

**NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY  
 FACULTY OF INDUSTRIAL TECHNOLOGY  
 BACHELOR OF ENGINEERING (HONS) DEGREE  
 DEPARTMENT OF CIVIL AND WATER ENGINEERING  
 PART V SECOND SEMESTER EXAMINATIONS- JUNE 2010**

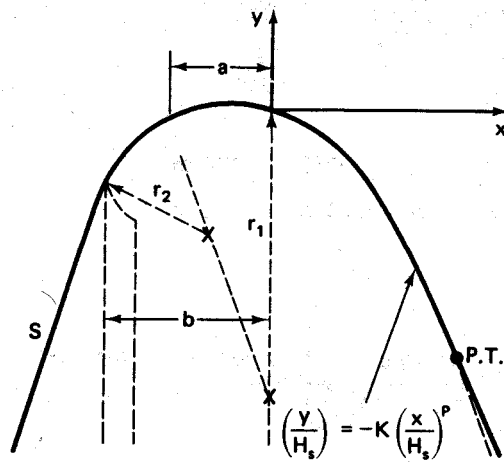
**HYDRAULIC DESIGN II – TCW5201**

**Instructions:**  
**Answer All**

Total marks: 100  
 Time: 3 hours

**QUESTION ONE**

- a. A horizontal rectangular stilling basin of U.S.B.R Type III is used at the outlet of a spillway to dissipate energy. The spillway discharges  $10\text{m}^3/\text{sec}$  and has a uniform width of  $10\text{m}$ . At the point here water enters the basin, the velocity is  $10\text{m}/\text{sec}$ . Calculate the sequent depth of the hydraulic jump. (5 marks)
- b. A spillway needs to be designed to carry a peak flow of  $50\text{m}^3/\text{sec}$  with the reservoir elevation  $1\text{m}$  above the crest of the spillway. The elevation difference between the reservoir and the tailwater is  $15\text{m}$ . If the overflow spillway is used with a crest coefficient of  $2.0$ , determine the length of the spillway crest required to handle the



	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

**Figure 8.12** Overflow spillway profile.

discharge. Define the crest profile assuming an upstream slope of 3:1.

(20 marks)

**QUESTION TWO**

- a. A masonry gravity dam of rectangular cross-section is to be constructed. The density of the masonry is  $2700\text{kg/m}^3$  and that of water  $1000\text{kg/m}^3$ . 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)
- b. Describe the techniques used in site investigation for a dam highlighting the information to be derived from these methods. (5 marks)
- c. Describe the factors that must be considered
  - i. When siting a dam
  - ii. When choosing the type of dam to be constructed. (5marks)

### **QUESTION THREE**

- a. Describe the effects of sedimentation in reservoirs and suggest ways to counter these. (5marks)
- b. Draw and label a typical cross section through a zoned earthdam highlighting the measures taken to control seepage and embankment erosion. (10 marks)
- c. Water flows over a broad crested weir 0.5m high that completely spans a rectangular channel 10.0m wide. When the discharge is  $19.03\text{m}^3/\text{sec}$ , estimate the depth of flow upstream of the weir. Assume no loss of energy and that critical depth occurs on the weir crest. (10 marks)

### **QUESTION FOUR**

- 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.
  - i. Determine the discharge if the head water level is 0.5m above the crown at the inlet.
  - ii. Determine the head water elevation for a discharge of  $10\text{m}^3/\text{sec}$  (15 marks)
- b. 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)