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BANGALORE - 560 037

Fourth Semester B.E. Degree Examination, June/July 2018
Hydraulics & Hydraulic Machines

Time: 3 hrs.

Max. Marks:100

Note: Answer FIVE full questions, selecting at least TWO questions from each part.

PART – A

- 1 a. Distinguish between (i) Geometric and Kinematic similarity (ii) Reynolds and Froude number. (iii) Distorted and undistorted model. (06 Marks)
- b. Prove that the discharge over a spill way is given by the relation, $Q = VD^2f \left[\frac{\sqrt{gD}}{V} \cdot \frac{H}{D} \right]$
where V = Velocity of flow; D = Depth at the Throat;
H = Head of water; g = acceleration due to gravity. (08 Marks)
- c. A pipe of dia 15 mm is required to transmit an oil of specific gravity 0.9 and viscosity 3×10^{-2} poise at 3000 lps. Tests were conducted on 150 mm dia pipe using water at 20°C. Find velocity and rate of flow of model if μ water at 20°C, if 0.01 poise. (06 Marks)
- 2 a. Bring out the difference between flow through pipes and flow through open channel. (05 Marks)
- b. Derive the conditions for most economical trapezoidal section. Also show that the most economical trapezoidal section for an open channel is one which has three sides tangential to the semicircle described on the water line. (07 Marks)
- c. A channel is 2 m width at bottom, the length of each sloping side is 1.95 m. The width of water surface is 5.5 m. The flow depth is 1.2 m and bed slope 1 in 5280. What is the discharge per minute? Take value of C = 34.6. (08 Marks)
- 3 a. Define the term hydraulic jump. Derive an expression for depth of hydraulic jump in terms of upstream Froud's number. (10 Marks)
- b. The loss of energy head in a hydraulic jump is 4.25. The Froud number just before the jump is 7.50. Find (i) Discharge per meter width of channel (ii) The depths before and after the hydraulic jump. (iii) Froud number after the jump (iv) Percentage loss of energy head due to jump (v) Length of the jump. (10 Marks)
- 4 a. State the impulse momentum principle. Show that the efficiency of jet striking normally on series of slot plates mounted on the periphery of wheel is 50%. (10 Marks)
- b. A 80 mm dia jet having a velocity of 40 m/sec strikes a flat plate the normal of which is inclined at 45° to the axis of the jet. Find the normal pressure on the plate (i) When the plate is stationary (ii) When the plate moving with a velocity of 20 m/sec and away from the jet. Also determine the power and efficiency of the jet when the plate is moving. (10 Marks)

PART – B

- 5 a. A jet of water strikes on unsymmetrical moving curved plate tangentially at one of the tips. Derive an expression for the force exerted by the jet in the horizontal direction of motion. Also describe the velocity triangles and obtain an expression for work done and efficiency. (10 Marks)

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- b. A jet of water having a velocity of 40 meters per second impinges without shock on a series of vanes moving at 12 m/sec. The jet is making an angle of 20° with the direction of motion of the vane. Relative velocity at exit is 0.9 times the relative velocity at entrance and the absolute velocity of water at exit is normal to the direction of the motion of the vanes.

Find :

- (i) Vane angle at entrance and exit.
(ii) Workdone on the vanes per N of water.
(iii) Efficiency. (10 Marks)
- 6 a. How will you classify the turbines? (04 Marks)
b. Derive an equation for efficiency of pelton wheel turbine. (08 Marks)
c. A Kaplan turbine develops 6500 kW under a head of 6 m. The velocity of flow through the runner is 6.50 m/sec. The diameters of the bolt is 0.35 times the external diameters. The vane tips have a velocity of 22 m/sec. The over all efficiency is 85%. Determine the dia and specific speed of the turbine. (08 Marks)
- 7 a. With a neat sketch, explain the general layout of a hydroelectric power plant. (10 Marks)
b. An inward flow water turbine has blades. The inner and outer radii of which are 30 cm and 50 cm respectively. Water enters the blades at the outer periphery with a velocity of 45 m/sec making an angle of 25° with the tangent to the wheel at the inlet tip. Water levels of the blade with a flow velocity of 8 m/sec. If the blade angles at inlet and outlet are 35° and 25° respectively. Determine (i) Speed of the turbine wheel (ii) Work done per Newton of water. (10 Marks)
- 8 a. With the help of neat sketches, explain the characteristic curves of the centrifugal pump. (08 Marks)
b. A multi stage centrifugal pump is required to lift $0.04 \text{ m}^3/\text{sec}$ of water against a head of 700 m of water. If the speed of the pump is 2500 rpm find the minimum number of stages required. If the specific speed is not less than 25. (06 Marks)
c. A centrifugal pump runs at 1000 rpm and delivers water against a head of 15 m. The impeller diameter and width at the outlet are 0.3 m and 0.05 m respectively. The vanes are curved back at an angle of 30° with the periphery at the outlet $\eta_{\text{mono}} = 0.92$, find discharge. (06 Marks)
