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17CV43

Fourth Semester B.E. Degree Examination, Jan./Feb. 2021
Applied Hydraulics

Time: 3 hrs. Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. Define dimensional homogeneity. Give two examples. **(04 Marks)**

b. Explain how repeating variables are selected for dimensional analysis in π-theorem. Also state π-theorem. **(06 Marks)**

c. The frictional torque T of a disc of diameter D rotating at a speed N in a fluid of viscosity μ and density ρ in a turbulent flow is given by

$$T = D^5N^2\rho\phi\left(\frac{\mu}{D^2N\rho}\right).$$

Prove this by Buckingham's π - theorem. **(10 Marks)**

OR

2 a. Define (i) Metacentric height (ii) Buoyancy (iii) Prototype (iv) Similitude. **(08 Marks)**

b. What do you understand by Froude model law? Mention its applications. Derive any 5 scale ratios for physical quantities based on Froude model law. **(12 Marks)**

Module-2

3 a. Derive Chezy's equation for flow through an open channel. Bring out relation between N and C. **(10 Marks)**

b. A trapezoidal channel has to carry 142 m^3/minute of water is designed to have a minimum cross section. Find the bottom width and depth of the bed slope is 1 in 1200, the side slopes at 45° and Chezy's coefficient is 55. **(10 Marks)**

OR

4 a. What is specific energy? Define and draw specific energy curve and also derive expressions for critical depth and critical velocity. **(10 Marks)**

b. The discharge of water through a rectangular channel of width 6m is 18 m^3/sec when depth of flow of water is 2m. Calculate

(i) Specific energy of the flowing water
(ii) Critical depth and critical velocity
(iii) Value of minimum specific energy
(iv) State whether the flow is subcritical or supercritical. **(10 Marks)**

Module-3

5 a. Explain the term hydraulic jump with a neat sketch. Derive an expression for loss of energy due to hydraulic jump. **(10 Marks)**

b. A sluice gate discharges water into a horizontal rectangular channel with a velocity of 6 m/s and depth of flow is 0.4m. The width of the channel is 8m. Determine whether a hydraulic jump will occur and if so, find its height and loss of energy per kg of water. Also find power lost in the hydraulic jump. **(10 Marks)**

OR

6 a. With a neat sketch, explain what is back water curve and afflux. Derive an expression for length of backwater curve. **(10 Marks)**

b. Find the slope of the free water surface in a rectangular channel of width 15m having depth of flow 4m. Discharge through channel is 40 m^3/sec. Bed of channel is having a slope of 1 in 4000. Take Chezy's C = 50. **(10 Marks)**

Module-4

7 a. With a neat sketch explain the concept of velocity triangles. **(10 Marks)**

b. A jet of water having a velocity of 35 m/s impinges on a series of vanes moving with a velocity of 20 m/s. The jet makes an angle of 30° to direction of motion of vanes when entering and leaves at 12°.

(i) Draw velocity Δ^{les} at inlet and outlet

(ii) Find angles of vane tips so that water enters and leaves without shock.

(iii) Work done per unit wt. of water entering the vanes. **(10 Marks)**

OR

8 a. Draw a typical layout of a hydroelectric plant and explain various heads. **(10 Marks)**

b. A Pelton wheel is to be designed for following specifications:
Shaft power = 11,772 kW ; Head = 380 m ; Speed = 750 rpm ; Overall efficiency = 86% ; Jet diameter not to exceed $1/6^{th}$ of wheel ϕ. Determine (i) Wheel diameter (ii) No. of Jets. **(10 Marks)**

Module-5

9 a. Define Draft Tube. Explain the draft tube theory with a sketch. **(10 Marks)**

b. Draw Kaplan turbine and label the parts legibly. Give the working proportions. **(10 Marks)**

OR

10 a. With the help of a neat sketch, explain main parts of a centrifugal pump. **(07 Marks)**

b. The diameter of an impeller of a centrifugal pump at inlet and outlet are 30cm and 60 cm respectively. The velocity of flow at outlet is 2.0 m/s and the vanes are set back at an angle of 45° at the outlet. Determine the minimum starting speed of the pump of manometer η is 70%. **(08 Marks)**

c. Write a short note on multistage pumps. **(05 Marks)**

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