POLITEKNIK
Jabatan Pengajian Politeknik

EXAMINATION AND EVALUATION DIVISION
DEPARTMENT OF POLYTECHNIC EDUCATION

(MINISTRY OF HIGHER EDUCATION)

MECHANICAL ENGINEERING DEPARTMENT

FINAL EXAMINATION

JUNE 2012 SESSION

JJ309: FLUID MECHANICS

DATE: 21 NOVEMBER 2012(WEDNESDAY)
DURATION: 2 HOURS (2.30 PM - 4.30 PM)

This paper consists of **SEVEN (7)** pages including the front page.

Structured (6 questions – answer 4)

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(The CLO stated is for reference only)

ESSAY (100 marks)

INSTRUCTION:
This paper consists of **SIX (6)** questions. Answer **FOUR (4)** questions only.

QUESTION 1

a) State the existing properties in a fluid. [CLO 1 : C1]
(5 marks)

b) The volume of a stone is 1.5 x10^{-4} m^3. If the relative density of the stone is 2.6, calculate: [CLO 2 : C3]
   i. The density
   ii. The specific weight
   iii. The specific volume
   iv. The weight
   v. The mass

(10 marks)

c) Given the volume of oil is 3 liter and the weight is 20N, determine the specific volume, relative density and specific weight of the oil. [CLO 2 : C3]
(10 marks)

QUESTION 2

a) A force, F_1 of 500 N is applied to a small cylinder of a hydraulic jack. The area, A_1 of a small piston is 20 cm^2 while the area, A_2 of a larger piston is 200 cm^2. Calculate the mass that can be lifted by the large piston.

[CLO 2 : C3]
(6 marks)

b) A multiple U-tube manometer is fitted to a pipe with a centre at A as shown in Figure 2(b). Determine the pressure at A.

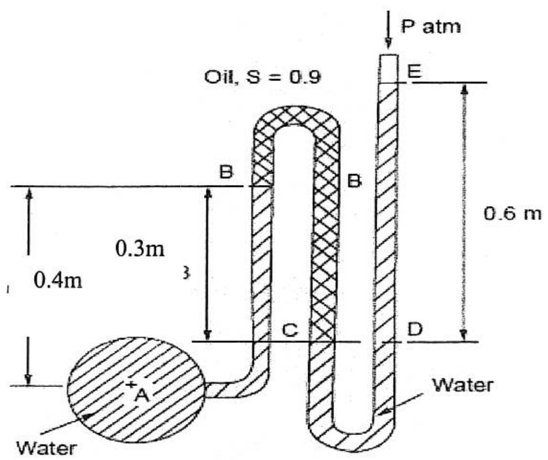

Figure 2(b)

[CLO 2 : C3]
(19 marks)

QUESTION 3

a) State **FIVE (5)** assumptions of fluid flow. [CLO 1 : C1]
(5 marks)

b) Explain the flow equation. [CLO 1 : C2]
(5 marks)

c) The raw oil flows through a pipe with a diameter of 40mm and entered a pipe with a diameter of 25mm. The volume flow rate is 3.75liter/s. Calculate the flow velocity of both pipes and the density of raw oil if the mass flow rate is 3.23 kg/s.

[CLO 2 : C3]
(15 marks)

QUESTION 4

a) State **FIVE (5)** minor losses of energy in pipe system. [CLO 1 : C1]
(5 marks)

b) Two huge open tanks are connected with 2 types of pipe by series. The specification is shown in Table 1. The total pressure drop, $P_A - P_B = 1.5$ kPa, and the elevation drop, $Z_A - Z_B = 5$ m . Calculate the discharge.

Pipe	Length	Diameter	Friction (f)
1	100 m	250 mm	0.01
2	200 m	400 mm	0.05

Table 1

[CLO 2 : C3]
(20 marks)

QUESTION 5

a) Define

i. Laminar flow

ii. Turbulent flow

[CLO 1 : C1]
(6 marks)

b) Oil flows through a pipe A with a diameter of 20 mm. This pipe is splited into two pipes: pipe B with a diameter of 10 mm and velocity of 0.3 m/s; and pipe C with a diameter of 15 mm and velocity of 0.6 m/s. Determine the velocity in pipe A.

[CLO 2 : C3]
(7 marks)

c) An inclined venturi meter with an inlet diameter of 4 cm and a throat diameter of 2 cm is used to measure the flow of oil with specific gravity of 0.83. A differential mercury manometer (specific gravity 13.6) is connected to the inlet and throat. The discharge of oil at the inlet is $0.017 m^3/s$ and the pressure difference is $2.5 kN/m^2$. Calculate:

i. the difference of height between the inlet and throat section

ii. the difference of the mercury level in the manometer

Neglect all energy losses.

[CLO 2 : C3]
(12 marks)

QUESTION 6

a) State and sketch TWO (2) types of nozzles.

[CLO 1 : C1]
(5 marks)

b) List **FIVE (5)** application of nozzles in engineering field.

[CLO 1 : C1]
(5 marks)

c) Air at 8.6 *bar* and 190 ℃ expands through a convergent divergent nozzle into a space at 1.03 *bar*. Assuming that the inlet velocity is negligible, calculate:

i. mass flow rate if the diameter at the throat is 60mm

ii. The exit cross-sectional areas of the nozzle if the mass flow rate is 4.5 kg/s.

[CLO 2 : C3]
(15 marks)

POLITEKNIK KEMENTERIAN PENGAJIAN TINGGI MALAYSIA
JABATAN KEJURUTERAAN MEKANIKAL
LIST OF FORMULAS
JJ309 FLUID MECHANICS

FLUID DYNAMICS

$$z_1 + \frac{P_1}{\omega} + \frac{v_1^2}{2g} = z_2 + \frac{P_2}{\omega} + \frac{v_2^2}{2g}$$

$$Q_{Actual} = C_d \left(Q_{Thoery}\right)$$

$$Q_{Thoery} = A_1 \sqrt{\frac{2gH}{(m^2 - 1)}}$$

$$H = \frac{P_1 - P_2}{\omega_{sub}} + (z_1 - z_2) = x \left[\frac{\omega_{Hg}}{\omega_{sub}} - 1\right]$$

ENERGY LOSSES IN PIPELINE

$$h_L = \frac{(v_1 - v_2)^2}{2g}$$

$$h_c = \left[\frac{1}{C_c} - 1\right]^2 x \frac{v^2}{2g}$$

$$h_f = \frac{4fL}{d}\frac{v^2}{2g}$$

$$h_i = \frac{1}{2}\left[\frac{v^2}{2g}\right]$$

$$h_o = \frac{v^2}{2g}$$

NOZZLE

$$\frac{P_c}{P_1} = \left[\frac{2}{\gamma + 1}\right]^{\frac{\gamma}{\gamma - 1}}$$

$$\frac{T_c}{T_1} = \frac{2}{\gamma + 1}$$

$$\frac{T_1}{T_2} = \left[\frac{P_1}{P_2}\right]^{\frac{\gamma - 1}{\gamma}}$$

$$V_c = \frac{RT_c}{P_c}$$

$$A_c = \frac{\dot{m}V_c}{C_c}$$

$$C_c = 44.72\sqrt{C_p(T_1 - T_c)}$$