CBCS SCHEME

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18CV43

Fourth Semester B.E. Degree Examination, June/July 2024
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. State and explain Buckingham's π theorem. Why this theorem is considered superior over the Rayleigh's method. **(06 Marks)**

b. Define the following non-dimensionless models:
(i) Reynold's model (ii) Froude's model **(04 Marks)**

c. The drag force exerted by a flowing fluid on a solid body depends upon the length of the body L, velocity V, density of fluid ρ, and viscosity μ. Find the expression for the drag force using Buckingham's π theorem. **(10 Marks)**

OR

2 a. Explain the term dimensionally homogenous equation with an example. **(04 Marks)**

b. Explain Metacentre and Metacentric height with sketches. **(08 Marks)**

c. A solid cylinder of diameter 4.0 m has a height of 4m. Find the metacentric height of cylinder if specific gravity of the material of cylinder = 0.6 and it is floating in water with its axis vertical. State whether the equilibrium is stable or unstable. **(08 Marks)**

Module-2

3 a. Explain the terms: (i) Rapidly varied flow (ii) Gradually varied flow. Give examples with sketches. **(10 Marks)**

b. Explain most economical channel section. What is the general condition to be satisfied in such a case? Find the slope of the bed of a rectangular channel of width 5m when depth of water is 2m and rate of flow is given as 20 m^3/sec. Take Chezy's constant c = 50. **(10 Marks)**

OR

4 a. What is specific energy curve? Explain with a sketch. Derive expressions for critical depth and critical velocity in a rectangular channel. **(10 Marks)**

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

Module-3

5 a. Define the term Afflux and Backwater curve. Prove that the length of backwater curve is given by $L = \frac{E_2 - E_1}{i_b - i_e}$. **(10 Marks)**

b. A hydraulic jump forms at the downstream end of spillway carrying 17.93 m^3/sec discharge. If the depth before jump is 0.8 m, determine the depth after the jump and energy loss. **(10 Marks)**

OR

6 a. Define hydraulic jump. Derive an expression for depth of hydraulic jump. **(10 Marks)**

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

Module-4

7 a. State Impulse-Momentum equation. Derive an expression for the force exerted by a jet of water on a fixed vertical plate in the direction of the jet. **(10 Marks)**

b. A jet of water having a velocity of 20 m/sec strikes a curved vane which is moving with a velocity of 10 m/sec. The jet strikes makes an angle of 20°. With the direction of motion of vane at inlet and leaves at an angle of 130° to the direction of motion of vane an outlet. Calculate: (i) Vane angles, so that the water enters and leaves the vane without shock
(ii) Work done per second per unit weight if water striking the vane per second. **(10 Marks)**

OR

8 a. Sketch and explain general layout of a hydro-electric plant. **(06 Marks)**

b. Explain in detail, how hydraulic turbines are classified. **(04 Marks)**

c. A pelton wheel is to be designed for the following specifications:
Shaft power = 735 KW, head = 200 m, speed = 600 rpm, overall efficiency = 0.75, the jet diameter not to exceed the length of wheel diameter, C_v = 0.958, speed ratio = 0.5. Determine:
(i) Wheel diameter (ii) Number of jets required
(iii) Diameter of jet (iv) Number of buckets **(10 Marks)**

Module-5

9 a. Sketch and explain Francis Turbine. **(10 Marks)**

b. A Kaplan turbine working under a head of 20 m develops 11772 K.Watt shaft power. The outer diameter of runner is 3.5 m and hub diameter 1.75 m. The guide blade angle at the extreme edge of runner is 35°. The hydraulic and overall efficiency of the turbine are 88% and 84%. If the velocity of whirl is zero at outlet, determine:
(i) Runner vane angles at inlet and outlet at the extreme edge of the runner
(ii) Speed of turbine **(10 Marks)**

OR

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

b. A centrifugal pump having overall efficiency 75% discharging water at the rate of 30 lit/sec through a pipe of 15 cm diameter and 125 m long. Calculate the power required to drive the pump if the water is lifted to a height of 25 m. Take f = 0.01. **(10 Marks)**

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