00283

The Open University of Sri Lanka
Faculty of Engineering Technology
Department of Civil Engineering

Study Programme	: Bachelor of Technology Honours in Engineering
Name of the Examination	: Final Examination
Course Code and Title	**:CVX 3340 Introduction to Hydraulics & Hydrology**
Academic Year	: 2019/20
Date	: 30th September 2020
Time	: 0930-1230hrs
Duration	: **03 hours**

General Instructions

1. Read all instructions carefully before answering the questions.
2. This question paper consists of **FIVE (05)** questions on **THREE (03)** pages.
3. Answer **ALL FIVE (05)** questions. They carry different marks as indicated.
4. Answer for each question should commence from a new page.
5. Necessary additional information is provided.
6. This is a Closed Book Test (CBT).
7. Answers should be in clear hand writing.
8. Do not use Red colour pen.
9. Take,

   Density of water = 1000 kgm^{-3} Acceleration due to gravity = 9.81 ms^{-2}

   Kinematic viscosity of water = 1.04 x 10^{-06} m^2/s

Question 01

(a) State the Bernoulli's equation and identify each term.

(02 marks)

(b) List the four conditions under the Bernoulli's equation is valid.

(02 marks)

(c) A tank in a fish farm is emptied using a siphon as shown in Figure Q1. The siphon has a uniform circular pipe of 125 mm diameter and consists of a bent pipe with its crest 1.8 m above water level discharging into the atmosphere at a level 2.8 m below water level. The total loss of head due to friction is $1.08\left(v^2/2g\right)$, where v is the velocity of flow. If the total length of the siphon is 9.0 m,

(i) Find the velocity of flow, the discharge and

(ii) the absolute pressure at crest level if the atmospheric pressure is equivalent to 10.0 m of water.

(iii) Plot the energy grade line and the hydraulic grade line.

(16 marks)

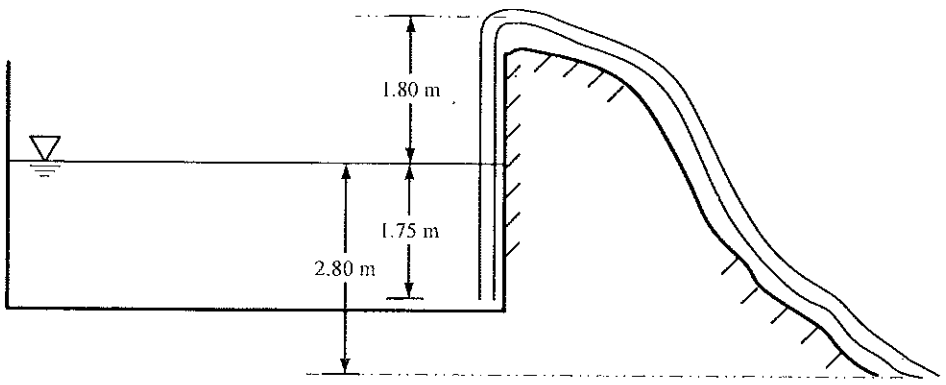

Figure Q1

Question 02

A sprinkler with unequal arms and jets of area 75 mm^2 facing in the same direction is shown in Figure Q2. A flow of 0.002 m^3/s enters the assembly normal to the rotating arm.

(a) Assuming the frictional torque to be 0.115 Nm, calculate the speed of rotation

(10 marks)

(b) What torque is required to hold it from rotating?

(05 marks)

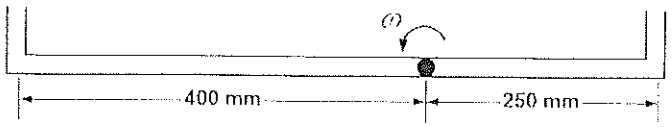

Figure Q2

Question 03

(a) What is a Newtonian fluid?

(03 marks)

(b) The vertical shaft of radius, a shown in the Figure Q3 rotates at an angular velocity, ω in a bearing of length, H. The thrust at the lower end of the shaft is transferred by a flat disc of radius, b to a flat housing. The space between the shaft and bearing and between disc and housing is filled with an oil of dynamic viscosity, μ. In each case the film thickness is $h(<<< a,b)$. Assuming that the velocity gradient is constant across the thickness of each oil film, show that the power absorbed in fluid friction is given by,

$$P = \frac{\pi\mu\omega^2}{2h}\left(4Ha^3 + b^4\right)$$

(12 marks)

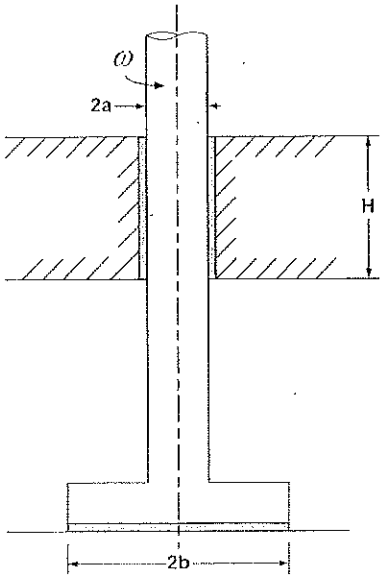

Figure Q3

Question 04

The coefficient of discharge, C_d of the submerged orifice shown in Figure Q4 is found to be equal to 0.63. The orifice diameter, d is 16 mm and the initial water levels above orifice level for tank 1 and 2 are 0.5 m and 0.14 m, respectively.

(a) What is the initial flow rate through the orifice?

(08 marks)

(b) If the cross-sectional areas of tank 1 and tank 2 are 0.08 m^2 and 0.04 m^2, respectively, determine the time taken to bring the water levels in two tanks to the same level.

(12 marks)

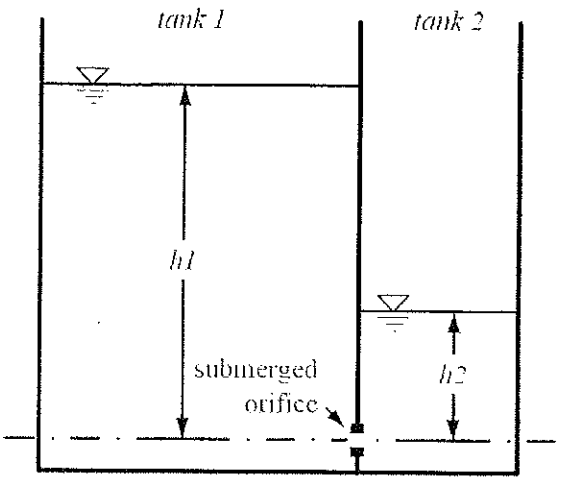

Figure Q4

Question 05

(a) Briefly describe three streamflow measurement techniques.

(06 marks)

(b) Give a detailed account of the different runoff mechanisms.

(09 marks)

(c) The following direct runoff values were obtained after deducting baseflow components of a storm hydrograph following a single storm.

(i) Obtain the Unit Hydrograph from the data provided and plot it. The catchment area is estimated to be 28.7 km^2.

Time (hr)	1	2	3	4	5	6	7	8	9	10	11	12
Rainfall (mm)	1	8	4	23	11	5	1					
Direct Runoff (m^3/s)				0	1.25	12.91	18.33	9.60	5.49	3.31	1.12	0

(ii) Obtain the direct runoff for the following storm (not necessary to plot).

Time (hr)	1	2	3
Rainfall (mm)	15	5	18

(15 marks)