BENGAL ENGINEERING AND SCIENCE UNIVERSITY, SHIBPUR
M.E. 1st SEMESTER (C.E.) FINAL EXAMINATION, NOVEMBER, 2011
Open Channel Hydraulics I (AM 913)

Full Marks: 70 **Time: 3 Hours**

All questions carry equal marks.
All symbols have their usual meaning.
Answer any FIVE questions.

1.(a) Write down the expressions for Coherence and Discharge Adjustment Factor of an open channel of compound cross-section with all side walls vertical. Derive the formula for Coherence that you have written.

1.(b) Starting from the basic equation of Kinetic Energy Correction Factor and Momentum Correction Factor for a fluid flow, derive the expressions of Kinetic Energy Correction Factor and Momentum Correction Factor for an open channel of compound cross-section with all side walls vertical.

1.(b) A straight open channel of compound cross section has **b** of 5.5 m, **B** of 25 m, **d** of 3 m and **D** of 3.0001 m. Compute the Coherence, $\mathbf{U_{mc}}$, $\mathbf{U_{fp}}$, the Froude Number in the main channel and the Froude number over the floodplains if Manning's **n** equals 0.021. Also find the streamwise velocity at the water surface at the centreline of the main channel and at the water surface over the floodplains. If the Discharge Adjustment Factor is 0.9, what is the value of the actual discharge through the entire channel section? What are the values of Kinetic Energy Correction Factor and Momentum Correction Factor for this channel?

2.(a)A supercritical flow has a Froude number of 2.3 and a flow depth of 0.9 metre. What is the mean velocity of the flow? What is the celerity of a transverse wave in the water, the velocity of the forward wavefront and the velocity of the backward wavefront?

2.(b)What is meant by a Control Section? A sharp-crested trapezoidal weir has its two side slopes inclined at 35 degree and 70 degree to the vertical. If the the bottom width of the weir is 0.7, the head on the crest of the weir is 0.35 m, and the Coefficient of Discharge is 0.94, compute the discharge?

2.(c)What is a broad-crested weir? Describe, with the aid of a neat diagram. What is the pressure distribution on a broad-crested weir?

3.(a)Describe, with neat sketches, the phenomenon of local scour around a bridge pier, clearly distinguishing between clear water scour and live bed scour. Describe in detail the impact of local scour around a bridge pier on bridge pier foundation configurations.

3.(b) Describe, with neat sketches, the following methods of local scour reduction explaining clearly how they function:

[I] Protective piles,
[II] Multiple piers.

4.(a) Explain, with the aid of neat diagrams, why shear stresses occur over the imaginary vertical interfaces between the main channel and the floodplains?

4.(b) What is the advantage of the power law over the logarithmic law in modelling the streamwise velocity in open channels of different planform and cross-section? What are the numerical values of the exponent in the power law for straight and curved channels?

4.(c) Interrelate Manning's roughness coefficient, Chézy's coefficient and Darcy-Weisbach friction factor by means of equations.

5.(a) Describe, with neat sketches, the following methods of local scour reduction explaining clearly how they function:

[I] Collar,
[II] Delta Wing,
[III] Slot.

5.(b) Discuss in detail about turbulence in open channels? Describe, with neat sketches, the Direct Numerical Simulation method and the Large Eddy Simulation method to find the velocity vector in turbulent open channel flow?

6.(a) What is meant by Coefficient of Sinuousity? Describe, with neat sketches, the causes meandering in natural open channels.

6.(b) Describe, with neat sketches, what is meant by adverse slope, mild slope, critical slope and steep slope showing the critical and normal depth lines in each sketch.

6.(c) Explain, with neat sketches, the fundamental difference between a supercritical flow and a subcritical flow from the viewpoint of the propagation of transverse surface waves in each type of flow? What is a shock front?