Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2018/2019

COURSE NAME	:	FLUID MECHANICS II
COURSE CODE	:	BDA 30203
PROGRAMME	:	BDD
EXAMINATION DATE	:	DECEMBER 2018/JANUARY 2019
DURATION	:	3 HOURS
INSTRUCTION	:	1. PART A : ANSWER **THREE** (3) FROM **FOUR** (4) QUESTIONS. 2. PART B : ANSWER **ALL** QUESTIONS.

THIS QUESTION PAPER CONSISTS OF **EIGHT** (**8**) PAGES

PART A : ANSWER **THREE** (3) FROM **FOUR** (4) QUESTIONS

Q1 (a) Describe briefly the different between pipe flow and open channel flow.

(5 marks)

(b) A liquid with density and dynamic viscosity of 998 kg/m^3, 5 x 10^{-3} N.s/m^2 respectively flows through a horizontal pipe of diameter 3.0 mm under a pressure gradient of 1800 N/m^3. Assuming the flow is laminar flow, determine:

(i) volume flowrate;

(ii) average velocity;

(iii) centerline velocity; and

(iv) the radial position at which the velocity is equal to average velocity.

(15 marks)

Q2 (a) Describe briefly the different between major and minor losses.

(5 marks)

(b) Underground water with density of 1000 kg/m^3 is to be pumped by a 70% efficient 5 kW submerged pump to a pool whose free surface is 30 m above the underground water level as shown in **Figure Q2(b)**. The diameter of the pipe is 7 cm on the intake side and 5 cm on the discharge side. If there is no head loss occurs in the piping system, determine the flowrate of the water and pressure different between inlet and outlet of the pump.

(15 marks)

Q3 (a) Describe briefly the following terms;

(i) Steady flow

(ii) Incompressible fluid flow

(iii) Irrotational flow

(5 marks)

(b) Continuity equation for a control volume can be defined as any change of mass within the control volume is equal to the net gain of mass flowing into the volume through the control surface. Based on this definition, show that the continuity equation for steady, three dimensional and incompressible flow is

$$\delta u/\delta x + \delta v/\delta y + \delta w/\delta z = 0$$

(15 marks)

Q4 (a) Describe briefly the effect of drag and lift forces on ground vehicles such as cars and trucks.

(5 marks)

(b) The drag coefficient of a car can be determined experimentally in a large wind tunnel in a full scale test. If the height, width and speed of the car are 1.4 m, 1.62 m, 90 km/h respectively, determine the drag coefficient if the horizontal force acting on the car is measured to be 300 N. The density of the air is 1.164 kg/m^3.

(5 marks)

(c) A submarine with a diameter of 5 m and length of 25 m cruise horizontally and steadily in seawater. If the drag coefficient of the submarine is 0.1, determine;

(i) the power required for this submarine to cruise horizontally and steadily at 40 km/h in seawater whose density is 1023 kg/m^3; and

(ii) maximum speed of the submarine if the maximum power produce by submarine power unit is 2000 kW.

(10 marks)

PART B : ANSWER **ALL** QUESTIONS.

Q5 (a) **Figure Q5(a)** shows a pump performance curves. Draw this performance curves in your answer script and label the pump head curve, the pump efficiency curve the shutoff head, the free delivery and the best efficiency point.

(5 marks)

(b) A 1/4–scale model centrifugal pump is tested to pump water with density of 1000 kg/m^3 under a head of 7.5 m at speed of 500 rpm. It was found that 7.5 kW was needed to drive the model. Assuming the pumps is geometrical similar and similar mechanical efficiency, determine;

(i) speed and power required by the prototype when pumping against a head of 44 m;

(ii) ratio of the discharges between model and prototype; and

(i) head, capacity and power coefficient of the pump.

(15 marks)

Q6 (a) Explain briefly the defination of critical properties in compressible fluid flow.

(5 marks)

(b) An airplane flies at Mach number of 0.8 in air at 15^{0}C and 100 kPa pressure. Determine the stagnation pressure and temperature. The specific heat at constant pressure, specific heat ratio, gas constant for air are 1.005 KJ/kg.K, 1.4, 283 J/kg K respectively.

(7 marks)

(c) Helium enters a converging-diverging nozzle at 0.7 MPa, 800 K and 100 m/s. If the specific heat ratio and specific heat at constant pressure for helium are 1.667, 5.19 kJ/kg.K respectively, determine the critical temperature and pressure that can be obtained at the throat of the nozzle.

(8 marks)

- END OF QUESTION –

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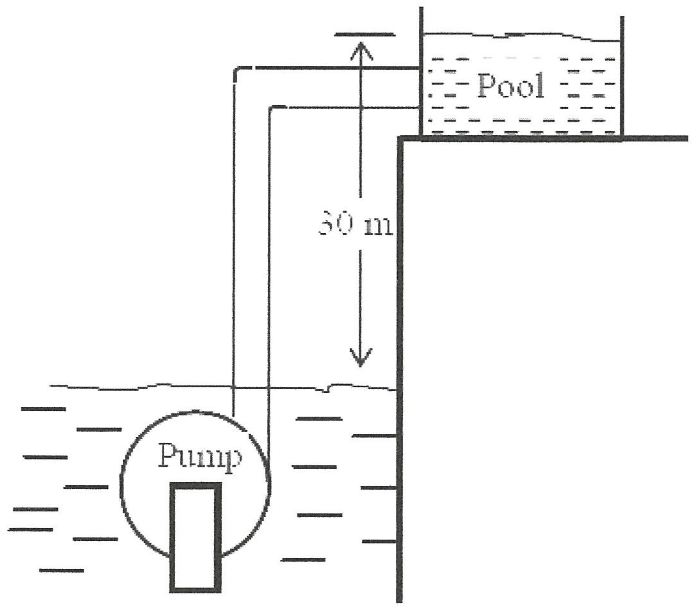

Figure Q2 (b)

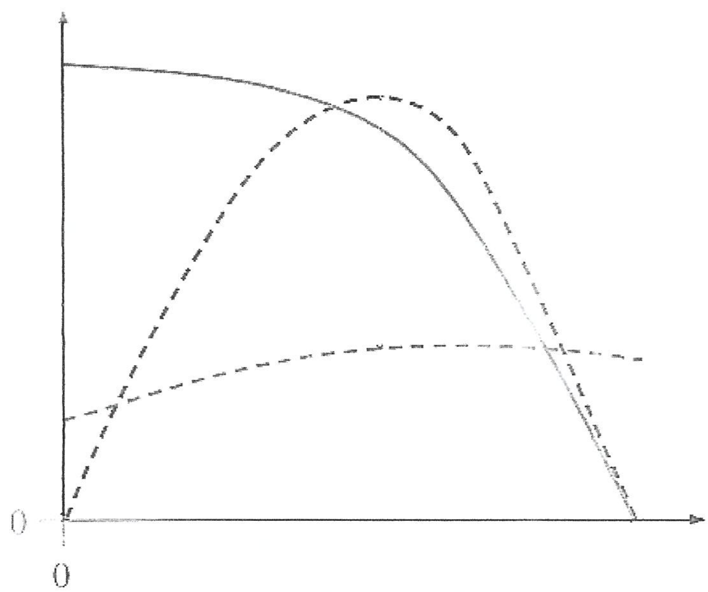

Figure Q5 (a)

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List of Formula

1. $Re = \rho v D/\mu$
2. $V = \Delta p\, D^2/32\mu l$
3. $Q = \pi D^4 \Delta p/128\mu l$
4. $Q = VA$
5. $U_r = V_c[1-(r/R)^2]$
6. $V_c = 2V$
7. $p_1/\rho g + v_1^2/2g + z_1 + h_p = p_2/\rho g + v_2^2/2g + z_2 + h_L$
8. $W = \rho g Q h_p$
9. $F_D = C_D\, ½\, \rho U^2 A$
10. $W = F_D V$
11. $F_B = \rho g \nabla$
12. $C_H = gH/N^2D^2$
13. $C_Q = Q/ND^3$
14. $C_P = P/\rho N^3 D^5$
15. $Ma = V/c$
16. $c = (kRT)^{1/2}$
17. $T_0 = T + (V^2/2\, c_p)$
18. $P_0/P = (T_0/T)^{k/(k-1)}$
19. $T^*/T_0 = [2/(k+1)]$
20. $P^*/P_0 = [2/(k+1)]^{k/(k-1)}$