CBCS SCHEME

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18CV43

Fourth Semester B.E. Degree Examination, June/July 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. Define the terms : (i) Reynold's number (ii) Froude's number (iii) Euler's number (iv) Webber's number (v) Mach number **(05 Marks)**

b. Using Buckingham's π-theorem, show that the velocity through a circular orifice is given by $V = \sqrt{2gH}\phi\left[\frac{\Delta}{H}, \frac{\mu}{\rho VH}\right]$, where H is the head causing flow, Δ is the diameter of the orifice, μ is co-efficient of viscosity, ρ is the mass density and g is the acceleration due to gravity. **(15 Marks)**

OR

2 a. State and prove the Buckingham's π-theorem. Why this theorem is considered superior over the Rayleigh's method. **(10 Marks)**

b. A pipe of diameter 1.5 m is required to transport an oil of Sp.Gr. 0.90 and viscosity 3×10^{-2} poise at the rate of 3000 litre/s. Tests were conducted on a 15 cm diameter pipe using water at 20°C. Find the velocity and rate of flow in the model. Viscosity of water at 20°C = 0.01 poise. **(10 Marks)**

Module-2

3 a. What is meant by economical section of a channel? Derive the condition for the most economical rectangular section. **(10 Marks)**

b. The discharge of water through a rectangular channel of width 8 m is 15 m^3/s. when depth of flow of water is 1.2 m. Calculate (i) Specific energy of the flowing water (ii) Critical depth and critical velocity (iii) Value of minimum specific energy. **(10 Marks)**

OR

4 a. Derive an expression for discharge through open channel by Chezy's formula and obtain an expression for conveyance. **(10 Marks)**

b. A trapezoidal channel has side slopes of 3H to 4V and slope of its bed is 1 in 2000. Determine the optimum dimensions of the channel, if it is to carry water at 0.5 m^3/s. [C = 80]. **(10 Marks)**

Module-3

5 a. The depth of flow of water, at a certain section of a rectangular channel of 2 m wide, is 0.3 m. The discharge through the channel is 1.5 m^3/s. Determine whether a hydraulic jump will occur, and if so, find its height and loss of energy. **(10 Marks)**

b. Define the terms : (i) Afflux (ii) Back water curve. Prove that the length of the back water curve is given by, $L = \frac{(E_2 - E_1)}{i_b - i_e}$. **(10 Marks)**

OR

6 a. Explain the term hydraulic jump. Derive an expression for the depth of hydraulic jump in terms of the upstream Froude number. **(10 Marks)**

b. Find the slope of the free water surface in a rectangular channel of width 20 m, having depth of flow 5 m. The discharge through the channel is 50 m^3/s. The bed of the channel is having a slope of 1 in 4000. Take the value of Chezy's constant C = 60. **(10 Marks)**

Module-4

7 a. Obtain an expression for the work done per sec by water on the runner of a pelton wheel. Hence derive an expression for max. efficiency of pelton wheel. **(10 Marks)**

b. A jet of water of dia. 10 cm strikes a flat plate normally with a velocity of 15 m/s. The plate is moving with a velocity of 6 m/s in the direction of the jet and away from the jet. Find
(i) The force exerted by the jet on the plate.
(ii) Work done by the jet on the plate per second. **(10 Marks)**

OR

8 a. Draw a neat sketch of hydro electric power plant and mention the function of each component. **(10 Marks)**

b. A Pelton wheel is to be designed for the following specifications:
Shaft power = 11772 kW, Head = 380 m, Speed = 750 rpm, Overall efficiency = 86%, Jet diameter is not to exceed one-sixth of the wheel diameter.
Determine (i) Wheel dia. (ii) No. of jets (iii) Dia. of jet. **(10 Marks)**

Module-5

9 a. Draw a neat sketch of Kaplan Turbine and explain the function of each part in brief. **(10 Marks)**

b. Derive an expression for the minimum starting speed of a centrifugal pump. **(10 Marks)**

OR

10 a. With a neat sketch, explain the components and working of a centrifugal pump. **(10 Marks)**

b. A Kaplan turbine develops 24647.6 kW power at an average head of 39 m. Assuming a speed ratio of 2, flow ratio of 0.6, diameter of the base equal to 0.35 times the diameter of the runner and an overall efficiency of 90%, calculate the diameter, speed and specific speed of the turbine. **(10 Marks)**

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