Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
(ONLINE)
SEMESTER II
SESSION 2020/2021

COURSE NAME	:	FLUID MECHANICS II
COURSE CODE	:	BDA 30203
PROGRAMME	:	BDD
EXAMINATION DATE	:	JULY 2021
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 **SEVEN** (7) PAGES

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

Q1 (a) **B**riefly describe the definition of hydraulic radius.

(5 marks)

(b) Air at 30^0C flows through a 70 m long, 2 cm x 2 cm rectangular cross section pipe as shown in **Figure 1(b)**. The flow is laminar flow and centerline velocity is 2 m/s. If the angle of pipe measure from horizontal plane is 35^0, determine :

(i) Reynold number;

(ii) pressure different;

(iii) head loss;

(iv) wall shear stress;

(v) shear stress at 1 cm from the center of the pipe; and

(vi) power required to maintain this flow.

(15 marks)

Q2 (a) Briefly describe the characteristic of turbulent flow.

(5 marks)

(b) **Figure Q2(b)** shows water at 25^0C flows through a 60 mm diameter 30 m long galvanized iron pipe from a tank. The pump power is 40 kW and its efficiency is 80%. If the water flows at 0.046 m^3/s, determine the height difference between the level of water in the tank and the nozzle. Neglect the minor losses that occur in the piping system.

(15 marks)

Q3 (a) **B**riefly describe the definition of Newton's Second Law.

(5 marks)

(b) **Figure Q3(b)** shows the shape of the infinitesimal fluid element used to derive a momentum equation. Based on this figure and the definition of Newton's Second Law, derive a momentum equation in the z-direction.

(15 marks)

Q4 (a) Briefly describe the advantages of having a vehicle which is streamlined compared to a non-streamlined body.

(5 marks)

(b) A smooth thin plate 10 m long and 1 m wide is placed in an air stream at 3 m/s with its length parallel with the flow. Determine the total drag force acting on the plate if the air temperature is 30^0C.

(8 marks)

(c) Based on question Q4(b), determine the total drag force acting on the thin plate if the length of the plate is 3 m long and the air stream velocity is 1 m/s.

(7 marks)

PART B : ANSWER **ALL** QUESTIONS.

Q5 (a) As a mechanical engineer, you can predict the performance of a new centrifugal pump using two methods which are One Dimensional Analysis (Velocity Triangle) and Hydraulic Scaling. Describe the limitation of each method.

(5 marks)

(b) **Figure Q5(b)** shows the performance curves for a 31 cm diameter centrifugal pump used to pump water when it operates at 1000 rpm. The density of the water is 998 kg/m^3. Determine head, capacity and power coefficient at its best efficiency point.

(9 marks)

(c) Based on Question Q5(b), determine the new head, flowrate and power of the pump if we were to double the impeller speed.

(6 marks)

Q6 (a) **B**riefly describe the different between incompressible and compressible fluid flow.

(5 marks)

(b) An airplane flies at a Mach number of 0.8 in air at 15^0C 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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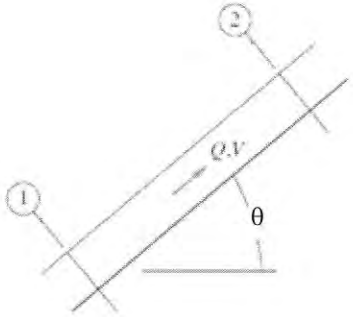

Figure Q1(b)

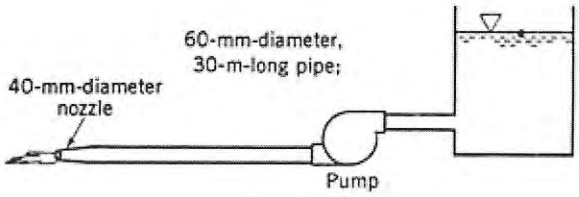

Figure Q2(b)

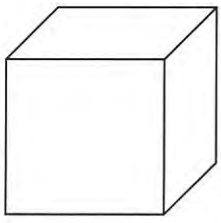

Figure Q3(b)

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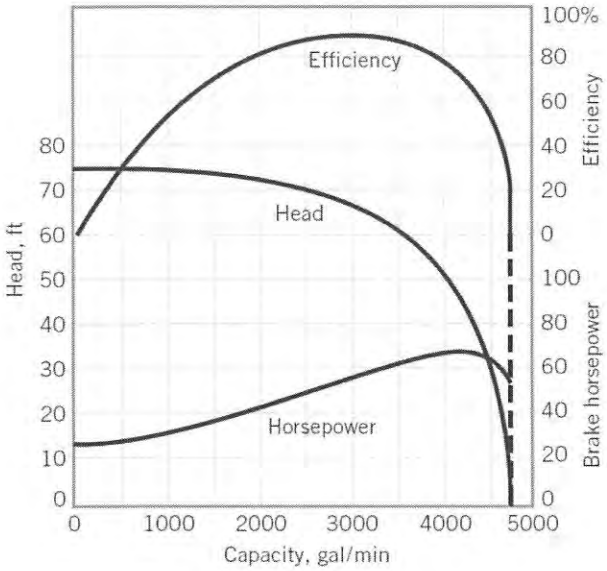

Conversion
1 gal/min = 6.31×10^{-5} m^3/s
1 ft = 0.3048 m
1 bhp = 745.7 W

Figure Q5(b)