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

PAPER ID : 0026 Roll No.

B.Tech.

(SEM IV) EVEN SEMESTER THEORY EXAMINATION, 2009-2010

HYDRAULICS AND HYDRAULIC MACHINES

Time : 3 Hours *Total Marks : 100*

Note : *(i) Attempt **all** questions.*

*(ii) All questions carry **equal** marks.*

(iii) Assume any data suitably, if required.

1. Attempt ***any four*** parts of the following : **(4x5=20)**

(a) Write difference between open channel flow and pipe flow. What causes the flow in an open channel ?

(b) Derive expression for equation of continuity for unsteady flow in an open channel.

(c) Describe critical depth of an open channel having rectangular section giving specific energy and Froude number.

(d) A discharge of 25 m^3/s flows in a 12 m wide rectangular channel under the critical condition. Find depth, specific energy and critical slope of the channel 2f n = 0.015.

(e) A trapezoidal channel has a bottom width of 8.0 m and side slope of 1 : 1. The depth of flow is 1.5 m at a discharge of 20 m^3/s. Determine the specific energy and alternate depth.

(f) A rectangular channel 4 m wide carries a discharge of 15 m^3/sec at a depth of 2.0 m. If the bed is raised by 0.30 m, find the depth of flow over the raised bed and fall in the water surface.

2. Attempt *any two* parts of the following : **(2x10=20)**

(a) Describe Manning's equation for uniform flow in an open channel with its limitations. Also find the depth of flow under uniform condition for a rectangular channel 1.0 m wide having velocity of 1 m/s, bed slope 2×10^{-3} and $h = 0.015$

(b) Briefly explain maximum discharge of a channel of the second kind. Also analyse the maximum discharge in a circular channel and prove that :

$$\frac{Q_m}{Q_F} = 1.0757$$

(c) A trapezoidal channel is to carry a discharge of 40 m^3/s. The maximum slope can be used is 1 : 2500 and soil is hard. Design the channel as unlined non erodible channel. Take $n = 0.020$ and side slope 1 : 1

3. Attempt *any two* parts of the following : **(2x10=20)**

(a) Enumerate and explain with neat sketches classification of flow profiles.

(b) Describe numerical integration method for computation of gradually varied flow in prismatic channels.

(c) A part of a river assumed as a trapezoidal channel of side slope 1 : 1 expanding uniformly from a bottom width of 10.0 m at its upstream end to 20.0 m at the downstream end of 1.0 km reach. The depth of flow at the downstream end is 5.0 m when the river is carrying a discharge of 100 m^3/s. The average slope of the river is 1 : 1000 and $n = 0.018$. Calculate the depth of flow at a distance of 200 m from the downstream end of the river.

4. Attempt *any two* parts of the following : **(2x10=20)**

(a) Define hydraulic jump. Write their uses. Describe with sketches types of hydraulic jumps on the basis of Froude number and jumps at vena contracta, repelled jump and submerged jump.

(b) An overflow spillway is 40.0 m high. At the design energy head of 2.5 m over the spillway calculate the sequent depths and energy loss in a hydraulic jump formed on a horizontal apron at the toe of the spillway. Neglect energy loss due to flow over spillway face. Take $C_d = 0.738$.

(c) Giving classification of surge with neat sketches and describe positive surge moving downstream and deduce expression .

5. Attempt *any four* parts of the following : (4x5=20)

(a) Enumerate classification of rotadynamic pumps and differentiate between Volute casing and Vortex casing for the pumps.

(b) Write a note on characteristics curves for rotadynamic pumps.

(c) 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%.

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

(e) An inward flow reaction turbine running at 500 rpm has an external diameter of 700 mm and a width of 180 mm. If the guide vanes are at 20° to the wheel tangent and the absolute velocity of water at inlet is 25 meters per second, find the discharge of the turbine and runner vane angle at inlet.

(f) A Kaplan turbine works under a head of 11 meters and runs at 95 rpm. The outlet vane angle at the extreme edge of the runner is 20°. The boss diameter is 1/3 of the diameter of the runner. The flow ratio is 0.5. Determine the diameters of the runner and the boss. Assume the whirl at outlet to be zero.

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