

Section B only



FACULTY OF FISHERIES AND MARINE SCIENCES & TECHNOLOGY

**Bachelor of Science Honors in Fisheries and Marine Sciences Degree/
Bachelor of Science Honors in Marine and Freshwater Sciences Degree**

Level III, Semester-I Examination -2023/2024

LIM 3112: Hydraulics

Time: 1 hour and 30 minutes

Answer **All** questions in **Section A** and **any Two (2)** out of three questions in **Section B**.

Gravitational Acceleration (g) = 9.81 ms^{-2} , Density of Water (ρ) = 1000 kg/m^3

Section A

Answer all questions in Section A. You may use suitable diagrams where relevant. (Total 40 Marks)

Section B

Question 01

(Total 30 marks)

- A) A smooth concrete-lined channel has trapezoidal cross-section (Figure 1) with base width 6 m and sides of slope 1V:2H. The bed slope is 1 in 500 ($s = 0.002$) and the Manning's n value is $0.012 \text{ m}^{-1/3} \text{ s}$.

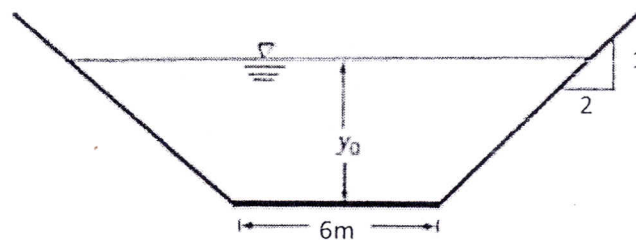


Figure 1

- (i) State the Manning's equation and define all the terms. (04 marks)
- (ii) Find the discharge when the normal depth is 2.0 m. (06 marks)
- B) A rectangular Channel has a width of 3.0 m and carries a discharge of $12.0 \text{ m}^3/\text{s}$ at a depth of 2.0 m.
 - (i) Calculate the Froude number and state the flow condition of the Channel. (04 marks)
 - (ii) It is proposed to reduce the width of the channel at a hydraulic structure. Assume the transition to be horizontal and the flow to be frictionless.
 - a) Draw the Flow Change profile along the Channel. (03 marks)
 - b) Find the minimum width of the channel that can facilitate the flow without changing the upstream water height (06 marks)
 - c) Consider that the width of the channel is reduced to 2.20 m at the hydraulic structure. Determine the upstream depth and downstream depth. (07 marks)

Question 02

(Total 30 marks)

- A) State the Darcy-Weisbach equation and define all the terms. (06 marks)
- B) In a pipe system, two sections of the pipeline are made of different materials with different roughness values. Explain how the roughness affects the friction factor and the total head loss in the system. (08 marks)
- C) A 30 m long pipeline is used to connect two tanks which have a water level difference of 12 m. The first 10 m of the pipeline from the upper tank is of 40 mm diameter and the next 20 m is of 60 mm diameter (Figure 2). The entrance to the pipe and exit from the pipe are sharp and the change of section at B is sudden. The Friction factor λ is 0.0216 for both pipes. Considering all the major and minor losses, calculate the volume flow rate through the pipe. (16 marks)

(Hint: Entrance loss at A is $0.5v_1^2/2g$, Loss due to sudden expansion at B is $(v_1 - v_2)^2/2g$ and Exit loss at C is $v_2^2/2g$)

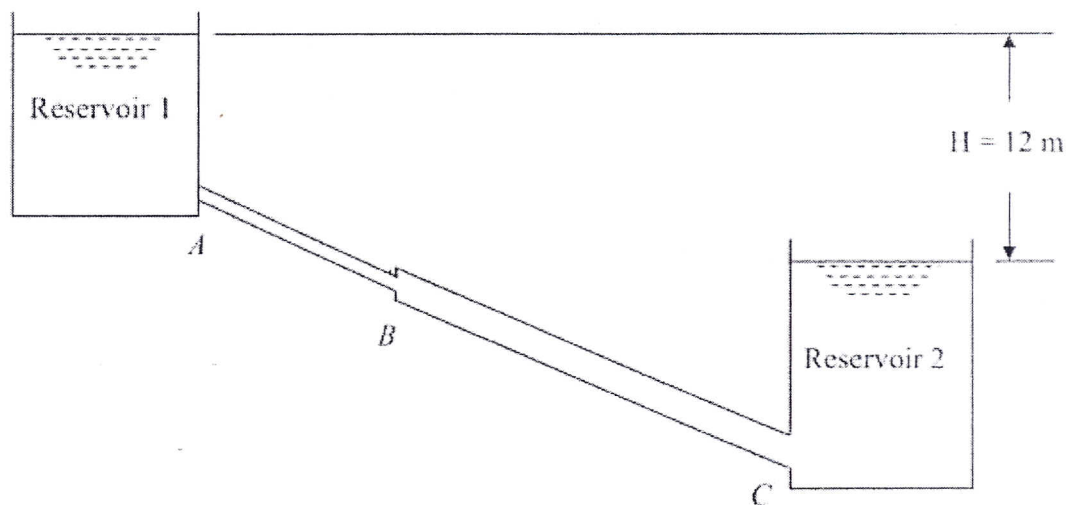


Figure 2

Question 03

(Total 30 marks)

- A) Describe absolute pressure, gauge pressure, atmospheric pressure, and explain the relationship among them. (06 marks)
- B) Explain Pascal's principle and its applications in hydraulic systems. (05 marks)
- C) A vertical rectangular gate of 4 m x 2 m is hinged at a point 0.25 m below the center of gravity of the gate. The free surface of water in the reservoir is 7 m above the ground surface (Figure 3). The density of water is 1000 kg/m³. The second moment of area for a rectangular plane is given by $I_g = \frac{BD^3}{12}$.

Assuming that the hinges are frictionless, determine the following quantities:

- (i) The force acting on the gate due to the pressure of water. (06 marks)
- (ii) The center of pressure from the surface of water. (07 marks)
- (iii) The horizontal force must be applied at the bottom of the gate to keep it closed. (06 marks)

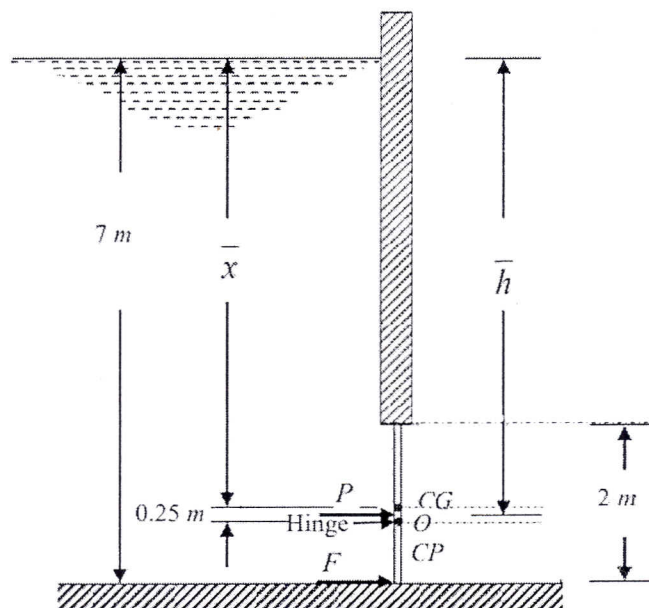


Figure 3

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