
UNIVERSITI SAINS MALAYSIA

First Semester Examination
Academic Session 2008/2009

November 2008

EAD 515/4 – Hydraulic Structure

Duration: 3 hours

Please check that this examination paper consists of **FOUR (4)** pages of printed material before you begin the examination.

Instructions: Answer **FOUR (4)** questions. All questions carry the same marks.

You may answer the question either in Bahasa Malaysia or English.

All questions **MUST BE** answered on a new sheet.

Write the answered question numbers on the cover sheet of the answer script.

1. A large dam is to be constructed in Selangor. The annual maximum daily rainfall data collected at a rainfall station located in the river basin is given below. By using the Hershfield technique and assume an adjustment factor of 1.13, calculate the 24-h probable maximum precipitation (PMP) that will yield the design flood to ensure the highest safety level of the dam.

Equations: $X_{PMP} = \bar{X}_n + K_m \sigma_n$
 $K_m = (X_1 - \bar{X}_{n-1}) / \sigma_{n-1}$

Length of data = 30 years

Year	X_n (mm)	Year	X_n (mm)	Year	X_n (mm)	Year	X_n (mm)	Year	X_n (mm)	Year	X_n (mm)
1	195	6	194	11	206	16	179	21	230	26	233
2	166	7	180	12	202	17	190	22	172	27	196
3	170	8	225	13	250	18	182	23	185	28	198
4	205	9	210	14	213	19	204	24	226	29	234
5	228	10	188	15	174	20	208	25	219	30	226

[25 marks]

2. A vertical lift gate discharges into a channel with the upstream depth, $y_1=3.0\text{m}$.

Estimate:

- (i) The discharge and the force acting on the gate when the downstream depth, $y_3=0.5\text{m}$. Assume $c_c=0.605$, and $\beta=1$.

[10 marks]

- (ii) The force acting on the gate when the downstream depth, $y_3=2.1\text{m}$. Assuming the discharge remains constant as in (i).

[15 marks]

Equation: $C_d = C_c \left(1 + C_c \frac{a}{H} \right)^{1/2}$

3. (a) A box culvert that will be built has the following characteristics:

Manning roughness coefficient = 0.013

Height = 2m

Width = 3m

Length = 30m

Bed slope = 0.001

Head loss coefficient = 0.5

(i) Calculate the flow rate (Q) and approaching depth (H) if the depth of flow in the culvert is 1.2m.

[7 marks]

(ii) Calculate the flow rate (Q) for full culvert flow with approaching depth equal to 5m.

[3 marks]

3. (b) Describe the energy dissipation mechanism in stilling basin and explain **FOUR (4)** types stilling basin?

[15 marks]

4. (a) Explain **THREE (3)** types of energy dissipaters and describe their functions?

[10 marks]

(b) Explain Ogee spillway under submerged condition?

[8 marks]

(c) Briefly describe **FOUR (4)** schemes of water power development plants?

[7 marks]

5. (a) The overfall spillway length = 200 m has been designed for a head of 2.8m. What will be the discharge for heads of 0.20m and 1.5m, and what is the maximum discharge that can be passed over this spillway (assuming the dam free board to be high enough and the spillway to be well constructed) with out cavitation?

[15 marks]

- (b) What is duty point of pump? Use the data below and calculate duty point for pump when the friction factor = 0.04?

[10 marks]

Total Head (m)	30	50	65	80
Discharge (lit/min)	2000	1750	1410	800