UTHM
Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2018/2019

COURSE NAME	:	FLUID MECHANICS
COURSE CODE	:	BNP 10303
PROGRAMME CODE	:	BNB/BNA/BNC
EXAMINATION DATE	:	JUNE/JULY 2019
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **ALL** QUESTIONS

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

Q1 (a) Give **THREE (3)** types of pressure.

(3 marks)

(b) Describe the buoyancy principle.

(4 marks)

(c) In a fluid the velocity measured at a distance of 75 mm from the boundary is 1.125 m/s. The fluid has absolute viscosity 0.048 Pa.s and relative density of 0.913. Determine the kinematic viscosity.

(5 marks)

(d) A 1.5 mm diameter tube is inserted into a liquid whose density is 860 kg/m^3 and it is observed that the liquid rises 8 mm in the tube, making a contact angle of 25^o. Estimate the surface tension of the liquid.

(8 marks)

Q2 (a) List **THREE (3)** applications of the Bernoulli equation.

(3 marks)

(b) Explain **TWO (2)** considerations in using Bernoulli equation.

(4 marks)

(c) A water flows in a pipe, which bend to the horizontal axis at 45°. The inlet pipe's diameter is 600 mm and reduce to 200 mm in the end. Given the inlet's pressure and flow rate are 150 kN/m^2 and 0.525 m^3/s respectively.

(i) Determine the pressure at the outlet.

(5 marks)

(ii) Neglecting the friction, calculate the resultant force at the bend.

(8 marks)

Q3 (a) State **THREE (3)** characteristics of laminar flow.

(3 marks)

(b) Differentiate between the major and minor head loss.

(4 marks)

(c) Fluid flows through a galvanised iron pipe with length and diameter are 45 m and 150 mm respectively for discharge 5.630 L/s. Calculate the head loss due to fluid friction of pipe. (Given $\rho = 869$ kg/m^3, $\mu = 8.14 \times 10^{-2}$ Pa.s, 1 m^3 = 1000 L).

(5 marks)

(d) A 5 cm diameter horizontal water pipe expands gradually to an 8 cm diameter pipe. The walls of the expansion section are angled 10° from the axis. The average velocity and pressure of water before the expansion section are 8 m/s and 150 kPa, respectively. Estimate the head loss in the expansion section and the pressure in the larger-diameter pipe.

(8 marks)

Q4 (a) Define the following:

(i) Hydraulic grade line
(ii) Energy grade line

(3 marks)

(b) A piping system involves two pipes of identical diameters but of different lengths connected in parallel. Explain, how would you compare the pressure drops in these two pipes.

(4 marks)

(c) Calculate the difference level between two reservoirs which is connected by single pipe of cast iron for 2 km. Discharge and diameter is given as 0.02 m^3/s and 7 cm respectively. ($\nu = 1.14 \times 10^{-6}$ m^2/s, e = 0.25)

(5 marks)

(d) A certain part of cast iron piping of a water distribution system involves a parallel section as shown in **Figure Q4(d)**. Both parallel pipes have a diameter of 30 cm, and the flow is fully turbulent. One of the branches (pipe *A*) is 1000 m long while the other branch (pipe *B*) is 3000 m long. If the flow rate through pipe *A* is 0.4 m^3/s, measure the flow rate through pipe *B*. Disregard minor losses. (Given ρ = 999.1 kg/m^3 and $\mu = 1.138 \times 10^{-3} kg/m \times s$. The roughness of cast iron pipe is ε = 0.00026 m.)

(8 marks)

Q5 (a) State **THREE (3)** usages of dimensional analysis.

(3 marks)

(b) Explain briefly **TWO (2)** differences between geometry and kinematic similitude.

(4 marks)

(c) A 1:25 scale model of a dam had a velocity of 6 m/s. Based on Froude number similarity, calculate the prototype velocity of the dam.

(5 marks)

(d) Some students want to visualize flow over a spinning baseball. Their fluids laboratory has a nice water tunnel into which they can inject multicolored dye streak lines, so they decide to test a spinning baseball in the water tunnel. Similarity requires that they match the Reynolds number between their model test and the actual baseball that moves through the air at 80 mph. Both the air and the water are at 20 degrees C. Estimate the speed they should run the water in the water tunnel. For air at $T = 20^{\circ}C$ and atmospheric pressure, $\rho = 1.204\ kg/m^3$ and $\mu = 1.825 \times 10^{-5}\ kg/m \cdot s$. For water at $T = 20^{\circ}C$ and atmospheric pressure, $\rho = 998.0\ kg/m^3$ and $\mu = 1.002 \times 10^{-3}\ kg/m \cdot s$.

(8 marks)

- END OF QUESTIONS -

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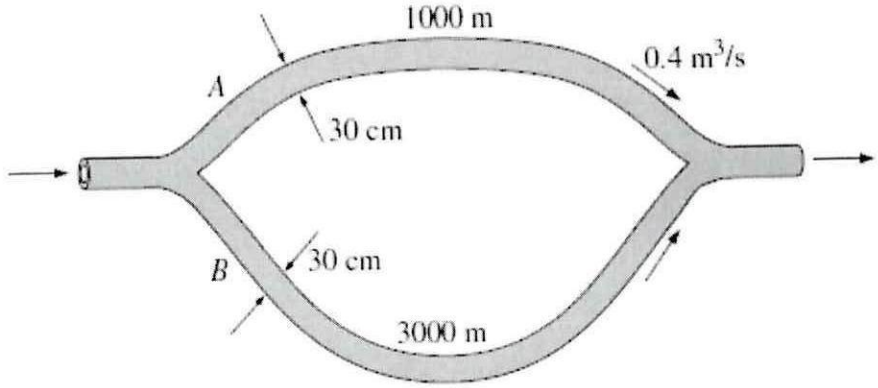

Figure Q4 (d) A parallel pipe system

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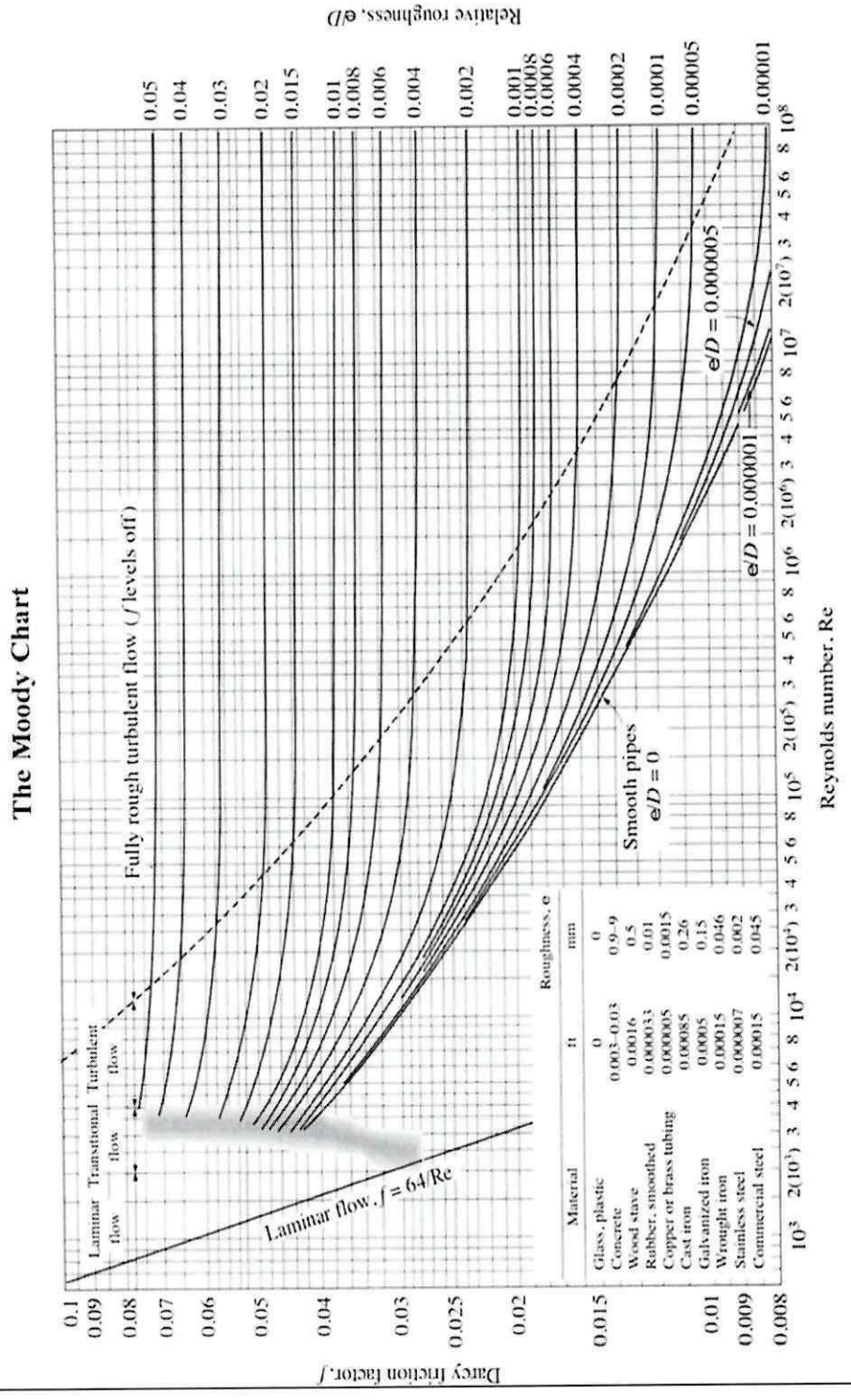

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COMPLIMENTARY EQUATIONS

$$h = \frac{2\sigma_s}{\rho g R}\cos\phi$$

$$\mathrm{Re} = \frac{\rho V D}{\mu} = \frac{DV}{\nu} \qquad \mathrm{F_r} = \frac{V}{\sqrt{gL}} \qquad h_f = f\left(\frac{L}{D}\right)\frac{V^2}{2g}$$

$$H = \frac{P}{\gamma} + z + \frac{V^2}{2g} \qquad h_k = k\frac{v^2}{2g} \qquad F = \sqrt{F_x^{\,2} + F_y^2} \qquad F_y = \rho g V$$

$$F_x = \rho g A\bar{x} \qquad \phi = \tan^{-1}\frac{F_y}{F_x} \qquad BM = \frac{I}{V} \qquad \mathrm{W = mg}$$

$$\mathrm{R = \rho g V} \qquad \rho = \frac{M}{V} \qquad P = \rho g h \qquad \gamma = \rho g$$

$$V = \sqrt{2gh} \qquad h_L = H - \frac{V_a}{2g} \qquad \mathrm{F_r} = \frac{V}{\sqrt{gL}}$$

$$\nu = \mu/\rho \qquad \tau = \mu\,(du/dy)$$

$$Q = C_d a\sqrt{2gH} \qquad \dot{m} = \rho A V$$

$$\frac{1}{\sqrt{f}} = -2\log\left(\frac{\varepsilon/D}{3.7} + \frac{2.51}{\mathrm{Re}\sqrt{f}}\right)$$