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10CV45

Fourth Semester B.E. Degree Examination, June/July 2019
Hydraulics and Hydraulic Machines

Time: 3 hrs.

Max. Marks:100

- Note:** 1. Answer any FIVE full questions, selecting at least TWO full questions from each part.
2. Missing data may be suitably assumed.

PART – A

- 1 a. What is a dimensionally homogeneous equation explain with examples. (04 Marks)
- b. Using Buckingham's π theorem show that velocity through a circular orifice is given by
$$V = \sqrt{2gH} \phi \left[\frac{D}{H}, \frac{\mu}{\rho v H} \right]$$
 where D is the diameter of the orifice H is head, μ is the coefficient of viscosity ρ is the density and g is the acceleration due to gravity. (08 Marks)
- c. Water is flowing through a pipe of diameter 30cm at a velocity of 4m/s. Find the velocity of oil flowing in another pipe of diameter 10cm. If the condition of dynamic similarity is satisfied between the two pipes. The viscosity of water and oil is given as 0.01 poise and 0.025 poise. The specific gravity of oil is 0.8. (08 Marks)
- 2 a. Briefly explain the difference between flow through pipes and flow through open channel. (04 Marks)
- b. Derive the condition for the trapezoidal channel of best section show that the hydraulic mean depth for such a channel is one half of the depth of flow. (08 Marks)
- c. The rate of flow of water through a circular channel of diameter 0.6m is 150 liters/s. Find the slope of the bed of the channel for maximum velocity for $C = 60$. (08 Marks)
- 3 a. What is specific energy curve? With a neat sketch explain the specific energy curve. (04 Marks)
- b. Explain the term hydraulic jump. Derive an expression for the depth of hydraulic jump in terms of U/S Froude number. (08 Marks)
- c. The specific energy for a 3m wide channel is to be 3kg-m/kg. What would be the maximum possible discharge? (08 Marks)
- 4 a. Derive an expression for the force exerted on a flat vertical plate moving in the direction of the jet. (10 Marks)
- b. A jet of water of diameter 10cm strikes a flat plate normally with a velocity of 15m/s. The plate is moving with a velocity of 6m/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)

PART – B

- 5 a. Derive an expression for the force exerted by a jet of water on an Un-symmetrical moving curved plate when the jet strikes tangentially at one of the tips. (10 Marks)
- b. A jet of water having a velocity of 15m/s strikes a curved vane which is moving with a velocity of 5m/s in the same direction as that of the jet at inlet. The vane is also so shaped that the jet is deflected through 135° . The diameter of the jet is 100mm. Assuming the vane to be smooth. Find the force exerted by the jet on the vane in the direction of motion. (10 Marks)

- 6 a. Differentiate between:
i) Radial and axial flow turbines
ii) Inwards and outwards radial flow turbine. (04 Marks)
- b. Obtain an expression for the work done per second by water on the runner of a pelton wheel. (08 Marks)
- c. Two jets strike the buckets of a pelton wheel, which is having shaft power as 15450kW. The diameter of each jet is given as 200mm. If the net head on the turbine is 400m find the overall efficiency of the turbine take $C_v = 1.0$. (08 Marks)
- 7 a. What is a draft tube with a neat sketches describe the different types of draft tube. (04 Marks)
- b. Give the range of specific speed of Kaplan, Francis turbines and pelton wheels. What factors decide whether Kaplan, Francis or a pelton type turbine would be used in a hydroelectric projects? (08 Marks)
- c. A Kaplan turbine runner is to be designed to develop 9100kW. The net available head is 5.6m. If the speed ratio = 2.09, flow ratio = 0.68, overall efficiency 86% and the diameter of the boss is $1/3$ the diameter of the runner. Find the diameter of the runner, its speed and the specific speed of the turbine. (08 Marks)
- 8 a. Briefly explain with equations the manometric efficiency, mechanical efficiency and overall efficiency of centrifugal pump. (04 Marks)
- b. Obtain an expression for the work done by impeller of a centrifugal pump on water per sec per unit weight of water. (08 Marks)
- c. The diameters of an impeller of centrifugal pump at inlet and out let are 30cm and 60cm respectively. Determine the minimum starting speed of the pump if it works against a head of 30m. (08 Marks)

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