UNIVERSITI TUN HUSSEIN ONN MALAYSIA

PEPERIKSAAN AKHIR
SEMESTER II
SESI 2008/2009

NAMA MATA PELAJARAN	:	HIDRAULIK
KOD MATA PELAJARAN	:	BFC 2073
KURSUS	:	2 BFF
TARIKH PEPERIKSAAN	:	APRIL 2009
JANGKA MASA	:	3 JAM
ARAHAN	:	JAWAB **LIMA (5)** SOALAN SAHAJA DARIPADA ENAM (6) SOALAN.

KERTAS SOALAN INI MENGANDUNGI SEMBILAN BELAS (19) MUKA SURAT

S1. (a) Masa dan ruang merupakan dua kriteria utama yang digunakan untuk mengkelaskan jenis- jenis aliran di dalam saluran terbuka. Terangkan kedua-dua kriteria tersebut.

(4 markah)

(b) Berdasarkan Rajah S1,

(i) Kira lebar permukaan saluran segiempat, luas keratan rentas saluran, perimeter basah dan jejari hidraulik jika ukur dalam aliran adalah 6.0 m.

(6 markah)

(ii) Tentukan regim aliran berdasarkan nombor Reynolds dan Froude jika diberi kadar alir sebanyak $10\ m^3/s$, panjang saluran 15 m dan kelikatan kinematik ialah $0.8 \times 10^{-6}\ m^2/s$.

(10 markah)

S2. (a) Satu saluran terbuka berbentuk segiempat tepat mempunyai cerun dasar S_o dan kadar alir maksimum Q. Keratan rentas saluran tersebut mempunyai lebar B dan kedalaman aliran y. Tunjukkan jejari hidraulik berkesan, $R = \frac{y}{2}$.

(13 markah)

(b) Sekiranya kadar alir maksimum, pekali Manning dan cerun dasar masing-masing adalah $6.0\ m^3/s$, 0.015 dan 0.0005, dengan mengunakan formula jejari hidraulik berkesan dan luas berkesan, kira kedalaman dan lebar saluran segiempat tepat tersebut.

(7 markah)

S3. (a) Terangkan tiga (3) kegunaan lompatan hidraulik dalam bidang kejuruteraan dan lukiskan gambarajah lompatan hidraulik.

(6 markah)

(b) Kadaralir bagi satu limpahan banjir adalah sebanyak $7.75\ m^3/s$ per meter lebar saluran tersebut. Pada bahagian hilir limpahan tersebut, ukurdalam air di apron didapati setinggi 0.50 meter. Berapakah ketinggian air di hilir , y_2 yang diperlukan untuk berlakunya lompatan hidraulik?

Sekiranya lompatan hidraulik terjadi, tentukan:

(i) Jenis lompatan,

(ii) Kehilangan tenaga,

(iii) Peratus kehilangan tenaga berbanding tenaga asal

(iv) Kuasa yang terlesap per meter lebar saluran.

(14 markah)

S4. (a) Terangkan dengan ringkas 3 jenis susuk (profil) aliran yang mungkin terjadi apabila aliran mengalir di dalam saluran berkecerunan mendatar

(4 markah)

(b) Saluran tanah berbentuk segiempat (n = 0.02) mempunyai kelebaran 6 m dan berkecerunan 0.006. Air mengalir pada 30 m^3/s didalam saluran dan memasukki takungan seperti yang ditunjukkan di Rajah S4. Kedalaman air sebelum memasukki takungan adalah 3 m iaitu dua kali ganda nilai kedalaman normal. Tentukan;

(i) Kedalaman genting aliran dan kadaralir per meter lebar
(ii) Jenis cerun saluran.
(iii) Panjang, L susuk (profil) permukaan air menggunakan menggunakan Kaedah Terperingkat Terus untuk 2 peringkat.

(Kiraan mesti dicatatkan di Jadual 1 pada Lampiran II dan disertakan sekali dalam buku jawapan anda).

(16 markah)

S5. (a) Berikan 2 kepentingan penggunaan analisis dimensi dalam bidang kejuruteraan serta nyatakan perbezaan antara model dan prototaip?

(5 markah)

(b) Anda ingin menghasilkan sebuah bot. Berikan pendapat anda, apakah perlu dilakukan untuk menghasilkan prototaip sebuah bot.

(6 markah)

(c) Sebuat bot dengan bilah prototaip mempunyai diameter 1.0 m. Ia berfungsi untuk mengira daya yang bertindak dengan kadaralir 5 m/s dan bilah model dengan diameter 0.1 m pula berfungsi dalam terowong angin.Untuk mengekalkan keadaan keserupaan dinamik, berapakah kadar halaju yang diperlukan untuk udara itu beredar dalam terowong angin tersebut? (μ_{water}= 1.0 $\times 10^6$ kg/ms , μ_{air}= 1.7 $\times 10^5$ kg/ms , ρ_{water} = 1000 kg/m^3, ρ_{air} = 12.5 kg/m^3)

(9 markah)

S6. (a) Namakan dua (2) jenis pam dan dua(2) jenis turbin.

(4 markah)

(b) Terangkan dengan ringkas beserta gambarajah mengenai pengaliran kadar alir Q dan turus tekanan H, di dalam sistem pam bersiri dan selari.

(6 markah)

(c) Dua jenis pam yang serupa iaitu pam A dan pam B mempunyai kelajuan 600 ppm. Pam A mempunyai diameter impeller 50 cm dengan kadaralir 0.4 m^3/s di bawah turus tekanan 50 m. Kirakan diameter impeller pada pam B dan turus tekanan sekiranya ia mampu untuk mengepam air sebanyak 0.3 m^3/s ?

(10 markah)

Lampiran 1

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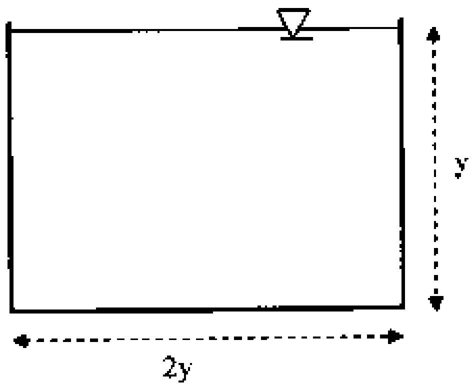
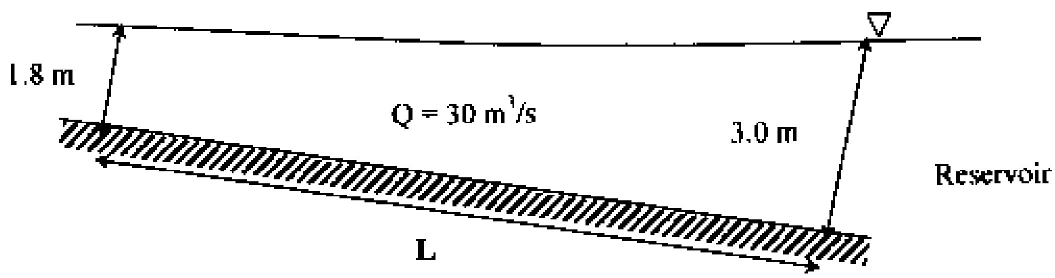


Rajah S1



Rajah S4

Lampiran II

PEPERIKSAAN AKHIR

SEMESTER / SESI : SEM II / 2008/2009
MATA PELAJARAN : HIDRAULIK

KURSUS : 2 BFF
KOD MATA PELAJARAN : BFC 2073

Nama:...

Nombor Matrik:......................................

Jadual 1: Analisis Profil Permukaaan Air

y	R	V	$\frac{V^2}{2g}$	E	ΔE	i	$\bar{i}$	$S_o - \bar{i}$	Δx	L

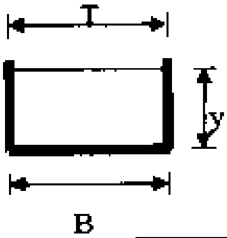
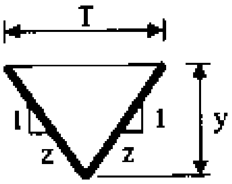
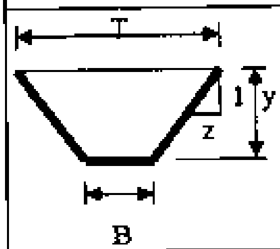
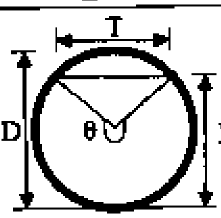
Lampiran III

PEPERIKSAAN AKHIR

SEMESTER / SESI : SEM II / 2008/2009 KURSUS : 2 BFF

MATA PELAJARAN : HIDRAULIK KOD MATA PELAJARAN : BFC 2073

Jadual 2 :Bentuk Geometri Saluran Terbuka

Bentuk	A	T	P
	By	B	B + 2y
	zy^2	2zy	$2y\sqrt{1+z^2}$
	$By + zy^2$	B + 2zy	$B + 2y\sqrt{1+z^2}$
	$\frac{D^2}{8}(\theta - \sin\theta)$ θ dalam radian	$D(\sin\frac{\theta}{2})$ atau $2\sqrt{y(D-y)}$	$\frac{\theta D}{2}$ θ dalam radian

Lampiran IV

PEPERIKSAAN AKHIR

SEMESTER / SESI : SEM II / 2008/2009 KURSUS : 2 BFF
MATA PELAJARAN : HIDRAULIK KOD MATA PELAJARAN : BFC 2073

Jadual 3 : Dimensi dan Kuantiti Mekanik Bendalir

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}

Lampiran V

PEPERIKSAAN AKHIR

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MATA PELAJARAN : HIDRAULIK

KURSUS : 2 BFF
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Jadual 4

Characteristic	Dimension	Scale ratios for laws of: Reynolds	Froude	Mach
Geometric				
Length	L	L_r	L_r	L_r
Area	L^2	L_r^2	L_r^2	L_r^2
Volume	L^3	L_r^3	L_r^3	L_r^3
Kinematic				
Time	T	$\left(\frac{L^2\rho}{\mu}\right)_r$	$(L^{1/2}g^{-1/2})_r$	$\left(\frac{L\rho^{1/2}}{E_v^{1/2}}\right)_r$
Velocity	LT^{-1}	$\left(\frac{\mu}{L\rho}\right)_r$	$(L^{1/2}g^{1/2})_r$	$\left(\frac{E_v^{1/2}}{\rho^{1/2}}\right)_r$
Acceleration	LT^{-2}	$\left(\frac{\mu^2}{\rho^2L^3}\right)_r$	g_r	$\left(\frac{E_v}{L\rho}\right)_r$
Discharge	L^3T^{-1}	$\left(\frac{L\mu}{\rho}\right)_r$	$(L^{5/2}g^{1/2})_r$	$\left(\frac{L^2E_v^{1/2}}{\rho^{1/2}}\right)_r$
Dynamic				
Mass	M	$(L^3\rho)_r$	$(L^3\rho)_r$	$(L^3\rho)_r$
Force	MLT^{-2}	$\left(\frac{\mu^2}{\rho}\right)_r$	$(L^3\rho g)_r$	$(L^2E_v)_r$
Pressure	$ML^{-1}T^{-2}$	$\left(\frac{\mu^2}{L^2\rho}\right)_r$	$(L\rho g)_r$	$(E_v)_r$
Impulse and momentum	MLT^{-1}	$(L^2\mu)_r$	$(L^{7/2}\rho g^{1/2})_r$	$(L^3\rho^{1/2}E_v^{1/2})_r$
Energy and work	ML^2T^{-2}	$\left(\frac{L\mu^2}{\rho}\right)_r$	$(L^4\rho g)_r$	$(L^3E_v)_r$
Power	ML^2T^{-3}	$\left(\frac{\mu^3}{L\rho^2}\right)_r$	$(L^{7/2}\rho g^{3/2})_r$	$\left(\frac{L^2E_v^{3/2}}{\rho^{1/2}}\right)_r$

Note: Usually g is the same in model and prototype.

Lampiran VI

PEPERIKSAAN AKHIR

SEMESTER / SESI : SEM II / 2008/2009 KURSUS : 2 BFF
MATA PELAJARAN : HIDRAULIK KOD MATA PELAJARAN : BFC 2073

RUMUS /PERSAMAAN

$$Q = \frac{1}{n} A R^{2/3} S_o^{1/2}$$

$$y_c = \left(\frac{q^2}{g} \right)^{1/3}$$

$$\frac{y_2}{y_1} = \frac{1}{2}\left[-1 + \sqrt{1 + 8F_r^2} \right]$$

$$E_L = \frac{(y_2 - y_1)^3}{4 y_1 y_2}$$

$$F_r = \frac{V}{\sqrt{gy}}$$

$$P = \gamma Q E_L$$

$$E = y + \frac{Q^2}{2gA^2}$$

$$Z = \frac{Q}{\sqrt{g}} = A\sqrt{D}$$

$$P = \eta_o \gamma Q H$$

$$P_2 = P_1 \left(\frac{H_2}{H_1} \right)^{3/2}$$

$$N_s = \frac{N\sqrt{P}}{H^{5/4}}$$

$$N_2 = N_1 \sqrt{H_2 / H_1}$$

$$\Delta x = \frac{\Delta E}{S_o - \bar{i}}$$

$$i = \frac{n^2 v^2}{R^{4/3}}$$

$$K_o = \frac{Q}{\sqrt{S_o}}$$

$$\bar{K} = \frac{1}{n} \bar{A} . \bar{R}^{2/3}$$

$$\Delta y = \frac{y_{jauh} - y_{dekat}}{N}$$

$$\bar{y} = \frac{y_i + y_{i+1}}{2}$$

Lampiran VII

PEPERIKSAAN AKHIR

SEMESTER / SESI : SEM II / 2008/2009
MATA PELAJARAN : HIDRAULIK

KURSUS : 2 BFF
KOD MATA PELAJARAN : BFC 2073

RUMUS /PERSAMAAN

$$\left(\frac{NQ^{1/2}}{H^{3/4}}\right)_1 = \left(\frac{NQ^{1/2}}{H^{3/4}}\right)_2$$

$$\left(\frac{Q}{ND^3}\right)_1 = \left(\frac{Q}{ND^3}\right)_2$$

$$\left(\frac{H}{N^2D^2}\right)_1 = \left(\frac{H}{N^2D^2}\right)_2$$

$$\eta_H = \frac{H}{H'} = \frac{gH}{u_2V_{u2} - u_1V_{u1}}$$

$$N_s = \frac{NQ^{1/2}}{H^{5/4}}$$

Q1. (a) Time and space are the main criteria used in classifying types of flow. Explain both criteria.

(4 marks)

(b) Refer to Figure 1

(i) Calculate the section width of rectangular channel, cross section area, wetted perimeter and hydraulic radius if the water depth is 6.0 m.

(6 marks)

(ii) Define the flow regime of the channel based on Reynolds and Froude number if the flow rate is 10 m^3/s, the length of the section is 15 m and the kinematic viscosity is 0.8 x 10^{-6} m^2/s

(10 marks)

Q2. (a) A rectangular channel has a side slope S_o and maximum flow rate of Q. The width of channel cross section is B and depth of flow is y. Show the effective of hydraulic radius $R = \frac{y}{2}$.

(13 marks)

(b) If the maximum flow rate, Manning coefficient and bed slope are 6.0 m^3/s, 0.015 and 0.0005 respectively, by using hydraulic radius and cross section area, determine the flow depth and the width of the channel.

(7 marks)

Q3. (a) Define three (3) usefulness of hydraulic jumps in engineering field and sketch the figure of hydraulic jumps.

(6 marks)

(b) A spillway discharges a flood flow at a rate of $q = 7.75$ m^3/s per meter width. At the downstream horizontal apron the depth of flow was found to be 0.50 m. What tail water depth, y_2 is needed to form a hydraulic jump?

If a jump is formed, find its

(i) Type of jump,
(ii) Energy loss,
(iii) Percentage of energy loss to the initial energy
(iv) Power dissipated per meter width of the channel

(14 marks)

Q4. (a) Explain briefly 3 types of water surface profile that will be occurred when water flows in the horizontal slope channel.

(4 marks)

(b) The earth rectangular channel (n = 0.02) with 6 m width laid on a slope of 0.005236. Water flows at 30 m^3/s in the channel and enters a reservoir as shown in figure Q4. The depth of water increase as 3 m before the entry which is two times of normal depth. Determine;

(i) Critical depth of flow and flowrate per meter width.
(ii) Type of channel slope
(iii) Length, L of water surface profile by using Direct Step Method in 2 steps.
(All calculation must be done in Table 1 at Appendix II and attach it with your question book)

(16 marks)

Q5. (a) State two (2) important of dimensionless analysis in engineering field and define the dissimilar between model and prototype.

(5 marks)

(b) You want to create a boat which can move fast. Give your opinion, what is needed to create a prototype of boat.

(6 marks)

(c) A prototype boat propeller has a diameter of 1.0 m. It is necessary to determine the force it will experience when water flows past at 5 m/s. A model propeller is available of diameter 0.1m and can be placed in a wind tunnel. To obtain the dynamically similar conditions at what velocity would the air need to flow in the wind tunnel? (μ_{water} = 1.0×10^6 kg/ms , μ_{air} = 1.7×10^5 kg/ms , ρ_{water} = 1000 kg/m^3 , ρ_{air} = 12.5 kg/m^3)

(9 marks)

Q6. (a) Name two (2) types of pump and two (2) types of turbine .

(4 marks)

(b) Briefly explain with aid of figure of relationship between flow rate Q, and a different head H, in a series and parallel pump systems.

(6 marks)

(c) Two homologous pumps A and B have a same speed of 600 rpm. Pump A has an impeller of 50 cm diameter and discharges 0.4 m^3/s of water under a net head of 50m. Determine the diameter of impeller of pump B and its net head if it is to discharge 0.3 m^3/s ?

(10 marks)

Appendix I

FINAL EXAM

SEMESTER / SESSION : SEM II / 2008/2009 COURSE : 2 BFF
SUBJECT : HYDRAULICS CODE SUBJECT : BFC 2073

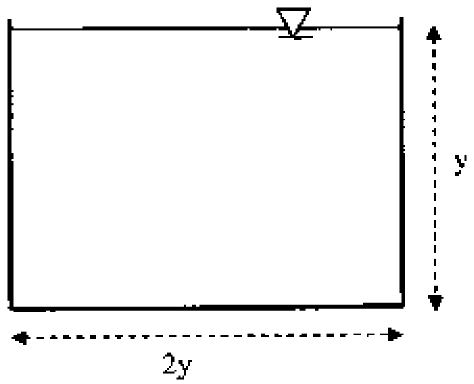


Figure Q1

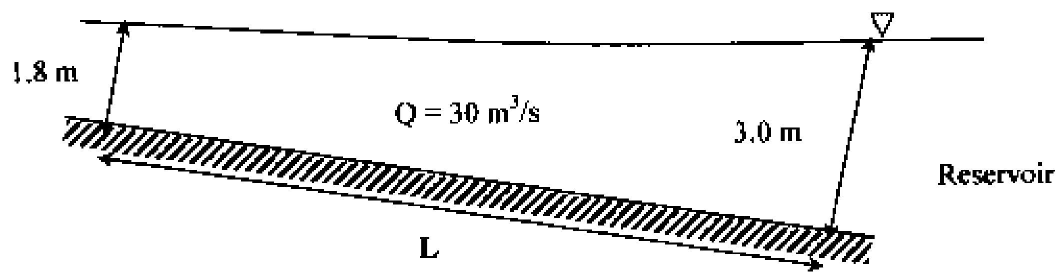


Figure Q4

Appendix II

FINAL EXAM

SEMESTER / SESSION : SEM II / 2008/2009   COURSE : 2 BFF
SUBJECT : HYDRAULICS   CODE SUBJECT : BFC 2073

Name:……………………………

Matric Number :…………………………

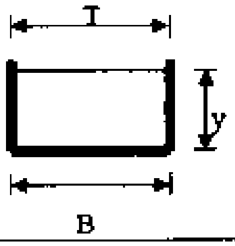
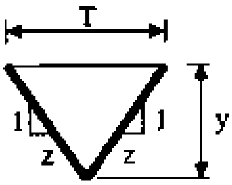
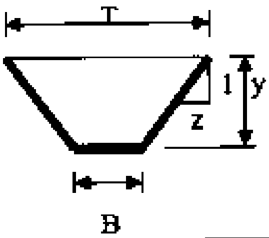
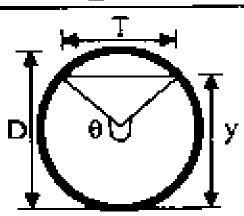
Table 1: Analysis of Water Surface Profile

y	R	V	$\frac{V^2}{2g}$	E	ΔE	i	$\bar{i}$	$S_o - \bar{i}$	Δx	L

FINAL EXAM

SEMESTER / SESSION : SEM II / 2008/2009 COURSE : 2 BFF
SUBJECT : HYDRAULICS CODE SUBJECT : BFC 2073

Table 2 : Geometri Types in Open Channel

Bentuk	A	T	P
	By	B	$B + 2y$
	zy^2	$2zy$	$2y\sqrt{1+z^2}$
	$By + zy^2$	$B + 2zy$	$B + 2y\sqrt{1+z^2}$
	$\frac{D^2}{8}(\theta - \sin\theta)$ θ dalam radian	$D(\sin\frac{\theta}{2})$ atau $2\sqrt{y(D-y)}$	$\frac{\theta D}{2}$ θ dalam radian

Appendix IV

FINAL EXAM

SEMESTER / SESSION : SEM II / 2008/2009 COURSE : 2 BFF
SUBJECT : HYDRAULICS CODE SUBJECT : BFC 2073

Table 3 : Dimension and Fluid Mechanics Quantity

Quantity	Quantity	Symbol	Dimension
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^{-1}
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^{-1}
Kelikatan dinamik	Dynamic viscosity	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}

FINAL EXAM

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SUBJECT : HYDRAULICS   CODE SUBJECT : BFC 2073

Table 4

		Scale ratios for laws of		
Characteristic	**Dimension**	**Reynolds**	**Froude**	**Mach**
Geometric				
Length	L	L_r	L_r	L_r
Area	L^2	L_r^2	L_r^2	L_r^2
Volume	L^3	L_r^3	L_r^3	L_r^3
Kinematic				
Time	T	$\left(\frac{L^2\rho}{\mu}\right)_r$	$(L^{1/2}g^{-1/2})_r$	$\left(\frac{L\rho^{1/2}}{E_v^{1/2}}\right)_r$
Velocity	LT^{-1}	$\left(\frac{\mu}{L\rho}\right)_r$	$(L^{1/2}g^{1/2})_r$	$\left(\frac{E_v^{1/2}}{\rho^{1/2}}\right)_r$
Acceleration	LT^{-2}	$\left(\frac{\mu^2}{\rho^2L^3}\right)_r$	g_r	$\left(\frac{E_v}{L\rho}\right)_r$
Discharge	L^3T^{-1}	$\left(\frac{L\mu}{\rho}\right)_r$	$(L^{5/2}g^{1/2})_r$	$\left(\frac{L^2E_v^{1/2}}{\rho^{1/2}}\right)_r$
Dynamic				
Mass	M	$(L^3\rho)_r$	$(L^3\rho)_r$	$(L^3\rho)_r$
Force	MLT^{-2}	$\left(\frac{\mu^2}{\rho}\right)_r$	$(L^3\rho g)_r$	$(L^2E_v)_r$
Pressure	$ML^{-1}T^{-2}$	$\left(\frac{\mu^2}{L^2\rho}\right)_r$	$(L\rho g)_r$	$(E_v)_r$
Impulse and momentum	MLT^{-1}	$(L^2\mu)_r$	$(L^{7/2}\rho g^{1/2})_r$	$(L^3\rho^{1/2}E_v^{1/2})_r$
Energy and work	ML^2T^{-2}	$\left(\frac{L\mu^2}{\rho}\right)_r$	$(L^4\rho g)_r$	$(L^3E_v)_r$
Power	ML^2T^{-3}	$\left(\frac{\mu^3}{L\rho^2}\right)_r$	$(L^{7/2}\rho g^{3/2})_r$	$\left(\frac{L^2E_v^{3/2}}{\rho^{1/2}}\right)_r$

Note: Usually g is the same in model and prototype.

FINAL EXAM

SEMESTER / SESSION : SEM II / 2008/2009 — COURSE : 2 BFF

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EQUATIONS

$$Q = \frac{1}{n} A R^{2/3} S_o^{1/2}$$

$$y_c = \left(\frac{q^2}{g} \right)^{1/3}$$

$$\frac{y_2}{y_1} = \frac{1}{2}\left[-1 + \sqrt{1 + 8F_r^{\,2}} \right]$$

$$E_L = \frac{(y_2 - y_1)^3}{4 y_1 y_2}$$

$$F_r = \frac{V}{\sqrt{gy}}$$

$$P = \gamma Q E_L$$

$$E = y + \frac{Q^2}{2gA^2}$$

$$Z = \frac{Q}{\sqrt{g}} = A\sqrt{D}$$

$$P = \eta_o \gamma Q H$$

$$P_2 = P_1 \left(\frac{H_2}{H_1} \right)^{3/2}$$

$$N_s = \frac{N\sqrt{P}}{H^{5/4}}$$

$$N_2 = N_1 \sqrt{H_2 / H_1}$$

$$\Delta x = \frac{\Delta E}{S_o - \bar{i}}$$

$$i = \frac{n^2 v^2}{R^{4/3}}$$

$$K_o = \frac{Q}{\sqrt{S_o}}$$

$$\bar{K} = \frac{1}{n} \bar{A} \bar{R}^{2/3}$$

$$\Delta y = \frac{y_{jauh} - y_{dekat}}{N}$$

$$\bar{y} = \frac{y_i + y_{i+1}}{2}$$

Appendix VII

FINAL EXAM

SEMESTER / SESSION : SEM II / 2008/2009 COURSE : 2 BFF
SUBJECT : HYDRAULICS CODE SUBJECT : BFC 2073

EQUATIONS

$$\left(\frac{NQ^{1/2}}{H^{3/4}}\right)_1 = \left(\frac{NQ^{1/2}}{H^{3/4}}\right)_2$$

$$\left(\frac{Q}{ND^3}\right)_1 = \left(\frac{Q}{ND^3}\right)_2$$

$$\left(\frac{H}{N^2D^2}\right)_1 = \left(\frac{H}{N^2D^2}\right)_2$$

$$\eta_H = \frac{H}{H} = \frac{gH}{u_2V_{w2} - u_1V_{w1}}$$

$$N_s = \frac{NQ^{1/2}}{H^{3/4}}$$