac{32\mu Lv}{\gamma d^2}$$

$$\mathrm{Re} = \frac{vR\rho}{\mu}$$

$$f = 64/\mathrm{Re}$$

$$v^2 = \frac{8gRS}{f}$$

$$Q_{actual} = C_d \frac{8}{15} B\sqrt{2g}\tan\left(\frac{\theta}{2}\right)H^{5/2}$$

	 Rectangle	 Trapezoid	 Circle
area, A	by	$(b+xy)y$	$\frac{1}{8}(\phi-\sin\phi)D^2$
wetted perimeter, P	$b+2y$	$b+2y\sqrt{1+x^2}$	$\frac{1}{2}\phi D$
top width, B	b	$b+2xy$	$\left(\sin\frac{\phi}{2}\right)D$
hydraulic radius, R	$\frac{by}{b+2y}$	$\frac{(b+xy)y}{b+2y\sqrt{1+x^2}}$	$\frac{1}{4}\left(1-\frac{\sin\phi}{\phi}\right)D$
hydraulic mean depth, D_m	y	$\frac{(b+xy)y}{b+2xy}$	$\frac{1}{8}\left(\frac{\phi-\sin\phi}{\sin(1/2\phi)}\right)D$