INTI International University & Colleges

FINAL
Examination Paper

(COVER PAGE)

Session	:	**April 2019**
Programme	:	Diploma In Mechanical Engineering (DMEN)
Course	:	**EGR2180 : Fluid Mechanics 2**
Date of Examination	:	August 2, 2019 (Friday)
Time	:	5:00 pm – 7:00 pm Reading Time: Nil
Duration	:	2 Hours
Special Instructions	:	

This paper consists of **SIX (6)** questions. Answer any **FOUR (4)** questions in the answer booklet provided. All questions carry equal marks.

Materials permitted :

Non-Programmable Calculator

Materials provided :

Nil

Examiner (s)	:	**Teow Hsien Loong** and Dr Aaron Edward Teo
Moderator	:	Dr Fauziah Jerai Junaidi

*This paper consists of **6** printed pages, including the cover page.*

DIPLOMA IN MECHANICAL ENGINEERING PROGRAMME (DMEN)
EGR2180: FLUID MECHANICS 2
FINAL EXAMINATION: APRIL 2019 SESSION

Instructions: This paper consists of **SIX (6)** questions. Answer any **FOUR (4)** questions in the answer booklet provided. All questions carry equal marks.

Question 1

(a) A 3-m-diameter tank is initially filled with water 2 m above the center of a sharp-edged 10-cm-diameter orifice. The tank water surface is open to the atmosphere and drains to the atmosphere through a 100-m-long pipe. In order to drain the tank faster, a pump is installed near the tank exit as shown in Figure 1. Taking the friction coefficient of the pipe as 0.015, the loss coefficient of sharp edge entrance as 0.5 and the density of water as 996 kg/m^3. Neglect minor losses.

(i) Determine how much pump power input is necessary to establish an average water velocity of 4 m/s when the tank is full at z = 2 m.

(12 marks)

(ii) Also, assuming the discharge velocity to remain constant, estimate the time required to drain the tank.

(5 marks)

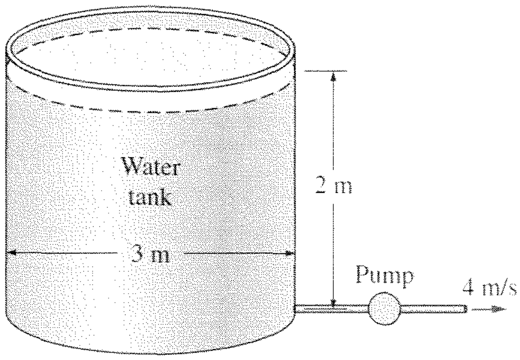

Figure Q1

(b) Calculate the loss of head due to friction and the minimum power required to maintain flow in a horizontal circular pipe of 40 mm diameter and 750 m long when water flows at a rate 30 litres/min. Take the friction factor *f* as 0.032.

(8 marks)

Question 2

(a) Water flows out through the 65mm diameter pipe with a velocity of 2 m/s. Calculate the total head loss of the simple piping shown in Figure 2. The friction factor of the pipe is 0.029. Loss coefficient of elbow and the gate valve is 0.9 and 10 respectively.

(6 marks)

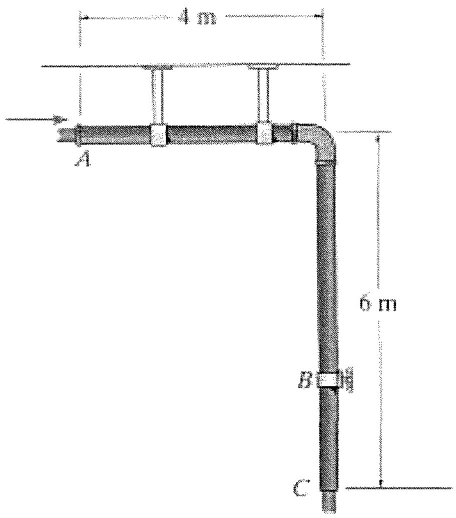

Figure Q2 (a)

(b) Briefly explain the cause of water hammer. State one (1) way to reduce the effect of water hammer.

(6 marks)

(c) Gasoline (SG=0.79) flows through a 30cm diameter pipe at a rate of 175 L/s. The pipe is 500m long and a gate valve is fitted at the end of the pipe. Neglecting the elasticity of pipe and assume sonic velocity, c as 1250 m/s. Determine the pressure rise due to water hammer effect if the valve is closed in :

(i) 0.6 second

(8 marks)

(ii) 6 seconds

(5 marks)

Question 3

(a) Water flows through a 20cm diameter 800m long steel pipe at a rate of 3000 L/min. The thickness of the pipe is 6mm. Taking bulk modulus of water as 2 GPa and the modulus of steel as 206 GPa. Determine the rise in pressure when a valve at the end of the pipe is closed instantaneously.

(10 marks)

(b) A jet plane flies at M = 2.3 when it is at an altitude of 18 km. Determine the time for someone on the ground to hear the sound of the plane just after the plane passes overhead. Take c = 295 m/s. Please include the sketch/drawing of this problem to help you solve it.

(9 marks)

(c) A gas initially at a subsonic velocity enters an adiabatic converging duct. Discuss how this affects

(i) the velocity

(ii) the temperature

(iii) the pressure

(6 marks)

Question 4

(a) Air at 200 kPa, 100°C, and Mach number M = 0.8 flows through a duct. Taking R = 287 Pa.m^3/kg.K and k = 1.4. Calculate the air's :

(i) velocity

(ii) stagnation pressure

(iii) stagnation temperature

(iv) stagnation density.

(16 marks)

(b) Water is flowing uniformly in a wide rectangular channel at an average velocity of 2 m/s. The density of water is 998 kg.m^3 and the dynamic viscosity is 1.002 x 10^{-3} kg/ms. If the water depth is 0.2 m, determine whether :

(i) the flow is laminar or turbulent

(ii) the flow is subcritical or supercritical.

(9 marks)

Question 5

(a) Given the average flow velocity and the flow depth, explain how you would determine if the flow in open channels is subcritical, critical, or supercritical.

(5 marks)

(b) Water is flowing in a 90° V-shaped cast iron channel with a bottom slope of 0.002 at a rate of 3 m^3/s. Determine if the slope of this channel should be classified as mild, critical, or steep for this flow. Use Manning coefficient of 0.013.

(16 marks)

(c) Briefly explain the difference between centrifugal-flow pump and axial-flow pump.

(4 marks)

Question 6

(a) A Pelton wheel is used to produce hydroelectric power. The average radius of the wheel is 1.83 m, and the jet velocity is 102 m/s from a nozzle of exit diameter equal to 10.0 cm. The turning angle of the buckets is $\beta = 165°$. Take water density as 998 kg/m^3.

(i) Calculate the volume flow rate through the turbine in m^3/s.

(4 marks)

(ii) What is the optimum rotation rate (in rpm) of the wheel (for maximum power)?

(5 marks)

(iii) Calculate the output shaft power in MW if the efficiency of the turbine is 82 percent.

(6 marks)

(b) A centrifugal pump rotates at n = 750 rpm. Water enters the impeller normal to the blades ($\alpha 1 = 0°$) and exits at an angle of 35° from radial ($\alpha 2 = 35°$). The inlet radius is r1 = 12.0 cm, at which the blade width b1 = 18.0 cm. The outlet radius is r2 = 24.0 cm, at which the blade width b2 = 14.0 cm. The volume flow rate is 0.573 m^3/s. Taking water density as 998 kg/m^3 and assuming 100 percent efficiency, calculate

(i) the net head produced by this pump in cm of water column height.

(7 marks)

(ii) the required brake horsepower in W.

(3 marks)

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