Printed Pages—4 ECE403

(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : 0026 Roll No.

B.Tech.

(SEM. IV) EVEN THEORY EXAMINATION 2012-13

HYDRAULICS AND HYDRAULIC MACHINES

Time : 3 Hours *Total Marks : 100*

Note :– (i) Attempt **ALL** questions.

(ii) Use illustrations, wherever needed.

(iii) Assume missing data suitably, if any, and state the assumptions made.

1. Attempt any **four** parts of the following: **(5×4=20)**

(a) Define-Prismatic channel, hydraulic mean depth and steady uniform open channel flow.

(b) Show by using Manning's formula that the average boundary shear stress is given by

$$\tau_0 = \frac{pg\, n^2 V^2}{R^{1/3}}$$

where R is hydraulic radius, V is average velocity n is Manning's coefficient.

(c) Draw the velocity distribution curve along the depth of the rectangular and circular channel.

(d) A trapezoidal channel with side slopes of 2 (H) : 1 (V) has to be designed to carry 20 m^3/s at slope of $\frac{1}{5500}$. Determine the depth of flow. Bottom width 3.0 m and Manning's coefficient n = 0.015.

(e) What is Chezy's formula ? How is it derived ?

(f) Derive the expression for specific force in a rectangular channel section.

2. Attempt any **two** parts of the following : **(2×10=20)**

(a) What are the conditions for the trapezoidal channel of best section ? Derive any two conditions.

(b) A bridge is planned on a 50 m-wide rectangular channel carrying a flow of 200 m^3/s at a flow depth of 4.0 m. For reducing the length of the bridge, what is the minimum channel width such that the upstream water level is not influenced for this discharge ?

(c) A concrete lined circular channel of 3 m diameter has a bed slope of 1 in 5000. Determine the velocity and the flow rate for the condition of :

(i) Maximum velocity and

(ii) Maximum discharge

Take Chezy's constant C = 50.

3. Attempt any **two** parts of the following : **(2×10=20)**

(a) Define the terms :

(i) Afflux

(ii) Back water curve

(iii) Drawdown curve

Derive expression for the length of the back water curve in case of gradually varied flow.

(b) Classify the various flow profiles with the help of their neat sketches.

(c) For a wide rectangular channel, derive expression for the channel bottom slope to be mild, steep and critical.

4. Attempt any **two** parts of the following : **(2×10=20)**

(a) Describe different types of hydraulic jump. Discuss the use of the hydraulic jump as an energy dissipator below a hydraulic structure.

(b) A rectangular channel 3.0 m wide has a flow of 3.8 m^3/sec with the velocity of 0.9 m/s. If the sudden release of additional flow at the upstream end of the channel causes the depth to raise by 50 percent, determine the absolute velocity of the resulting surge and the new flow rate.

(c) If the flow depth at the entrance to the constant width, rectangular transition with bottom slope S_o is equal to the critical depth, y_{ci}, then prove that the flow depth y in the transition is given by the equation

$$S_o\ x = y + \frac{1\ y\ c^3}{2\ y\ z} - \frac{3}{2}\ yc$$

5. Attempt any **four** parts of the following : **(5×4=20)**

(a) Define and explain-Hydraulic efficiency, mechanical efficiency and overall efficiency in case of turbines. Derive relationship among themselves.

(b) Define the terms unit power, unit speed and unit discharge. Obtain an expression for unit speed.

(c) Write a note on characteristic curves for rotadynamic pumps.

(d) Enumerate classification of rotadynamic pumps and differentiate between volute casing and vortex casing for the pumps.

(e) Derive an expression for condition for maximum hydraulic efficiency of a Pelton wheel turbine giving equation for maximum efficiency.

(f) A rotadynamic pump running at 1500 rpm discharges 120 litres per second against a head of 25 meters. If the diameter of the impeller is 250 mm and its width is 50 mm, find the vane angle at the outer periphery. The manometric efficiency of the pump is 75%.