(*University of Choice*)

MASINDE MULIRO UNIVERSITY OF SCIENCE AND TECHNOLOGY (MMUST)

MAIN CAMPUS

UNIVERSITY SPECIAL/SUPPLEMENTARY EXAMINATIONS 2021/2022 ACADEMIC YEAR

SECOND YEAR SECOND SEMESTER EXAMINATIONS

FOR THE DEGREE OF BACHELOR OF SCIENCE IN CIVIL AND STRUCTURAL ENGINEERING

COURSE CODE: CSE 252/TEB 352

COURSE TITLE: FLUID MECHANICS II

DATE: 28TH JULY 2022 **TIME: 11 A.M – 1 P.M**

INSTRUCTIONS:

1. This paper consists of **SIX** questions.
2. Answer any **FOUR** questions
3. All symbols have their usual meaning unless otherwise stated
4. Time allowed is **TWO (2)** hours

MMUST observes ZERO tolerance to examination cheating

This Paper Consists of 4 Printed Pages. Please Turn Over.

Question ONE

a) There are different patterns of fluid flow, usually characterized by time and distance; explain (2 marks)

b) Using the law of conservation of energy to a control volume, show that the energy equation (Bernoulli's equation) is given by: (10 marks)

$$\frac{P_1}{\rho g} + \frac{v_1^2}{2g} + z_1 = \frac{P_2}{\rho g} + \frac{v_2^2}{2g} + z_2 = H = constant$$

c) A horizontal venturimeter with inlet and throat diameters of 30cm and 15cm respectively is used to measure the flow of water. The reading of differential manometer connected to inlet and the throat is 20cm of mercury. Determine the rate of flow. Take C_d as 0.98 (8 marks)

Question TWO

a) Using a sketch show that the continuity equation is given by:

$$A_1 v_1 = A_2 v_2$$

(3 marks)

b) Water flows through the pipe AB of diameter 1.2m at 3 m/s and then passes through the pipe BC of diameter 1.5m. At C, the pipe branches in CD and CE. Branch CD is 0.8m in diameter an carries a third of the flow in AB. The flow velocity in branch CE is 2.5 m/s (See Figure Q2 (b) below). Find:

i. the flow in AB (3 marks)
ii. the velocity in BC (3 marks)
iii. the velocity in CD (3 marks)
iv. diameter of CE (3 marks)

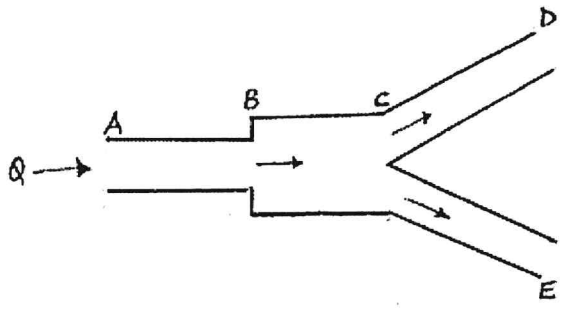

Figure Q2 (b)

c) Two tanks of 8m and 3m diameters respectively are connected by 300m long pipe of diameter 250mm. the level of water in bigger tank is 10m higher than that of small diameter. Determine the time taken to flow 1800 litres of water. Take f as 0.0075 (5 marks)

Question THREE

a) Show that the change in momentum of a flowing fluid is given by:

$$F - \rho Q(v_2 - v_1)$$

(3 marks)

b) A rectangular orifice 0.9m wide and 1.2m deep is discharging water from a vessel. The top of the orifice is 0.6m below the water surface in the vessel. Calculate the discharge through the orifice if C_d is 0.6 and the percentage error if the orifice is treated as a small orifice (7 marks)

c) A syphon of diameter 200mm connects two reservoirs having a difference in elevation of 20m. The length of the syphon is 500m and the summit is 3m above the water level in the upper reservoir. The length of pipe from upper reservoir to the summit is 100m (See Figure Q3 (c) below). Determine the discharge through the syphon and also the pressure at the summit. Neglect minor losses. Take f as 0.05 (10 marks)

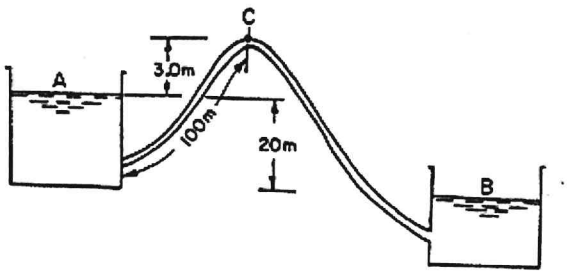

Figure Q3 (c)

Question FOUR

a) Show that the Darcy's loss in head due to friction is given by:

$$h_f \cong \frac{flQ^2}{3d^5}$$

(10 marks)

b) Water is being discharged from a reservoir through a pipe 4km long and 500mm diameter to another reservoir having water level at 12.5m below the first reservoir. It is required to feed a third reservoir whose water level is 15m below the first reservoir, through a pipe of 1.5km long and to be connected to the pipe at a distance of 1km from the entrance as shown in Figure Q4 (b) below. Find the diameter of the pipe connecting the third reservoir. Take f as 0.008 (10 marks)

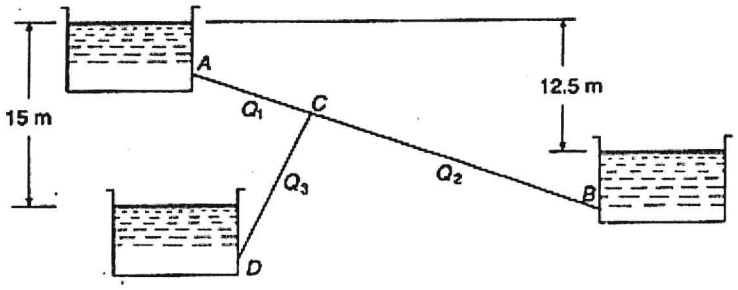

Figure Q4 (b)

Question FIVE

a) Show that the discharge over a rectangular weir is given by:

$$Q = \frac{2}{3} C_d * L\sqrt{2g}[H^{3/2}]$$

(6 marks)

b) A Cipolletti weir of crest length 60cm discharges water. The head of water over the weir is 360cm. Find the discharge (considering velocity of approach) over the weir if the channel is 80cm wide and 50cm deep. Take C_d as 0.60 (7 marks)

c) A pipe of diameter 300mm and length 3500m is used for transmission of power by water. The total head at inlet of the pipe is 500m. Find the maximum power available at the outlet of the pipe. Take f as 0.006 (7 marks)

Question SIX

a) State the following laws (3 marks)

i. The law of conservation of matter
ii. The law of conservation of energy
iii. The law of conservation of momentum

b) Show that the power transmitted through a pipe is maximum when the head lost due to friction is equal to a third of the total supply head, that is:

$$h_f = \frac{H}{3}$$

(10 marks)

c) Figure Q6 (c) shows a stepped notch. Find the discharge through the notch if C_d for all sections is 0.62. (7 marks)

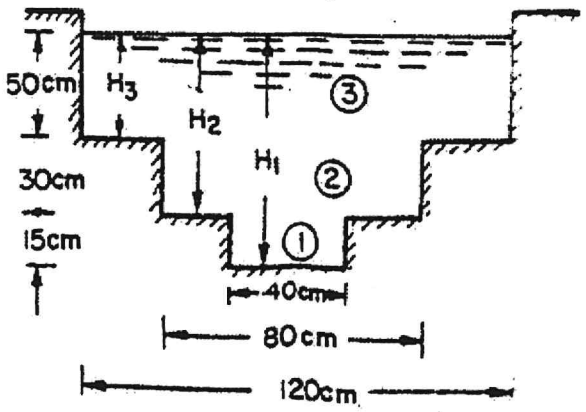

Figure Q6 (c)