El-Mansoura University
Faculty of Engineering
Dept. of Irrigation & Hydraulics
Third Year Civil Engineering

First Term Examination
Hydraulics
January 22, 2014
Time Allowed: 3 Hours

Answer the following questions. Tidy and neat answers are necessary.

Question (I):

(a) Define the following hydraulic terms:

Steady varied flow	Rough turbulent flow
Convex curvilinear flow	Velocity coefficients
Turbulent boundary layer	Boundary layer thickness

(b) A wide channel carries approximately uniform flow at a depth of 4.0 m. The velocities at 0.2 and 0.8 of the depth are found to be 0.8 m/sec (maximum) and 0.4 m/sec respectively. Estimate:
(i) the discharge per unit width, and (ii) values of momentum and energy coefficients.
(c) Derive the continuity equation for unsteady flow . While measuring the discharge in an open channel, It was found that the depth of flow increases at a rate of 0.2 m/ hr. If the discharge at a section was12 m^3 / sec and the surface width was 10 m, estimate the discharge at 2 km downstream
(d) A smooth square plate 1.5 m side is kept immersed in water which moves with a velocity 60 cm/sec. Find the thickness of the boundary layer and the average shear stress at a distance 1.0 m from the leading edge. Take the kinematic viscosity of water equal to 10^{-6} m^2/sec.

Question (II):

(a) Prove that for a given specific energy in a channel of unrestricted cross section the discharge is maximum when the flow is critical.
(b) What do you understand by the term control section?
Water flows from a lake into a steep rectangular channel 10.0 m wide, and the lake level is 3.0 m above the channel bed at the outfall. Find the discharge.
(c) A uniform flow of 20 m^3/sec occurs in a rectangular channel 5 m width and 2.5 m water depth. Calculate :
(i) the greatest allowable constriction in width for the upstream flow to be as possible as specified, draw the relationship between y_1, y_2 and b_2/b_1.
(ii) the height of hump to produce critical depth, draw the relationship between y_1, y_2 and ΔZ.
(iii) what is the effect of increasing the height of hump to 1.0 m on the water surface.
Illustrate your answer by drawing the specific energy and specific discharge diagrams.

Question (III):

(a) Derive a relationship between the initial depth and sequent depth of the hydraulic jump in a rectangular channel.
A Hydraulic jump is formed in a horizontal smooth rectangular open channel, bed with is 10 m and the two conjugate depths are 2 m and 5 m. Calculate the discharge passing, the power dissipated by the jump, the relative sequent depth the overall efficiency, and the length of the jump.

P.T.O.

(b) What does a positive surge mean?
A rectangular channel 4 m wide conveys a discharge of 25 m^3 /sec at a depth of 3.0 m. The gate is suddenly closed to release a discharge of 12 m^3 /sec, calculate the initial celerity and the depth of the surge wave.
(c) Verify from dimensionless forms for both the specific energy and momentum functions that there is a reciprocal relationship between them

Question IV:

(a) A rectangular channel 4.0 m wide carries water at 20 o at a depth of 1.5 m, is laid on a slope 0.0004, (i) find the hydrodynamic nature of the surface of the bed if Ks = 0.6 mm, and (ii) estimate the discharge using Chezy Equation with the modified Col-brook formula.
(b) A rectangular channel 4.0 m wide had badly damaged surface and had Manning n = 0.03. For repair, its bed was lined with concrete (n= 0.015). If the depth remains the same at 1.5 m before and after repair, what is the increase in discharge as a result of this repair.

Best Wishes