UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2016/2017

COURSE NAME	:	HYDRAULICS AND HYDROLOGY
COURSE CODE	:	BNP 20103
PROGRAMME	:	BNA/BNB/BNC
EXAMINATION DATE	:	DECEMBER 2016/JANUARY 2017
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **FIVE (5)** QUESTIONS. **TWO (2)** FROM PART A AND **TWO (2)** FROM PART B. **ONE (1)** FROM ANY PARTS

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

PART A: HYDROLOGY

Q1 (a) Explain the hydrologic cycle with the aid of labeled sketch.

(3 marks)

(b) A pond is 100 ha-cm with outflow of 3 m^3/s and inflow of 10 m^3/s. After 2 hours later, the outflow increases to10 m^3/s when while the inflow reduces to 5 m^3/s with precipitation of 15 mm. By neglecting the evaporation and infiltration, calculate

(i) Volume of the pond
(ii) Storage change (in m^3) in the pond after 2 hours

(Given 1 ha = 10,000 m^2)

(10 marks)

(c) Estimate the missing precipitation depth (cm) using the quadrant method for the data tabulated in Table Q1(c).

Table Q1(c): Precipitation Data

Quadrant	Gauge	Precipitation Depth (cm)	Coordinates (x,y)
I	A	12.2	6,15
	B	11.4	14,8
II	C	9.9	7,-8
	D	10.2	14,-8
IV	E	14.2	-9,10
	F	10.7	-18,7
	G	9.9	-15,19

(7 marks)

Q2 (a) Define

(i) Evapotranspiration potential

(ii) Evapotranspiration actual

(iii) Catchment area

(6 marks)

(b) An isolated storm produced surface runoff volume of 17500 m^3 over 50 hectares catchment area. The cumulative rainfall over the catchment is shown in **Table Q2(b)**. Sketch the hyetograph and calculate the Φ index for the storm in cm/hr.

Table Q3

Time (minute)	Cumulative rainfall (cm)
0	0
30	0.5
60	1.65
90	3.55
120	3.55
150	4.70
180	6.80
210	7.95
240	8.45

(14 marks)

Q3 (a) Explain **TWO (2)** factors affecting surface runoff.

(5 marks)

(b) Diagram **TWO (2)** techniques of baseflow separation.

(5 marks)

(c) (i) Correlate **TWO (2)** factors affecting the hydrograph shape.

(4 marks)

(ii) **Table Q3 (c)** below are the streamflows from a catchment area of 20 km^2 due to a storm of 1 hour duration. Find the Unit Hidrograph ordinates from an effective rain of 6 cm (UH_{6cm}) of 1 hour duration. Assume that a constant base flow of 15 m^3/s.

Table Q3 (c)

Time (hour)	0	1	2	3	4	5	6	7	8	9	10
Stream flow, Q (m^3/s)	15	25	50	55	48	35	30	27	24	20	15

(6 marks)

PART B: HYDRAULICS

Q4 (a) State the definition of uniform and steady flow

(2 marks)

(b) A 3 m width rectangular channel with side slope 6(H) : 4(V) carries a discharge of 25000 L/s on longitudinal slope of 0.002 and roughness n = 0.036. Determine normal depth of flow using graph method.
(Please attach your graph in answer sheet)

(10 marks)

(c) The concrete drain is to be built to convey 6 m^3/s of flow over a slope of 0.0005. If Manning's n is given as 0.015, analyze dimension of rectangular and triangular section for best hydraulic section. Justify the best shape of drain to minimize construction cost, and give a reason.

(8 marks)

Q5 (a) Energy conservation is an important concept when analyzing open channel flows. For given values of unit discharge, q, a specific energy diagram depicting energy and the depth of water, y, can be developed. With the aid of sketch, explain clearly this diagram.

(5 marks)

(b) A 2 m width of rectangular channel is conveying flow at 180 m^3/min. Manning n and slope of cannel is given as 0.03 and 0.00937, respectively. At the middle of channel, the width is reduced to 1.85 m.

(i) Calculate critical and normal depth of flow.
(ii) Analyze depth of flow before and after the constriction width.
(iii) Sketch the flow surface profile.

(15 marks)

Q6 (a) Name **THREE (3)** classification of turbine and give **ONE (1)** example of each classification.

(6 marks)

(b) 10000 L/s of water is supplied to a turbine to operate under a head of 28 m at 185 rpm. If efficiency of turbine is 90%, determine the revolution per-minute (rpm), discharge and brake power of the turbine to operate under 20 m head.

(8 marks)

(c) Relate the head H, efficiency η, inflow power P_i, and the best efficiency point (BEP) of a centrifugal pump.

(6 marks)

- END OF QUESTION –

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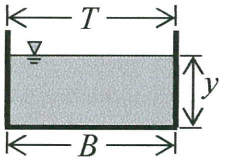
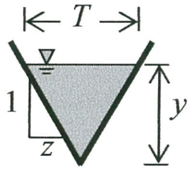
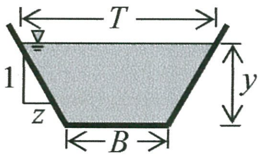
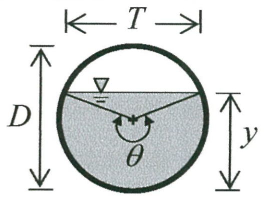
Table 1. Open channel flow section geometries

Section	Area A	Top width T	Wetted perimeter P
 Rectangular	By	B	$B + 2y$
 Triangular	zy^2	$2zy$	$2y\sqrt{1+z^2}$
 Trapezoidal	$By + zy^2$	$B + 2zy$	$B + 2y\sqrt{1+z^2}$
 Circular	$\frac{D^2}{8}(\theta - \sin\theta)$	$D\left(\frac{\sin\theta}{2}\right)$	$\frac{\theta D}{2}$

TERBUKA

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Table 2. Best hydraulic sections

Cross section	Area A	Wetted perimeter P	Hydraulic radius R	Top width T	Hydraulic depth D
Trapezoid	$\sqrt{3}y^2$	$2\sqrt{3}y$	$\frac{y}{2}$	$\frac{4\sqrt{3}}{3}y$	$\frac{3}{4}y$
Rectangle	$2y^2$	$4y$	$\frac{y}{2}$	$2y$	y
Triangle	y^2	$2\sqrt{2}y$	$\frac{\sqrt{2}}{4}y$	$2y$	$\frac{y}{2}$
Semicircle	$\frac{\pi}{2}y^2$	πy	$\frac{y}{2}$	$2y$	$\frac{\pi}{4}y$
Parabola	$\frac{4\sqrt{2}}{3}y^2$	$\frac{8\sqrt{2}}{3}y$	$\frac{y}{2}$	$2\sqrt{2}y$	$\frac{2}{3}y$

Some useful equations:

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

$$Q = ACR^{\frac{1}{2}}S_o^{\frac{1}{2}}$$

$$P = \gamma QH$$

$$\mathrm{Fr} = \frac{V}{\sqrt{gD}}$$

$$q_{\max} = \sqrt{gy_c^{\,3}}$$

$$q_{\max} = \frac{Q}{B_{\max}}$$

$$\frac{P}{D^5N^3}$$

$$\frac{ND}{\sqrt{H}}$$

$$\frac{Q}{ND^3}$$

$$E = y + \frac{V^2}{2g}$$

$$E_{\min} = \frac{3}{2}y_c$$

$$y_c = \sqrt[3]{\frac{q^2}{g}}$$