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

First Term Examination
Hydraulics
Dec.15, 2012
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
Boundary layer thickness	Turbulent boundary layer
Convex curvilinear flow	Velocity coefficients

(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 0.9 m/sec (maximum) and 0.5 m/sec respectively. Estimate:
(i) the discharge per unit width, and (ii) values of momentum and energy coefficients.

(c) A smooth square plate 2.0 m side is kept immersed in water which moves with a velocity 50 cm/sec. Find the thickness of the boundary layer and the average shear stress at a distance 1.2 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 discharge in a channel of unrestricted cross section the specific energy is minimum 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 5.0 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) Prove that for a given discharge, the momentum function has its minimum value at critical depth.

(b) Derive a relationship between the initial depth and sequent depth of the hydraulic jump in a rectangular channel.
A spillway discharges a flood flow in a rectangular channel at a rate of 12 m^3/sec/m. At downstream horizontal apron the depth is found to be 0.8 m. What downstream water depth is needed to form a hydraulic jump. If the jump is formed, find its type, length, and power dissipated by the jump in watts.

P.T.O.

(c) What does a positive surge mean?
A rectangular channel 5.0 m wide conveys a discharge of 20 m^3/sec at a depth of 2.5 m. Determine the depth and celerity of surge wave resulting from sudden gate closure.

Question (IV):

(a) From the first principle, derive Chezy's equation. Draw the modified Moody diagrams showing the behavior of the Chezy C with Reynolds number Re.

(b) A rectangular channel 5.0 m wide carries water at 20° C at a depth 2.0 m is laid on a slope0.0004 find the hydrodynamic nature of the surface If k_s = 0.5 mm, and estimate the discharge by using Chezy equation with modified Colebrook White formula

(c) Write different assumptions used for determining the equivalent Manning's coefficient n for a channel of composite roughness.
A trapezoidal channel with bed slope of 0.005, bed width 3.0 m and side slop 1 : 1 has a gravel bed (n = 0.025) and concrete sides (n = 0.015). Calculate the uniform flow discharge when the depth of flow is 1.0 m using:
(i) the Einstein; (ii) the Pavlovskij; and (iii) the Lotter Methods.
Comment upon your results.

Best Wishes