NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY
FACULTY OF INDUSTRIAL TECHNOLOGY
BACHELOR OF ENGINEERING (HONS) DEGREE
DEPARTMENT OF CIVIL AND WATER ENGINEERING
PART V SUPPLEMENTARY EXAMINATIONS- JULY 2011

HYDRAULIC DESIGN II – TCW5201

Instructions:
Answer ANY FOUR questions
Total marks: 100
Time: 3 hours

QUESTION 1

a. Circular concrete pipes (n=0.013) are used as culvert on a slope of 0.09. The culvert is 1.2m in diameter, 42m long. The entrance is square edged (k_{ent}= 0.5) and flush with the wall. The tail water level is 0.6m below the culvert crown at outlet. Determine the discharge if the head water is 0.5m above the crown at the inlet. (15 marks)

b. Draw and label a typical cross section through a zoned earthdam highlighting the measures taken to control seepage and embankment erosion.   (10 marks)

QUESTION 2

a. Estimate the discharge for a venturi flume with a level invert, having a throat width of 1m installed at one point of a rectangular open channel 2m wide if:

   i.   The upstream depth is 1.2m and the critical flow occurs in the flume

   ii.   If the upstream depth is 1.2m and the depth in the throat is 1.05m. Assume C_v =1 and C_d= 0.95   (10marks)

b. A masonry gravity dam of rectangular crossection is to be constructed. The density of the masonry is 2700kg/m^3 and that of water 1000kg/m^3. The maximum reservoir level is 305m, while the level of the crest of the dam is 300m and the level of the base of the dam is 270m. Draw a neat sketch showing the loading on the dam and the related pressure distribution of these forces and determine the minimum width of the dam assuming a 1m length. (15 marks)

QUESTION 3

a. Describe the middle third rule and explain its application in the design of concrete gravity dams. (5 marks)

b. What are the functions of a stilling basin and what major considerations should be taken into account in designing a stilling basin? (5 marks)

c. Discuss flood routing as an essential tool in the design of dams. What other factors and considerations should be made in dam design? (15 marks)

QUESTION 4

An overflow spillway 80m wide carries a maximum discharge of 400m³/sec. Define the crest profile for the spillway, assuming a 3:1 upstream slope and a 2:1 downstream slope and that C=2.2. (25 marks)

QUESTION 5

a. Describe the effects of sedimentation in reservoirs and suggest ways to counter these. (5marks)

b. Water flows along a rectangular channel at depth of 1.30m when discharge is 8.74m³/sec and the channel width is 5.5m. Ignoring energy losses, what is the minimum height of a rectangular broad crested weir if it is to function with critical depth on its crest? (10 marks)

c. With aid of neatly labeled sketches describe how the venture flume is used to measure flow in an open channel. (10 marks)
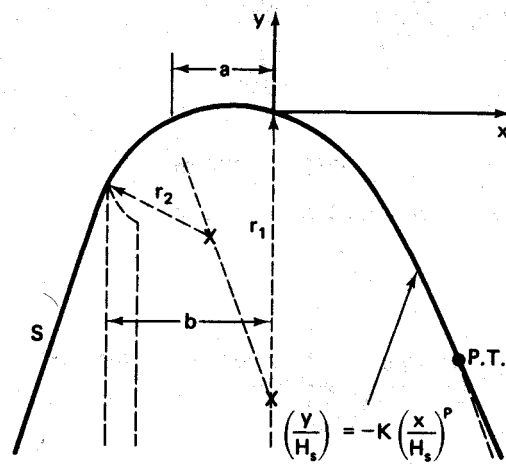

Upstream slope (vert/hor.)

	3/0	3/1	3/2	3/3
a/H_s	0.175	0.139	0.115	0
b/H_s	0.282	0.237	0.214	0.199
r_1/H_s	0.50	0.68	0.48	0.45
r_2/H_s	0.20	0.21	0.22	–
K	0.500	0.516	0.515	0.534
P	1.850	1.836	1.810	1.776

$$\left(\frac{y}{H_s}\right) = -K\left(\frac{x}{H_s}\right)^P$$

Figure 8.12 Overflow spillway profile.