leaves with patches

Day 3	Day 4	Day 5
0	0	0
04	04	05
05	06	12
04	05	14
03	04	06
02	03	05

on.

9
3.66
4.12
4.45
4.72
4.97
5.23
5.50
5.81
6.23
7.33
0.9
8.09

s, 35

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 -2022/2023

LIM 3112: Hydraulics **Time: 1 hour and 30 minutes**

Section B

Question 01 **(Total 30 marks)**

A team of trainees with Marine and Freshwater Science students is tasked with providing recommendations for improving the hydraulic efficiency of an existing irrigation system that supplies water to crop areas downstream through an interconnected network of channels. In the upstream section, water from the main reservoir is discharged through a sluice gate into a 3.5 m wide horizontal rectangular distributary channel. The discharge rate is 35.0 m^3/s. A hydraulic jump is formed at a downstream point along the channel where the initial water depth is 1.3 m.

The relationship between the flow depths of a hydraulic jump is given by (with usual notation):

$$y_2 = \frac{y_1}{2}\{-1 + \sqrt{1 + 8\frac{q^2}{g y_1^3}}\}$$

For rectangular channel, the momentum equation can be written as,

$$F_1 - F_2 = \rho Q\,(V_2 - V_1)$$

(i) Define a hydraulic jump and outline three practical applications.

(05 marks)

(ii) Show that the energy dissipation due to the jump is given by:

$$\Delta E = (E_1\text{-}E_2) = \frac{(y_2-y_1)^3}{4y_1y_2}$$

(Hint: Use energy equation and the momentum equation) (10 marks)

(iii) In order to identify the type and extent of scour protection in the downstream, the following information are required for the channel flow through the above sluice gate.

Accordingly, determine the:

a) Flow depth after the jump

b) Velocity after the jump

c) Froude number after the jump

d) Energy dissipated in the jump

e) Percentage of energy dissipated

(15 marks)

Question 02 **(Total 30 marks)**

A) What are laminar flow and turbulent flow, and how do they differ in terms of fluid motion patterns?

(05 marks)

B) Water flows steadily through a steel pipe with a diameter, d = 40 mm, a roughness factor, $k = 0.045\times10^{-3}$ m, and a dynamic viscosity, $\mu = 0.001$ Ns/m^2 at a rate of 1 L/s (0.001 m^3/s).

1) Utilizing the Moody chart, determine:

a) The friction factor. (07 marks)

b) The head loss due to friction per meter length of the pipe. (05 marks)

C) A pipe transmits water from a tank A to point C that is lower than water level in the tank by 4 m. The pipe is 100 mm diameter and 15 m long. The highest point on the pipe B is 1.5 m above water level in the tank and 5 m long from the tank. The friction factor (λ) is 0.32, with sharp inlet and outlet to the pipe. Minor losses are ignored.

a) Determine the velocity of water leaving the pipe at C. (07 marks)

b) Calculate the pressure in the pipe at the point B. (06 marks)

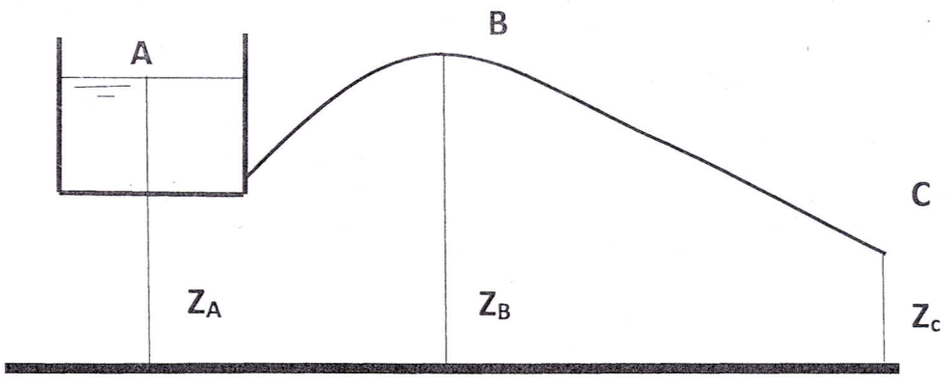


Figure 1

Question 03 **(Total 30 marks)**

A) Describe gauge pressure and absolute pressure. (05 marks)

B) Prove that total pressure force acting on the plane is equal to $\rho g A \bar{h}$. (use Figure 02) (06 marks)

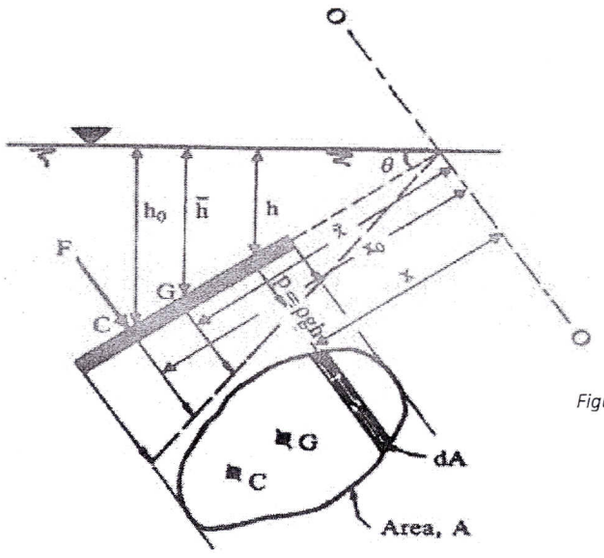


Figure 2

the tank by 4 m.
5 m above water
1 sharp inlet and

(07 marks)
(06 marks)

C

Z_c

30 marks)

(05 marks)
(06 marks)

C) A culvert in the side of a reservoir is closed by a vertical rectangular gate 2.0 m wide and 1.0 m deep as shown in the Figure. The gate is hinged about a horizontal axis which passes through the center of the gate. The free surface of water in the reservoir is 2.5 m above the axis of the hinge. The density of water is 1000 kg/m^3.

Assuming that the hinges are frictionless and that the culvert is open to atmosphere, determine the followings:

(i) The force acting on the gate when it is closed due to the pressure of water. (06 marks)

(ii) The center of pressure from the surface of water. (07 marks)

(iii) The moment to be applied about the hinge axis to open the gate. (06 marks)

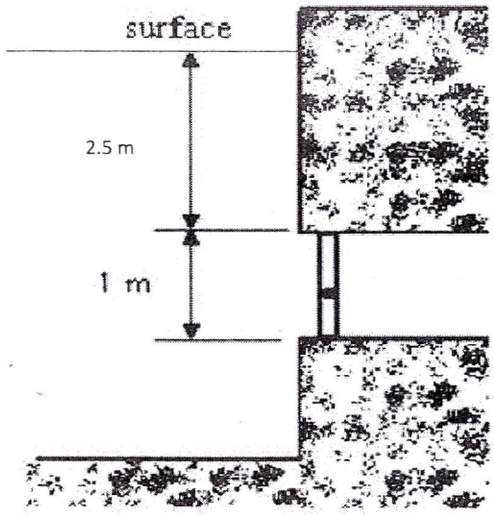
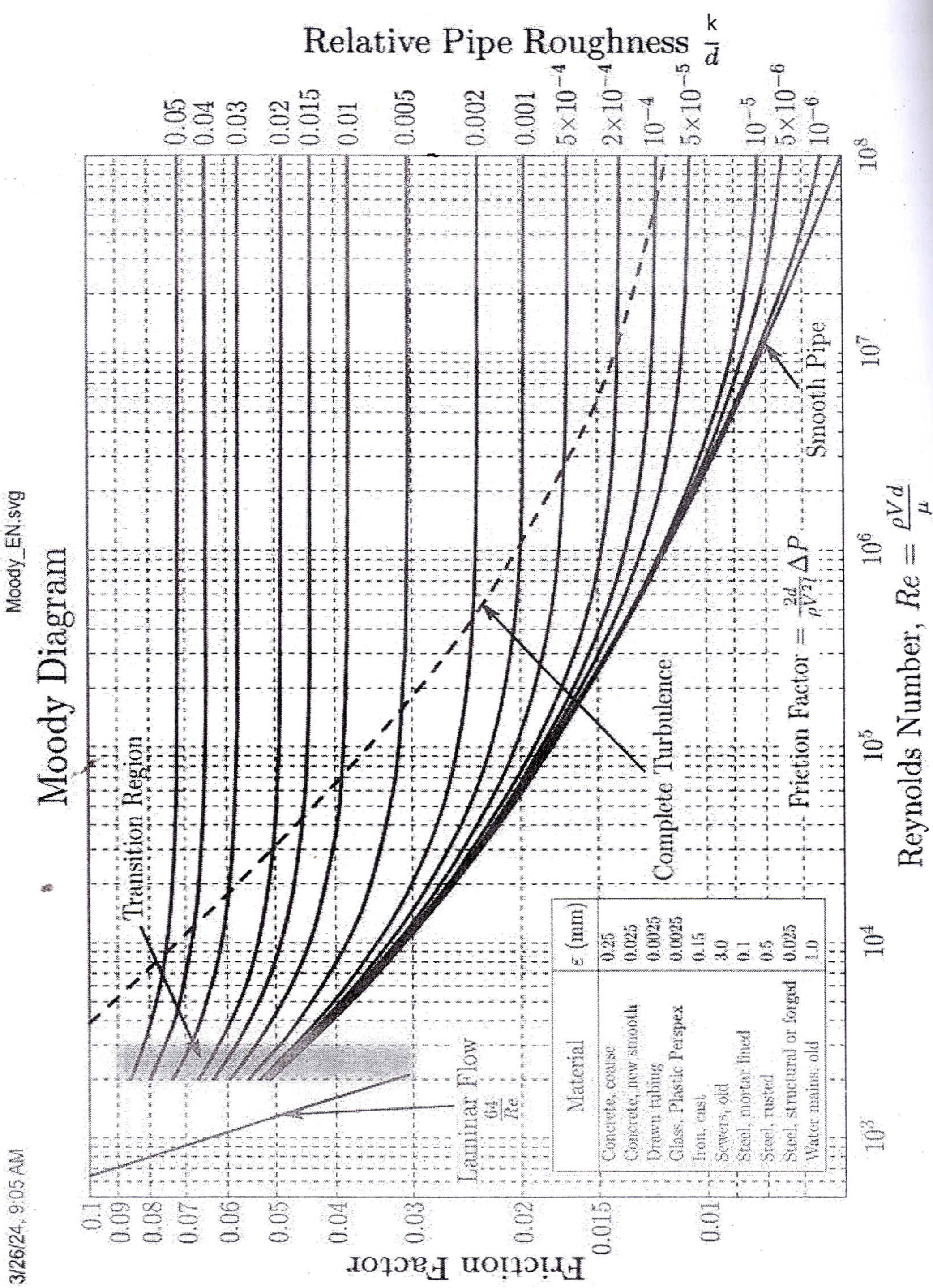


Figure 3



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