B.Tech. Civil (Water Resources Engineering)

Term-End Examination

June, 2007

ET-533(B) : OPEN CHANNEL FLOW

Time : 3 hours *Maximum Marks : 70*

Note : *Solve any **five** questions. All questions carry equal marks. Give neat and labelled sketches in support of your answer. Use of calculator is allowed.*

1. (a) A triangular section with side slope z = 1·5 runs water at a depth of 3·5 m. Calculate its hydraulic radius (R), and top width (T). *5*

(b) Distinguish between hydraulic radius and hydraulic depth of an open channel. *4*

(c) If a triangular section has a section factor (z) = 9·2 in metric units, find the depth of flow in it if z = 2. *5*

2. (a) Explain what you understand by specific energy; and give a typical specific-energy curve for a given discharge in an open channel. *6*

(b) A rectangular channel expands smoothly from a width of 2 m to 3·5 m. If u/s of the expansion has a depth of flow as 0·75 m, and the velocity of flow is 2·3 m/s, derive the equation in terms of y (d/s flow depth) to help estimate the depth of flow after the expansion. (There is no change in the elevation of the channel bed). Indicate how you will solve this equation; and which value of y would you adopt out of the values that form the solution of the equation. *8*

3. (a) Explain how bed slopes are categorised as horizontal, mild, critical, and steep. *4*

(b) Derive, from first principles, an expression for the hydraulic exponent for a uniform-flow computation in terms of flow depth, flow area, top flow width, hydraulic radius, and (dP)/dy. *7*

(c) If the hydraulic exponent for the critical flow computation, M = 3·12, and hydraulic exponent for uniform flow computation, N = 3·71, find the value of J. *3*

4. (a) Discuss, in brief, the design of channel contractions and expansions at transitions. *5*

(b) A venturi flume is 1·5 m wide at its entrance, and 0·5 m at its throat. Neglecting hydraulic losses in the flume, determine the flow through the flume, if the depth of flow at these sections is 0·6 m and 0·55 m, respectively. *9*

5. Show that for negative surges in an open channel :

$$V_w = 3\sqrt{gy} - V_2 - 2\sqrt{gy_2},$$

symbols denoting their usual meaning. *14*

6. Starting from velocity potential (ϕ), discuss mathematically the particle velocity and orbital motion with respect to a wave in an open channel. *14*

7. Write short notes on any ***two*** of the following : *2×7*

(i) Velocity distribution in open channels with triangular, trapezoidal, narrow rectangular and circular cross-sectional shapes

(ii) Wave action on dams

(iii) Wave action on structures standing on shores