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 3532/CEX3232 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 **SEVEN (07)** questions on **FOUR (04)** pages.
3. Answer **FOUR (04)** questions from **SECTION A** and **ONE (01)** question from **SECTION B**. All questions carry equal marks.
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

SECTION A

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)

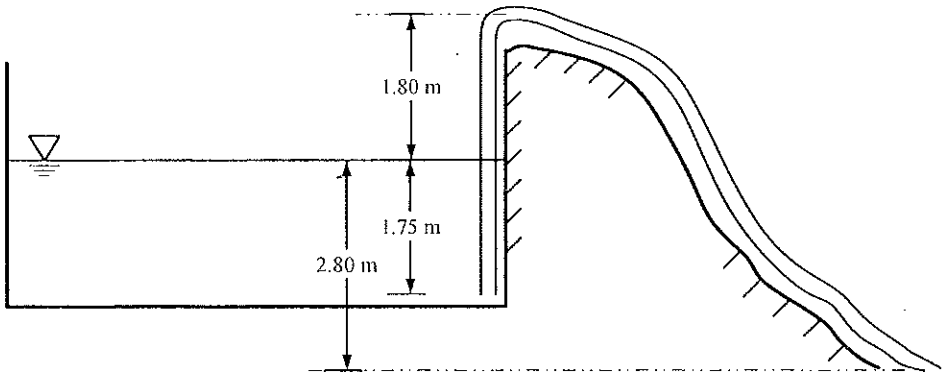

Figure Q1

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)

(c) If the jets are set in opposite directions, what would be the speed of rotation?

(05 marks)

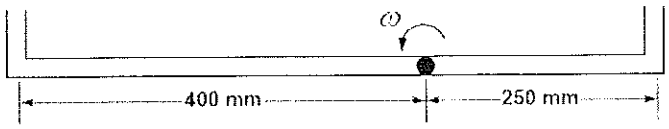

Figure Q2

Question 03

(a) Using a neat diagram, show that the actual discharge over a rectangular weir can be expressed by,

$$Q_a = \frac{2}{3}\sqrt{2g}C_d B H^{3/2}$$

where, C_d is the coefficient f discharge, B is the length of the weir and H is the head of water over the crest of the weir.

(09 marks)

(b) Explain how you would incorporate the velocity of approach in re-formulating the expression given for discharge over a rectangular weir in part (a).

(04 marks)

(c) Estimate the discharge over the stepped weir shown in Figure Q3. The coefficient of discharge, C_d for all section is 0.61.

(07 marks)

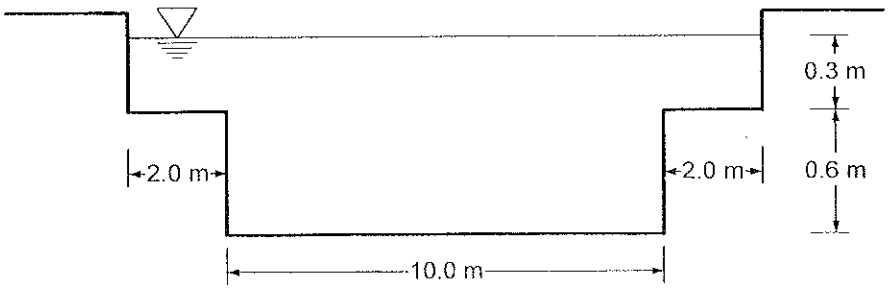

Figure Q3

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 0.50 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)

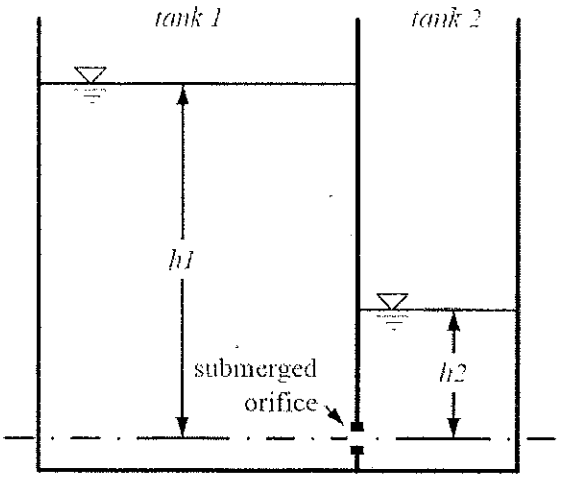

Figure Q4

Question 05

Using head balancing method, demonstrate how you could compute the flow rates in the simple pipe network shown in Figure Q5. Pipe lengths (l), diameters (d) are provided in the table. Assume a friction factor, f of 0.01 for all pipes. Perform up to two iterations.

(20 marks)

Pipe	Length, l	Diameter, d
AB	100.0 m	150 mm
AC	60.0 m	150 mm
BD	60.0 m	125 mm
CD	100.0 m	125 mm

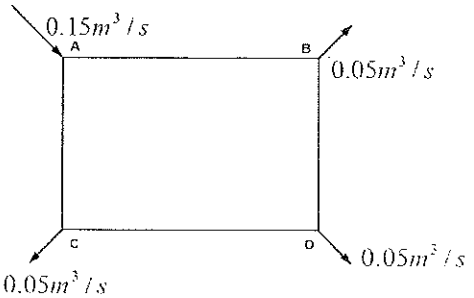

Figure Q5

Additional Information:

Friction head loss along a pipe, $h_f = f\frac{l}{d}\frac{v^2}{2g}$

Flow correction for head balancing method is given by,

$$\Delta Q = \frac{\sum h_f}{2\sum(h_f/Q)}$$

SECTION B

Question 06

(a) Briefly describe three streamflow measurement techniques.

(06 marks)

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

(09 marks)

(c) Explain using a neat diagram what a flood hydrograph is.

(05 marks)

Question 07

(a) State the Manning's equation and define all the variables associated with it.

(05 marks)

(b) Describe briefly, using a neat diagram, how the Manning's coefficient can be estimated in the laboratory.

(06 marks)

(c) Determine the diameter of a circular sewer pipe which is laid at a slope of 1:2000 and carries a discharge of 0.56 m^3/s, when flowing half full. Assume Manning's coefficient of the pipe material to be equal to 0.018.

(09 marks)