FINAL
ALTERNATIVE ASSESSMENT

(COVER PAGE)

Session	:	**August 2020**
Programme	:	Diploma in Mechanical Engineering (DMEN)
Course	:	**EGR2180: Fluid Mechanics 2**
Date of Examination	:	18 December 2020 (Friday)
Time	:	8.00am – 10.15am Reading Time : Nil
Duration	:	2 Hours 15 Minutes

Special Instructions :

This paper consists of **FOUR (4)** questions. Answer all **FOUR (4)** questions. All questions carry equal marks.

Material permitted :

Non-Programmable Scientific Calculator

Materials provided :

Nil

Examiner(s)	:	**Nur Hafizah Habideen**
Chief Moderator	:	Dr Aaron Edward Teo

*This paper consists of **4** printed pages, including the cover page*

DIPLOMA IN MECHANICAL ENGINEERING PROGRAMME (DMEN)
EGR2180: FLUID MECHANICS 2
FINAL ALTERNATIVE ASSESSMENT: AUGUST 2020 SESSION

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Question 1

(a) Figure Q1a shows a 3 m diameter tank that is initially filled with water. The water surface level is 2 m above the center of a sharp-edged 10 cm diameter orifice. The water surface is open to the atmosphere, and the orifice drains the water to the atmosphere through a 100 m long pipe. The friction coefficient of the pipe is 0.015. In order to drain the tank faster, a pump is installed near the tank exit. Assuming the discharge velocity to remain constant, compute:

(i) the pump power input needed to establish an average water velocity of 4 m/s when the tank is full,

(9 marks)

(ii) the time required to drain the tank.

(6 marks)

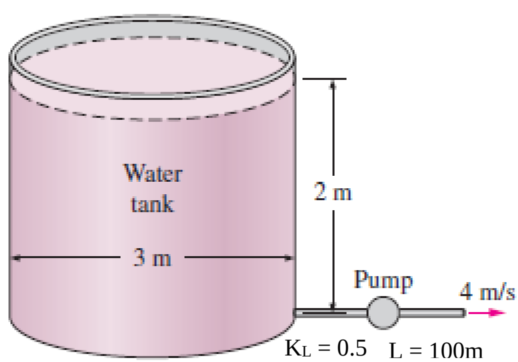

Figure Q1a

(b) A 900 mm diameter steel pipe carries water at the rate of 1.5 m^3/s. The pipe wall has a thickness of 1 cm. The elastic modulus of steel is 2×10^{11} N/m^2 and the bulk modulus of water is 2.1×10^9 N/m^2. Compute the increase in pressure if the valve at the end of 3.5 km long pipe line is closed in 3.5 seconds.

(10 marks)

Question 2

(a) Carbon dioxide enters an adiabatic nozzle at 1200 K with a velocity of 50 m/s and leaves at 400 K. Assuming constant specific heats at room temperature, compute the Mach number at the inlet and exit of the nozzle.

Take R = 0.1889 kJ/kg·K, c_p = 0.8439 kJ/kg·K and k = 1.288.

(12 marks)

(b) The absolute pressure within the entrance to the pipe is 98 kPa. The outside air is at rest, at a temperature of 20°C and atmospheric pressure of 101.3 kPa. The pipe has a diameter of 50 mm. Compute the mass flow rate into the pipe once the valve is opened.

Take density of air is 1.202 kg/m^3, k = 1.4 and R = 0.287 kJ/kg·K.

(13 marks)

Question 3

(a) Water flows half-full through a hexagon channel which has a bottom width of 2 m, at a rate of 45 m^3/s. Compute:

(i) the average velocity,

(4 marks)

(ii) the condition of the flow.

(6 marks)

(b) During a hydraulic jump in a wide channel, the flow depth increases from 0.6 to 3 m. Compute:

(i) the velocities,

(4 marks)

(ii) Froude numbers before and after the jump,

(5 marks)

(iii) the energy dissipation ratio.

(6 marks)

Question 4

(a) The blades on an impeller of the axial-flow water pump in Figure Q4a rotate at 1000 rev/min. If the pump is required to produce a flow of 0.2 m^3/s, compute the required initial blade angle β_1 so that the pump runs efficiently. Also, if β_2 = 70°, compute the average torque that must be applied to the shaft of the impeller and the average power output of the pump. The average open cross-sectional area through the impellers is 0.03 m^2.

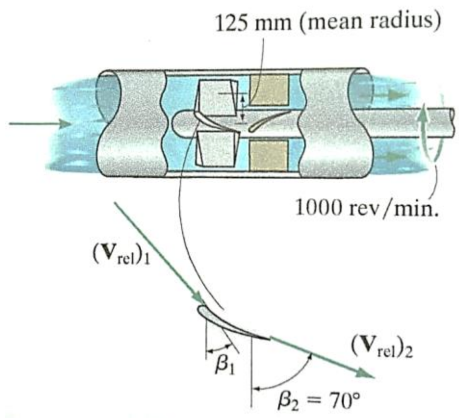

Figure Q4a

(14 marks)

(b) The guide vanes of a Francis turbine in Figure Q4b direct water onto the 200 mm wide runner blades at an angle of α_1 = 30° . The blades are rotating at 60 rev/min, and discharge water at 4m^3/s in the radial direction toward the center of the turbine, α_2 = 90°. Compute the power developed by the turbine and the ideal head loss.

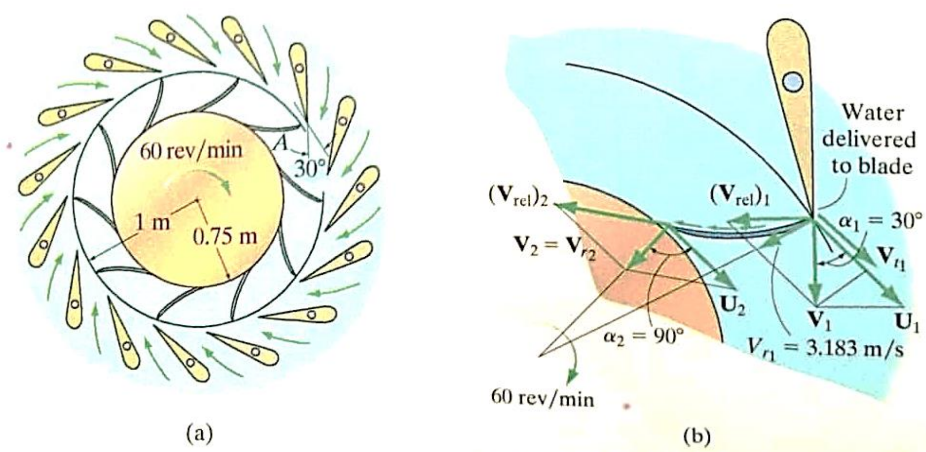

Figure Q4b

(11 marks)

~THE END~