UTHM
Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
(ONLINE)
SEMESTER II
SESSION 2019/2020

COURSE NAME	:	FLUID MECHANICS II
COURSE CODE	:	BDA 30203
PROGRAMME	:	BDD
EXAMINATION DATE	:	JULY 2020
DURATION	:	3 HOURS
INSTRUCTION	:	1. PART A : ANSWER **THREE** (**3**) FROM **FOUR** (**4**) QUESTIONS. 2. PART B : ANSWER **ALL** QUESTIONS. 3. OPEN BOOK EXAMINATION

THIS QUESTION PAPER CONSISTS OF **SEVEN** (7) PAGES

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

Q1 (a) Describe briefly the definition of fully developed laminar flow.

(5 marks)

(b) From governing laws for fully developed laminar flow, derive an equation for fully developed laminar flow that shows the relation between flowrate and pressure gradient.

(15 marks)

Q2 (a) Describe briefly the important of entrance region

(5 marks)

(b) Table 1 show the value of pressure at 1 m interval when fluid enters the piping system from a reservoir. The fluid flow at an average velocity of 10 m/s. The density and dynamic viscosity of the fluid are 950 kg/m^3, 8.9 x 10^{-4} N.s/m^2 respectively. The pipe is horizontal smooth pipe with diameter of 5 cm. Determine:

(i) Reynold Number;

(ii) wall shear stress;

(iii) the length of entrance region;

(iv) head loss; and

(v) fiction factor.

Table 1: Value of Pressure at 1 m Interval

Distance (m)	0	1	2	3	4	5	6
Pressure (kPa)	304	273	255	240	226	213	200

(15 marks)

Q3 (a) Describe briefly the definition of potential flow.

(5 marks)

(b) The mass balance 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, derive the equation of mass balance for 3 dimensional, steady and incompressible fluid flow.

(15 marks)

Q4 (a) Describe briefly the effect of drag and lift force on ground vehicle.

(5 marks)

(b) A small aircraft has a wing area of 35 m^2, lift coefficient of 0.45 at take-off settings, and total mass of 4000 kg. If the density of the air is 1.23 kg/m^3, determine:

(i) the take-off speed;

(ii) shear stress occur at the wing; and

(iii) the required power to maintain a constant cruising speed of 300 km/h for a cruising drag coefficient of 0.035.

(6 marks)

(c) A 2 m long, 0.2 m diameter cylindrical pine log with density 513 kg/m^3 and drag coefficient of 1.2 is suspended by a crane in the horizontal position as shown in **Figure Q4(c)**. The log is subjected to normal wind of 40 km/h. The density of the wind is 1.103 kg/m^3. Disregarding the weight of the cable and its drag, determine the angle θ the cable will make with the horizontal plane and the tension on the cable.

(9 marks)

PART B : ANSWER **ALL** QUESTIONS.

Q5 (a) Explain briefly the use of hydraulic scaling in determining the pump performance.

(5 marks)

(b) **Figure Q5(b)** shows the performance curves for 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.

(6 marks)

(c) A 20 cm diameter centrifugal pump operating at 1200 rpm is geometrically similar to the 31 cm diameter centrifugal pump having the performance characteristics as shown in **Figure 5(b)**. If the density of the fluid is 998 kg/m^3, determine head, capacity and power for this small centrifugal pump when operate at its best efficiency point.

(9 marks)

Q6 (a) Explain briefly the different between incompressible and compressible fluid flow.

(5 marks)

(b) Air at pressure and temperature of 200 kPa, 373.2 K flows through a duct at Mach Number of 0.8. The gas constant and specific heat ratio of air are 0.287 kJ/kg.k, 1.4 respectively. Determine;

(i) air velocity;

(ii) stagnation pressure;

(iii) stagnation temperature; and

(iv) stagnation density.

(8 marks)

(c) Nitrogen enters a converging diverging nozzle from a reservoir at a pressure of 700 kPa and temperature of 400 K. The gas constant and specific heat ratio of nitrogen are 0.2968 kJ/kg.k, 1.4 respectively. Determine;

(i) critical pressure

(ii) critical temperature;

(iii) critical density; and

(iv) critical velocity,

(7 marks)

- END OF QUESTION –

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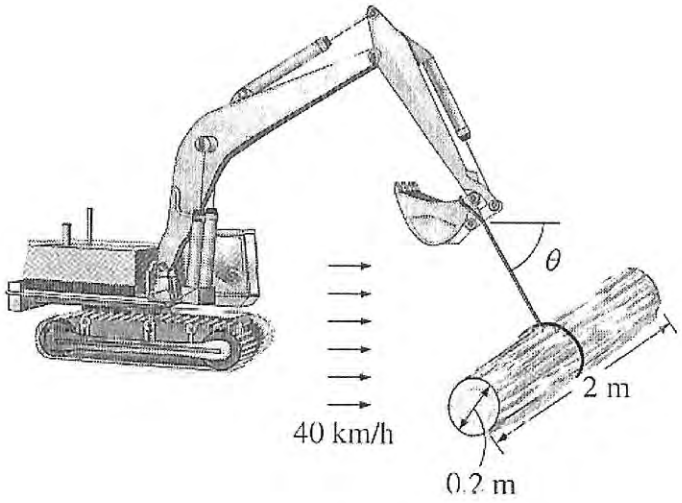
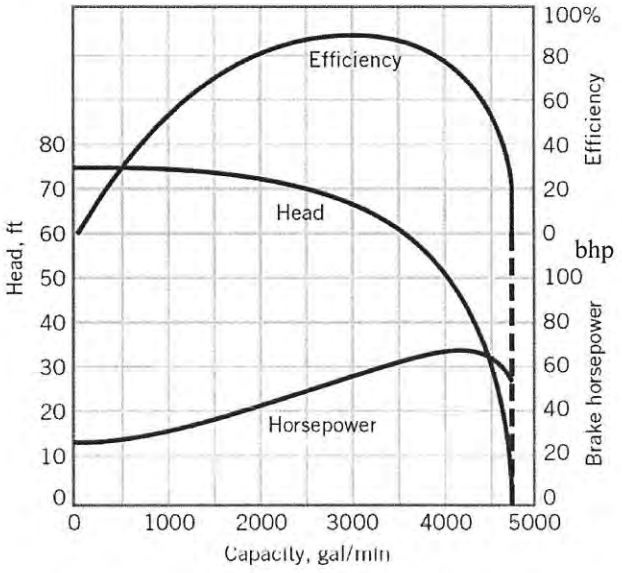


Figure Q4(c)



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

Figure Q5(b)

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Moody Chart