CBCS SCHEME

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17CV43

Fourth Semester B.E. Degree Examination, Jan./Feb. 2023
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. Explain the methods of dimensional analysis. **(06 Marks)**

b. 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 dimensional analysis. **(08 Marks)**

c. What are the types of similarities? Explain. **(06 Marks)**

OR

2 a. What are non-dimensional parameters used in model studies? Explain. **(08 Marks)**

b. Discuss the conditions of equilibrium of floating and submerged bodies. **(06 Marks)**

c. A block of wood of specific gravity 0.70 floats in water. Determine the meta-centric height of the block if its size is $2m \times 1m \times 0.8m$. **(06 Marks)**

Module-2

3 a. Explain (i) Laminar flow and turbulent flow. (ii) Sub-critical, critical and super critical flow in open channels. **(06 Marks)**

b. Derive the equation of discharge through open channel by Chezy's formula. **(06 Marks)**

c. Find the bed slope of trapezoidal channel of bed width 4 m, depth of water 3 m and side slope 2H : 3V when the discharge through channel is 20 m^3/s. Take Manning's N = 0.03. **(08 Marks)**

OR

4 a. Show that for most economical trapezoidal channel, half of top width must be equal to one of the sloping sides of the channel. **(06 Marks)**

b. A rectangular channel 4 m wide has depth of water 1.5 m. The slope of bed of the channel is 1 in 1000 and value of Chezy's constant C = 55. It is desired to increase the discharge to a maximum by changing the dimensions of the section for constant area of cross section, slope of bed and roughness of channel. Find the new dimensions of the channel and increase in discharge. **(08 Marks)**

c. Explain critical depth and critical velocity with equations. **(06 Marks)**

Module-3

5 a. Define hydraulic jump and derive an expression for depth of hydraulic jump. **(08 Marks)**

b. Derive the expression for variation of depth of flow in GVF. **(06 Marks)**

c. A sluice gate discharge water into a horizontal rectangular channel with a velocity of 6 m/s and depth of flow is 0.4 m. The width of the channel is 8 m. Determine whether a hydraulic jump will occur, and if so, find its height and loss of energy/kg of water. **(06 Marks)**

OR

6 a. Explain back water curve and afflux with a sketch. **(06 Marks)**

b. Derive an expression for the length of back water curve. **(06 Marks)**

c. Determine the length of back water curve caused by an afflux of 2.0 m in a rectangular channel of width 40 m and depth 2.5 m. The slope of the bed is given as 1 in 11000, take Manning's N = 0.03. **(08 Marks)**

Module-4

7 a. Derive an expression for force exerted by a jet on a stationary curved plate when the jet strikes at the centre of the curved plate. **(06 Marks)**

b. A Pelton wheel is having a mean bucket diameter of 1 m and is running at 1000 rpm. The net head on the Pelton wheel is 700 m. If the side clearance angle is 15° and discharge through nozzle is 0.1 m^3/s, find (i) Power available at nozzle, (ii) Hydraulic efficiency of turbine. **(06 Marks)**

c. Derive the equation for force by the jet on the inclined plate moving in the direction of the jet. **(08 Marks)**

OR

8 a. Give the classification of turbines. **(06 Marks)**

b. What are the main parts of Pelton wheel? Explain the working with a sketch. **(08 Marks)**

c. A jet of water of 30 mm diameter strikes a hinged square plate at its centre with a velocity of 20 m/s. The plate is reflected through an angle of 20°. Find the weight of the plate, if the plate is not allowed to swing what will be the force required at the lower edge of the plate to keep the plate in vertical position. **(06 Marks)**

Module-5

9 a. Define reaction turbine and explain the parts of radial flow reaction turbine with sketches. **(06 Marks)**

b. Explain the efficiencies of centrifugal pump, explain with equations. **(06 Marks)**

c. The external and internal diameter of an inward flow reaction turbine are 1.2 m and 0.6 m respectively. The head on the turbine is 22 m and velocity of flow through the runner is constant i.e. 2.5 m/s. The guide blade angle is 10° and runner vanes are radial to inlet. If the discharge at outlet is radial, determine (i) Speed of turbine (ii) hydraulic efficiency (iii) Vane angle at outlet. **(08 Marks)**

OR

10 a. What are the main parts of centrifugal pump, explain with sketch? **(08 Marks)**

b. Explain draft tube with sketches and its functions. **(06 Marks)**

c. A centrifugal pump delivers water against, a net head of 14.5 m and a design speed of 1000 rpm. The vanes are curved back to an angle of 30° with the periphery. The impeller diameter is 300 mm and outlet width 50 mm. Determine the discharge of the pump, if manometric efficiency is 95%. **(06 Marks)**

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