Bengal Engineering and Science University, Shibpur
M.E. (Civil) 1st Semester Examination, 2013
Sub: Open Channel Hydraulics – I (AM 913)

Time: 3 hours Full Marks: 70

Answer any four from the following. Two marks are reserved for neatness

---

1 a) A sluice gate in a 2.0 m wide horizontal rectangular channel is discharging freely as shown in figure. If the depths y_1 and y_2 are 2.5m and 0.20m respectively, determine the discharge in the channel assuming energy loss at the gate to be 10% of the upstream depth y_1. (12)

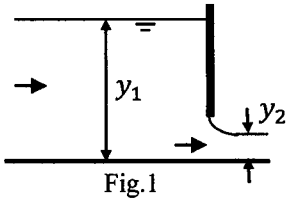

Fig.1

b) For the velocity distribution shown in Fig. 2, find α and β. (5)

2. If y_1 and y_2 are alternate depths in a rectangular channel show that

$$\frac{2y_1^2y_2^2}{(y_1+y_2)} = y_c^3$$

and hence the specific energy (17)

$$E = \frac{y_1^2 + y_1y_2 + y_2^2}{(y_1+y_2)}$$

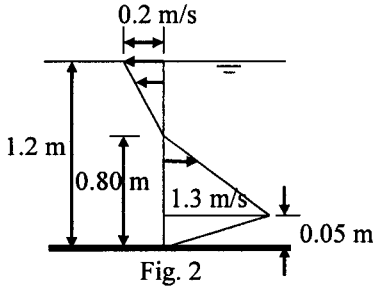

Fig. 2

3. Water flows at a velocity of 1.0 m/s and a depth of 2.0m in an open channel of rectangular cross-section and bed-width of 3.0m. At certain section the width is reduced to 1.80m and the bed is raised by 0.65m. Will the upstream depth be affected and if so, to what extent? (17)

4. For the following two pressure distributions in an open channel flow (Fig. 3 and Fig. 4), calculate the effective piezometric head. Take the hydrostatic pressure distribution as the reference. (8+9 =17)

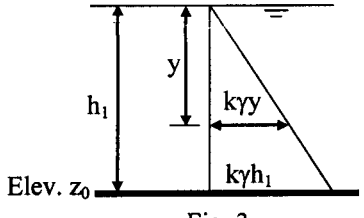

Fig. 3

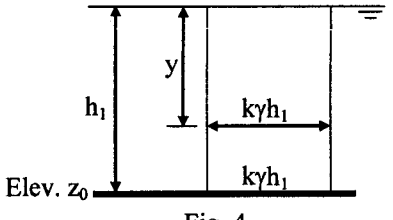

Fig. 4

5. Calculate the bottom width of a channel required to carry a discharge of 15.0 m^3/s as a critical flow at a depth of 1.2m, if the channel section is (a) rectangular, and (b) trapezoidal with side slope 1.5(H): 1(V). (8+9=17)

6. a) Derive the relationship between the specific energy and the critical depth for a triangular channel having side slope of *m*(H):1(V). (6)

b) A rectangular channel section is to have critical flow and at the same time the wetted perimeter is to be minimum. Show that for these two conditions to occur simultaneously, the width of the channel must be equal to 8/9 times the minimum specific energy head. (11)

7. A rectangular channel is 3.5m wide and conveys a discharge of 15.0 m^3/s at a depth of 2.0 m. It is proposed to reduce the width of the channel at a hydraulic structure. Assuming the transition to be horizontal and the flow to be frictionless, determine the water surface elevations upstream and downstream of the constriction when the constricted width is 2.5m. (17)

8. A concrete-lined trapezoidal channel (n = 0.015) is to have a side slope of 1(H):1(V). The bottom slope is to be 0.0004. Find the bottom width of the channel necessary to carry 100 m^3/s of discharge at a normal depth of (a) 2.50m and (b) 3.5m. (17)