UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2012/2013

COURSE NAME	:	FLUID MECHANICS
COURSE CODE	:	BFC 1043 / BFC 10403
PROGRAMME	:	1 BFF
EXAMINATION DATE	:	JUNE 2013
DURATION	:	3 HOURS
INSTRUCTIONS	:	1. ANSWER **FIVE (5)** FROM SIX (6) QUESTIONS 2. ATTACH **APPENDIX I, II, III , IV** AND **IV** WITH YOUR ANSWER BOOKLET

THIS PAPER CONSISTS OF **TWELVE (12)** PAGES

Q1 (a) Explain briefly the meaning of capillarity and surface tension.

(5 marks)

(b) Calculate the pressure gauge and absolute pressure of water at a depth of 12 m below the water surface.
(Given, ρ_{water} = 1000 kg/m^3 dan $P_{atmosphere}$= 101kN/m^2)

(6 marks)

(c) A manometer is attached to a tank containing three different fluids as shown in **Figure Ql(c).** Compute the difference of y in the manometer.

(9 marks)

Q2 (a) Define the hydrostatic principle and specify the Archimedes and Pascal's Law accordingly.

(6 marks)

(b) A block of wood 72 cm x 96 cm floats on the oil of specific gravity 0.751 and tilted as shown in **Figure Q2(b).** Determine the buoyant force acting on the block and its position.

(6 marks)

(c) A 40 m length canal has a cross section as shown in **Figure Q2(c).** Determine:

(i) The horizontal and vertical components of hydrostatic force against the quarter-circle wall.

(ii) The center of pressure (c .p), where the resultant force strikes the wall.

(8 marks)

Q3 (a) Define the principle of Bernoulli's Theorem.

(i) State the Bernoulli's Theorem equation if this principle is used in the operation of a pump and the occurrence of major and minor energy losses.

(ii) Give 2 examples of small energy loss

(7 marks)

(b) By using fluid parameters, derive the momentum equations.

(5 marks)

(c) A smooth curve blade shown in **Figure Q3(c)** is used to deflect a jet flow without any shock. The deflected angle is 134° and the jet flow rate and velocity are 2.4 kg/s and 24 m/s respectively. Determine,

(i) The resultant force of the jet hitting the static blade.

(ii) The resultant force of the jet hitting the blade if the blade moves at 12 m/s in the jet direction.

(8 marks)

Q4 (a) Explain briefly, **FOUR (4)** zones in the Moody chart.

(4 marks)

(b) A factory D as shown in **Figure Q4(b)** conveys water from a closed tank through a pipe with 150 mm diameter at a rate of 0.1 m^3/s. Given that kinematic viscosity of water, υ is 0.113×10^{-5} m^2/s, pipe friction factor, f is 0.016 and coefficient of minor losses for inlet and bend of pipe are 0.05 and 0.4 respectively.

(i) Prove that the flow is turbulent.

(ii) Calculate energy head losses in pipe.

(iii) Determine the tank pressure, P_1 if pressure at factory D is 50 kPa.

(10 marks)

(c) SAE oil 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).

(6 marks)

Q5 (a) List **ONE (1)** major head loss and **THREE (3)** minor head losses incurred in a water distribution system.

(4 marks)

(b) Briefly explain the characteristics of discharge Q and head loss h_f of flow in pipes installed as follows;

(i) Parallel

(ii) Series

(6 marks)

(c) A flow of water has been discharge 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.

(10 marks)

Q6 (a) State **THREE (3)** usefulness of dimensional analysis.

(6 marks)

(b) Differentiate between model and prototype?

(4 marks)

(c) Derive an equation of non-dimension group to describe the resistance force *(F)* using Buckingham Theorem. 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.

(10 marks)

END OF QUESTIONS

S1 (a) Terangkan maksud kererambutan dan tegangan permukaan.

(5 markah)

(b) Kirakan tolok tekanan dan tekanan mutlak bagi air pada kedalaman 12 m dibawah permukaan air.
(Diberi $\rho_{air} = 1000$ kg/m^3 dan $P_{atmosfera} = 101$kN/m^2)

(6 markah)

(c) Sebuah manometer A dipasang kepada tangki yang mengandungi tiga cecair yang berbeza seperti yang ditunjukkan dalam **Rajah S1 (c).** Cari nilai y dalam manometer tersebut.

(9 markah)

S2 (a) Berikan definasi bagi hidrostatik dan nyatakan Prinsip Archimedes dan Hukum Pascal

(6 markah)

(b) Sebuah bongkah kayu berdimensi 72 cm x 96 cm terapung dalam minyak yang mempunyai graviti tentu 0.751 berada dalam kedudukan seperti **Rajah S2(b).** Tentukan daya keapungan yang bertindak ke atas bongkah dan lokasi tindakannya.

(6 markah)

(c) Sebuah terusan sepanjang 40 m mempunyai keratan rentas seperti **Rajah S2(c).** Tentukan:

(i) komponen daya mengufuk dan menegak bagi daya hidrostatik yang bertindak di dinding suku bulatan.

(ii) lokasi titik tekanan dimana daya hidrostatik bertindak

(8 markah)

S3 (a) Nyatakan prinsip Theorem Bernoulli.

(i) Nyatakan persamaan Theorem Bernoulli jika prinsip ini digunakan didalam operasi yang menggunakan pam dan berlakunya kehilangan tenaga utama dan kecil.

(ii) Berikan 2 contoh kehilangan tenaga kecil.

(7 markah)

(b) Huraikan bagaimana persamaan momentum terhasil dengan menggunakan parameter bendalir.

(5 markah)

(c) Merujuk kepada **Rajah S3(c),** sebuah bilah lengkung licin digunakan untuk memesongkan suatu aliran jet air tanpa kejutan. Sudut pesongan bilah ialah 134^0. Kadaralir dan halaju jet masing-masing adalah 2.4 kg/s dan 24 m/s. Tentukan:

(i) daya paduan hentaman jet pada bilah pegun

(ii) daya paduan hentaman jet pada bilah jika bilah itu bergerak dengan halaju 12 m/s dalam arah jet.

(8 markah)

S4 (a) Terangkan dengan ringkas, **EMPAT (4)** zon yang terdapat dalam carta Moody

(4 markah)

(b) Sebuah kilang D seperti di **Rajah S4(b)** menyalurkan air daripada tangki bertutup melalui paip yang berdiameter 150 mm pada kadar 0.1 m^3/s. Diberi kelikatan kinematik bagi air, υ ialah 0.113×10^{-5} m^2/s, faktor geseran paip, f adalah 0.016 dan pekali kehilangan kecil bagi bahagian masuk dan lenturan masing-masing adalah 0.05 dan 0.4.

(i) Buktikan bahawa aliran dalam paip adalah gelora

(ii) Kira kehilangan tenaga dalam paip

(iii) Tentukan tekanan dalam tangki, P_1 jika tekanan di kilang D adalah 50kPa

(10 markah)

(c) Minyak SAE mengalir melalui paip besi bergalvani dengan kadaralir 5.630 L/s serta panjang dan diameter masing-masing adalah 45 m and 150 mm. Kirakan kehilangan turus minyak dalam paip tersebut.
(Diberi $\rho = 869$ kg/m^3, $\mu = 8.14 \times 10^{-2}$ Pa.s, 1 m^3 = 1000 L).

(6 markah)

S5 (a) Senaraikan **SATU (1)** kehilangan turus utama dan **TIGA (3)** kehilangan turus kecil yang berlaku dalam sebuah sistem pengagihan air.

(4 markah)

(b) Terangkan secara ringkas ciri-ciri kadar alir Q dan kehilangan turus h_f terhadap aliran dalam paip yang disambung secara berikut;

(i) Selari

(ii) Sesiri

(6 markah)

(c) Sebuah tangki tadahan mengalirkan air melalui sebatang paip mengufuk ke atmosfera. Paip tersebut terdiri daripada dua jenis paip iaitu paip berdiameter 10 cm dengan 25 m panjang dan paip berdiameter 12 cm dengan 35 m panjang yang disambungkan secara bersiri. Diberi pekali geseran adalah 0.002 untuk kedua-dua paip. Ketinggian paras air dalam tangki ialah 10 m daripada titik tengah paip di hujung (keluaran) paip. Dengan mengambil kira semua kehilangan tenaga, kira kadar alir apabila paip 10 cm di sambungkan ke tangki.

(10 markah)

S6 (a) Berikan **TIGA (3)** kegunaan analisis dimensi

(6 markah)

(b) Terangkan perbezaan antara model dan prototaip?

(4 markah)

(c) Terbitkan persamaan tak berdimensi bagi daya rintang *(F)* dengan menggunakan Theorem Buckingham. Daya rintang F pada sebuah kapal bergantung kepada panjang kapal L, halaju V, pecutan graviti g dan sifat bendalir iaitu ketumpatan bendalir ρ dan kelikatan dinamik μ

(10 markah)

SOALAN TAMAT

APPENDIX I

FINAL EXAMINATION

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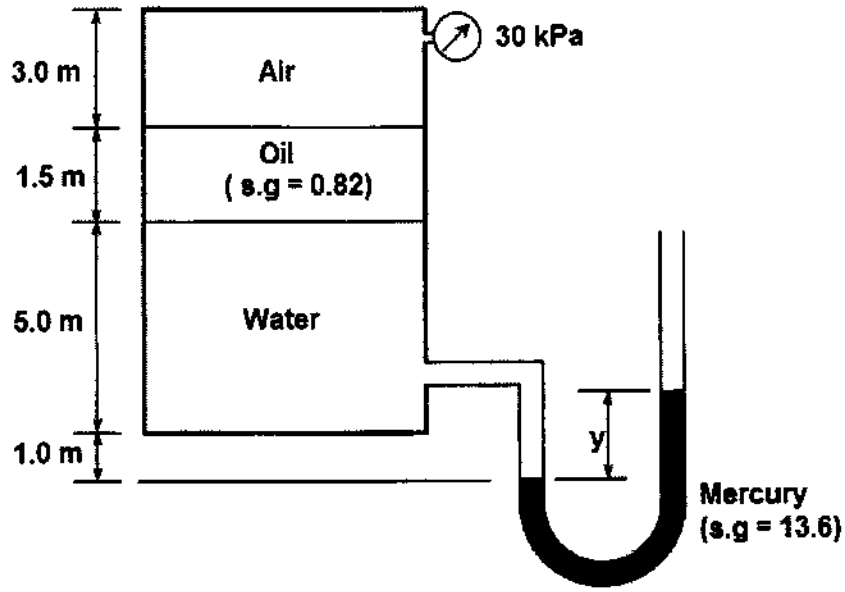

Figure Q1(c) / Rajah S1(c)

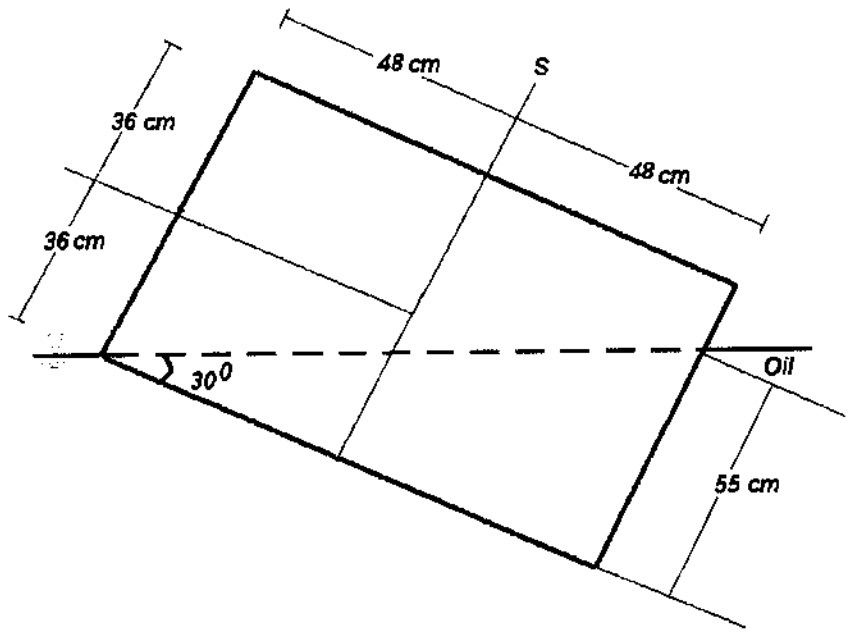

Figure Q2(b) / Rajah S2(b)

APPENDIX II

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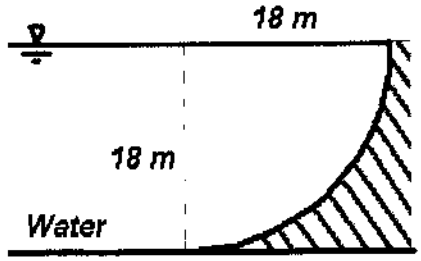

Figure Q2 (c) / Rajah S2 (c)

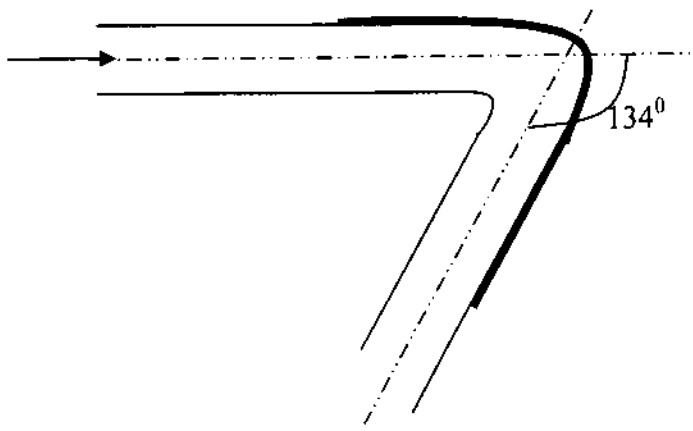

Figure Q3(c) / Rajah S3 (c)

APPENDIX III

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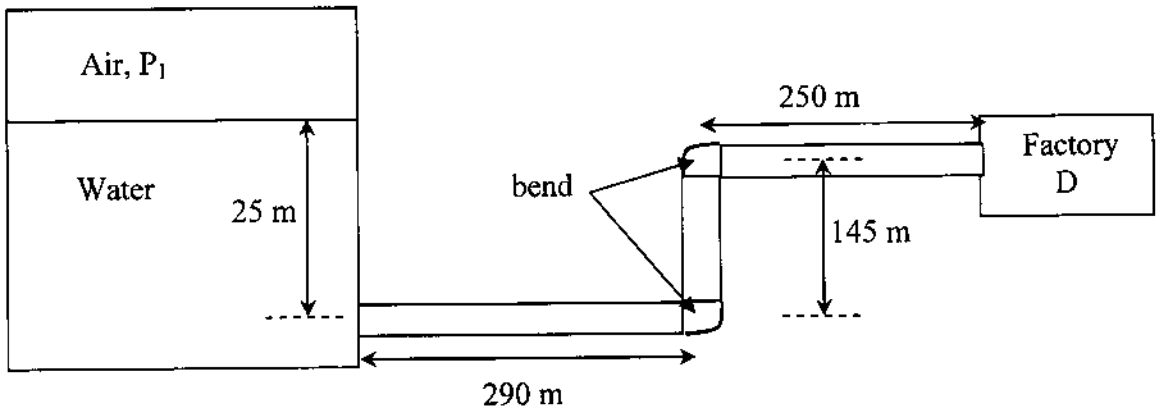

Figure Q4(b) / Rajah S4 (b)

APPENDIX IV

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Formula:

$$\mathrm{Re} = \frac{\rho VD}{\mu} = \frac{DV}{\nu} \qquad f = \frac{64}{\mathrm{Re}} \qquad \mathrm{F_r} = \frac{V}{\sqrt{gL}}$$

$$h_f = f\left(\frac{L}{D}\right)\frac{V^2}{2g} \qquad H = \frac{P}{\gamma} + z + \frac{V^2}{2g} \qquad h_k = k\frac{v^2}{2g}$$

$$F_x = \rho g A\bar{x} \qquad F_y = \rho g V \qquad F = \sqrt{F_x^{\,2} + F_y^{\,2}}$$

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

$$\mathrm{R = \rho gV} \qquad \rho = \frac{M}{V}$$

$$P = \rho gh \qquad \gamma = \rho g$$

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

$$C_V = \frac{V_a}{V} \qquad C_d = C_c x C_V$$

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

$$\mathrm{R_X} = \dot{m}(V_{X1} - V_{X2}) \qquad \mathrm{R_Y} = \dot{m}(V_{Y1} - V_{Y2}) \qquad R = \sqrt{R_x^{\,2} + R_y^{\,2}}$$

APPENDIX V

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Table / Jadual : 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}
Putaran	Circulation	Γ	L^2T^{-1}
Pusaran	Vorticity	Ω	T^{-1}