Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
(ONLINE)
SEMESTER I
SESSION 2020/2021

COURSE NAME	:	ADVANCED HYDRAULICS ENGINEERING
COURSE CODE	:	MFW10403
PROGRAMME CODE	:	MFA
EXAMINATION DATE	:	JANUARY / FEBRUARY 2021
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **ALL** QUESTIONS **OPEN BOOK EXAMINATION**

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

Q1 (a) Describe the mass conservation of energy using an appropriate example and relates the Bernoulli components with the energy conservation concept.

(7 marks)

(b) **TWO (2)** reservoirs are connected together by a pipeline which is 200 mm in diameter and 2000 m long for which the friction, f, is constant and equal to 0.0045. The head, **H** difference between the reservoirs is 25 m and the datum remains constant. Determine the flow discharge in the pipeline under these conditions and ignored the minor losses.

(8 marks)

(c) An earth channel with a base width 2 m and side slope 1 horizontal to 2 vertical carries water with a depth fo 1 m. The bed slope is 1 in 625. Calculate the discharge if manning's n = 0.03. Also determine the state of flow using Froude number criteria.

(10 marks)

Q2 (a) A concrete lined trapezoidal channel with uniform flow has a normal depth, 2 m. The base width is 5 m and the side sloped are equal to 1 : 2. Assume the manning's value as 0.015 and the bed slope, $S_0 = 0.001$, calculate the flow discharge, mean velocity and Froude number.

(5 marks)

(b) Determine the peak flow discharge for a new residential development for semi detached house in Batu Pahat for a total area of 40 000 m^2. Assume that 38% of the surface is the new development and the rest are park lawns and meadows. The length of overland flow is 400 m with average slope of 2 percent with paved surface and the existing drain length equal to 200 m.

(20 marks)

Q3 (a) Determine the size of a grassed channel at the downstream end of a proposed 150 hectare residential area (link and terrace house) in Alor Setar, Kedah. The engineered channel is to be design for 100-year ARI flow with n freeboard with design manning'n roughness coeeficient of 0.035. The post-development time of concentration, t_c is estimated to be 100 minutes.

(20 marks)

(b) Describe the difference between pre-development time of concentration, $t_{c\text{-}pre}$ and post-development time of concentration, $t_{c\text{-}post}$ and relates it with the estimation of peak flow for a catchment.

(5 marks)

Q4 (a) The catchment runoff of Kg Parit Haji Othman is drained gravitationally through a 500 m length into Sungai Muar. Although the drainage system of the catchment has been improved, frequent flooding still occurs whenever heavy downpour happens that coincide with high flood level at Sungai Muar that impede the local runoff from discharging into the river. The catchment area at the outlet to Sungai Muar is approximately 57.8 hectare with 55% of terrace house and the remaining are grass cover. Assume that the overland sheet flow length is 300 m with average grass cover and 1 in 1000 slope, determine the pumping rate and number of pumps required.

(15 marks)

(b) Assuming that the lowest and highest levels the pumps need to pump are 16.5 m-RL and 19.5 m-RL respectively and the weir level need to pump over is 21.5 m-RL, estimate the total dynamic head (TDH).

(10 marks)

– END OF QUESTIONS –

FINAL EXAMINATION

SEMESTER/SESSION : SEM I / 2020/2021
NAMA KURSUS : ADVANCED HYDRAULICS ENGINEERING
KOD PROGRAM : MFA
COURSE CODE : MFW10403

Appendix 1: Fitting Constants for the IDF Empirical Equations for the Different Locations in Malaysia for HIGH ARIs between 2 and 100 Year and Storm Durations from 5 minutes to 72 Hours.

State	No.	Station ID	Station Name	Constants			
				λ	κ	θ	η
Johor	1	1437116	Stor JPS Johor Baharu	59.972	0.163	0.121	0.793
	2	1534002	Pusat Kem. Pekan Nenas	54.265	0.179	0.100	0.756
	3	1541139	Johor Silica	59.060	0.202	0.128	0.660
	4	1636001	Balai Polis Kg Seelong	50.115	0.191	0.099	0.763
	5	1737001	SM Bukit Besar	50.554	0.193	0.117	0.722
	6	1829002	Setor JPS Batu Pahat	64.099	0.174	0.201	0.826
	7	1834124	Ladang Ulu Remis	55.864	0.166	0.174	0.810
	8	1839196	Simpang Masai K. Sedili	61.562	0.191	0.103	0.701
	9	1931003	Emp. Semberong	60.568	0.163	0.159	0.821
	10	2025001	Pintu Kaw. Tg. Agas	80.936	0.187	0.258	0.890
	11	2033001	JPS Kluang	54.428	0.192	0.108	0.740
	12	2231001	Ladang Chan Wing	57.188	0.186	0.093	0.777
	13	2232001	Ladang Kekayaan	53.457	0.180	0.094	0.735
	14	2235163	Ibu Bekalan Kahang	52.177	0.186	0.055	0.652
	15	2237164	Jalan Kluang-Mersing	56.966	0.190	0.144	0.637
	16	2330009	Ladang Labis	45.808	0.222	0.012	0.713
	17	2528012	Rmh. Tapis Segamat	45.212	0.224	0.039	0.711
	18	2534160	Kg Peta Hulu Sg Endau	59.500	0.185	0.129	0.623
	19	2636170	Setor JPS Endau	62.040	0.215	0.103	0.592
Kedah	1	5507076	Bt. 27, Jalan Baling	52.398	0.172	0.104	0.788
	2	5704055	Kedah Peak	81.579	0.200	0.437	0.719
	3	5806066	Klinik Jeniang	59.786	0.165	0.203	0.791
	4	5808001	Bt. 61, Jalang Baling	47.496	0.183	0.079	0.752
	5	6103047	Setor JPS Alor Setar	64.832	0.168	0.346	0.800
	6	6108001	Kompleks Rumah Muda	52.341	0.173	0.120	0.792
	7	6206035	Kuala Nerang	54.849	0.174	0.250	0.810
	8	6107032	AmpangPadu	66.103	0.177	0.284	0.842
	9	6306031	Padang Senai	60.331	0.193	0.249	0.829

FINAL EXAMINATION

SEMESTER/SESSION : SEM I / 2020/2021
NAMA KURSUS : ADVANCED HYDRAULICS ENGINEERING
KOD PROGRAM : MFA
COURSE CODE : MFW10403

Appendix 2: Values of Horton's Roughness, n (QUDM, 2007)

Land Surface	Horton's Roughness n^*
Paved	0.015
Bare Soil	0.0275
Poorly Grassed	0.035
Average Grassed	0.045
Densely Grassed	0.060

Appendix 3: Values of Manning's Roughness Coefficient (n) for Open Drains and Pipes (Chow, 1959; DID, 2000 and French, 1985)

Drain/Pipe	Manning Roughness n
Grassed Drain	
Short Grass Cover (< 150 mm)	0.035
Tall Grass Cover (≥ 150 mm)	0.050
Lined Drain	
Concrete	
Smooth Finish	0.015
Rough Finish	0.018
Stone Pitching	
Dressed Stone in Mortar	0.017
Random Stones in Mortar or Rubble Masonry	0.035
Rock Riprap	0.030
Brickwork	0.020
Pipe Material	
Vitrified Clay	0.012
Spun Precast Concrete	0.013
Fibre Reinforced Cement	0.013
UPVC	0.011

FINAL EXAMINATION

SEMESTER/SESSION : SEM I / 2020/2021
NAMA KURSUS : ADVANCED HYDRAULICS ENGINEERING
KOD PROGRAM : MFA
COURSE CODE : MFW10403

Appendix 4: Recommended Runoff Coefficients for Various Landuses (DID, 1980; Chow et. al., 1988; QUDM, 2007 and Darwin Harbour, 2009)

Landuse	Runoff Coefficient (C)	
	For Minor System (≤10 year ARI)	For Major System (> 10 year ARI)
Residential		
Bungalow	0.65	0.70
Semi-detached Bungalow	0.70	0.75
Link and Terrace House	0.80	0.90
Flat and Apartment	0.80	0.85
Condominium	0.75	0.80
Commercial and Business Centres	0.90	0.95
Industrial	0.90	0.95
Sport Fields, Park and Agriculture	0.30	0.40
Open Spaces		
Bare Soil (No Cover)	0.50	0.60
Grass Cover	0.40	0.50
Bush Cover	0.35	0.45
Forest Cover	0.30	0.40
Roads and Highways	0.95	0.95
Water Body (Pond)		
Detention Pond (with outlet)	0.95	0.95
Retention Pond (no outlet)	0.00	0.00

Note: The runoff coefficients in this table are given as a guide for designers. The near-field runoff coefficient for any single or mixed landuse should be determined based on the imperviousness of the area.

FINAL EXAMINATION

SEMESTER/SESSION : SEM I / 2020/2021
NAMA KURSUS : ADVANCED HYDRAULICS ENGINEERING
KOD PROGRAM : MFA
COURSE CODE : MFW10403

EQUATIONS

$$Q = A\frac{1}{n}R^{\frac{2}{3}}S_o^{\frac{1}{2}} \qquad q = \frac{Q}{B} \qquad y_c = \sqrt[3]{\frac{q^2}{g}} \qquad K = \frac{Q}{S_o^{\frac{1}{2}}} = \frac{1}{n}AR^{\frac{2}{3}}$$

$$Q = \frac{c \times i \times A}{360} \qquad H = \frac{P}{\rho g} + \frac{V^2}{2g} + Z \qquad Q = VA \qquad Fr = \frac{V}{\sqrt{2gy}}$$

$$h_f = \frac{fLV^2}{2gD} \qquad t_c = t_0 + t_d \qquad i = \frac{\lambda T^{\kappa}}{(d+\theta)^{\eta}} \qquad TDH = H_s + h_f + h_v + h_l$$

$$t_0 = \frac{107nL^{1/3}}{S^{1/5}} \qquad t_d = \frac{L}{V}$$