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UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2015/2016

COURSE NAME	:	FLUID MECHANICS
COURSE CODE	:	BFC10403
PROGRAMME	:	BACHELOR OF CIVIL ENGINEERING WITH HONOURS
EXAMINATION DATE	:	DECEMBER 2015/JANUARY 2016
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **FOUR (4)** QUESTIONS ONLY

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

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Q1 (a) Define vapor pressure. Predict whether vapor pressure will increase or decrease when the temperature increases.

(5 marks)

(b) Determine the specific weight, density, specific volume and specific gravity of certain liquid. The volume and weight are 6.5 m^3 and 55 kN, respectively.

(13 marks)

(c) Explain briefly surface tension in liquid. State **TWO (2)** phenomena in which the effect of surface tension is significant.

(7 marks)

Q2 (a) Explain briefly the hydrostatic force and buoyancy.

(6 marks)

(b) **FIGURE Q2(b)** shows a brass cube 152.4 mm on a side weighs 298.2 N. We want to hold this cube in equilibrium under water by attaching a light foam buoy to it. If the foam weighs 707.3 N/m^3, calculate the minimum required volume of the buoy.

(10 marks)

(c) A necked-down section in a pipe flow, called a *venturi*, develops a low throat pressure which can aspirate fluid upward from a reservoir, as shown in **FIGURE Q2(c)**. Using Bernoulli's equation with no losses, derive an expression for the velocity V_1 (in terms of h, D_1, D_2, and g) which is just sufficient to bring reservoir fluid into the throat.

(9 marks)

Q3 (a) From the first principle and with the aid of diagrams, derive the continuity equation. State any assumptions made in its derivation.

(6 marks)

(b) In a vertical pipe carrying water, pressure gauges are inserted at points A and B where the diameters are 0.15 m and 0.75 m respectively as shown in **FIGURE Q3(b)**. The point B is 2.5 m below A and when the flow rate down the pipe is 0.02 m^3/s, the pressure at B is 14715 N/m^2 greater than that at A. Assuming the losses in the pipe between A and B can be expressed as $kv^2/2g$ where v is the velocity at A, determine the value of k.

(12 marks)

(c) If the gauges at A and B in **FIGURE Q3(b)** are replaced by tubes filled with water and connected to a U-tube containing mercury of relative density 13.6, calculate the difference, R_p of the two limbs of the U-tube in metres.

(7 marks)

Q4 (a) Flow in pipe can be classified into 3 regimes based on Reynolds number.

i. Define the Reynolds number and explain the conditions to determine the flow regimes in pipe flow.

(5 marks)

ii. In pipe flow analysis, what criteria affecting the friction factor. State **TWO (2)** methods to determine the friction factor.

(5 marks)

(b) A flow of water has been discharged through a horizontal pipeline to the atmosphere. The pipeline is connected in series and consisted of two pipes which are 10 cm diameter and 25 m long and 12 cm diameter and 35 m long. The friction factor is 0.002 for both pipes. The water level in the tank is 10 m above the centre-line of the pipe at the entrance. Considering all the head losses, calculate the discharge when the 10 cm diameter pipe is connected to the tank

(12 marks)

(c) State the difference between Hydraulic Grade Line (HGL) and Energy Line (EL).

(3 marks)

Q5 (a) State **THREE (3)** advantages of using similarity.

(6 marks)

(b) List the **SIX (6)** steps that comprise the method of Buckingham Theorem.

(6 marks)

(c) Using Buckingham Theorem, derived an equation of non-dimension group to describe the resistance force (F). The resistance force (F) for a ship influenced by the function length L, velocity V, acceleration gravity g, density flow ρ and dynamic viscosity μ. (Repeating variables : ρ, V and L)

(13 marks)

- END OF QUESTIONS -

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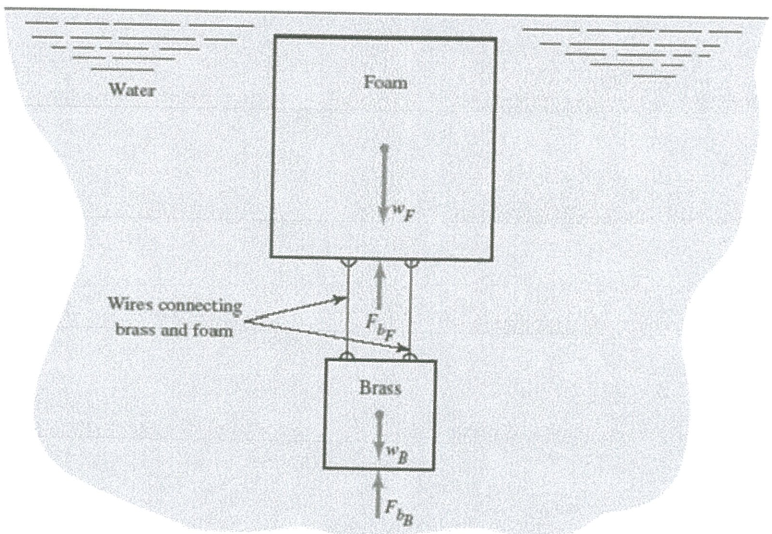

FIGURE Q2(b)

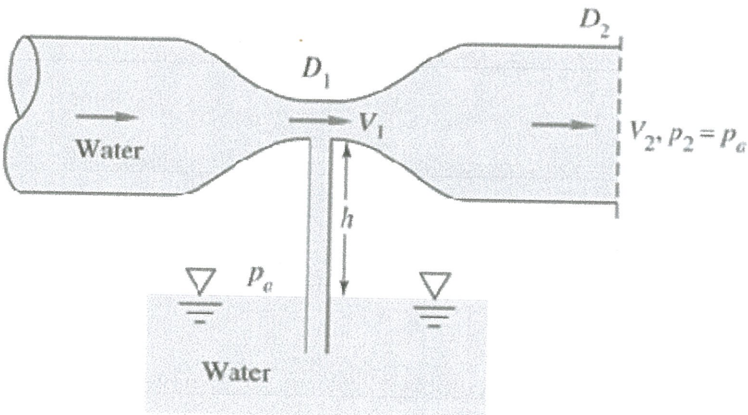

FIGURE Q2(c)

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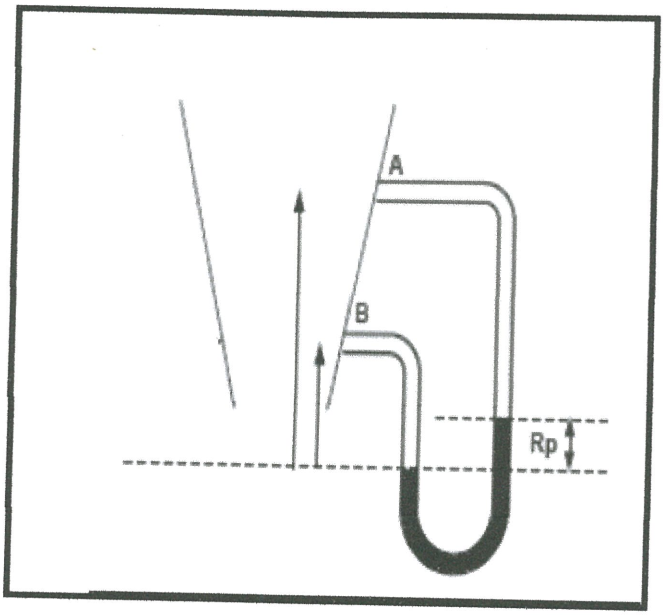

FIGURE Q3(b)

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Table 1: Dimensionless and Quantity for Fluid Mechanics

Kuantiti	Quantity	Simbol	Dimensi
ASAS	**FUNDAMENTAL**		
Jisim	Mass	m	M
Panjang	Length	L	L
Masa	Time	t	T
GEOMETRI	**GEOMETRIC**		
Luas	Area	A	L^2
Isipadu	Volume	V	L^3
Sudut	Angle	θ	$M^0L^0T^0$
Momen luas pertama	First area moment	Ax	L^3
Momen luar kedua	Second area moment	Ax^2	L^4
Keterikan	Strain	e	L^0
DINAMIK	**DINAMIC**		
Daya	Force	F	MLT^{-2}
Berat	Weight	W	MLT^{-2}
Berat tentu	Specific weight	γ	$ML^{-2}T^{-2}$
Ketumpatan	Density	ρ	ML^{-3}
Tekanan	Pressure	P	$ML^{-1}T^{-2}$
Tegasan ricih	Shear stress	τ	$ML^{-1}T^{-2}$
Modulus keanjalan	Modulus of elasticity	E, K	$ML^{-1}T^{-2}$
Momentum	Momentum	M	MLT^{-1}
Momentum sudut	Angular momentum		ML^2T^{-1}
Momen momentum	Moment of momentum		ML^2T^{-1}
Momen daya	Force moment	T	ML^2T^{-2}
Daya kilas	Torque	T	ML^2T^{-2}
Tenaga	Energy	E	L
Kerja	Work	W	ML^2T^{-2}
Kuasa	Power	P	ML^2T^{-3}
Kelikatan dinamik	Dynamic viscocity	μ	$ML^{-1}T^{-1}$
Tegangan permukaan	Surface tension	σ	MT^{-2}
KINEMATIK	**KINEMATIC**		
Halaju lelurus	Linear velocity	U,v,u	LT^{-1}
Halaju sudut	Angular velocity	ω	T^{-1}
Halaju putaran	Rotational speed	N	T^{-1}
Pecutan	Acceleration	a	LT^{-2}
Pecutan sudut	Angular acceleration	α	T^{-2}
Graviti	Gravity	g	LT^{-2}
Kadar alir	Discharge	Q	L^3T^{-1}
Kelikatan kinematik	Kinematic viscosity	υ	L^2T^{-1}
Fungsi arus	Stream function	Ψ	L^2T^{-1}
Pusaran	Circulation	Γ	L^2T^{-1}

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COMPLIMENTARY EQUATIONS

$$h=\frac{2\sigma_s}{\rho g R}\cos\phi \qquad y_p = y_c + \frac{I_{xxC}}{[y_c + P_o/(\rho g \sin\theta)]A}$$

$$\text{Re}=\frac{\rho VD}{\mu}=\frac{DV}{\nu} \qquad \text{F}_\text{r}=\frac{V}{\sqrt{gL}} \qquad h_f = f\left(\frac{L}{D}\right)\frac{V^2}{2g}$$

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

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

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

$$V=\sqrt{2gh} \qquad h_L = H-\frac{V_a}{2g} \qquad \text{F}_\text{r}=\frac{V}{\sqrt{gL}} \qquad C_d = C_c x C_V$$

$$Q=C_d a\sqrt{2gH} \qquad C_v=\frac{x}{\sqrt{4yH}} \qquad \dot{m}=\rho A V \qquad C_V=\frac{V_a}{V}$$

$$\text{R}_\text{X}=\dot{m}(V_{X1}-V_{X2}) \qquad \text{R}_\text{Y}=\dot{m}(V_{Y1}-V_{Y2}) \qquad R=\sqrt{R_X^{\ 2}+R_Y^{\ 2}}$$