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10CV45

**Fourth Semester B.E. Degree Examination, July/August 2021**  
**Hydraulics and Hydraulic Machines**

Time: 3 hrs.

Max. Marks: 100

**Note: Answer any FIVE full questions.**

- 1
  - a. What is dimensionally homogeneous equation? Give two examples. (04 Marks)
  - b. The following equation is applicable in M.K.S. system of units;  $V = 50\sqrt{RS}$ , find the dimensions of constant and its corresponding value in F.P.S. system of units. (06 Marks)
  - c. Find an expression for the drag force 'F' on smooth sphere of diameter 'D', moving with a uniform velocity 'V', in a fluid of density ' $\rho$ ', and dynamic viscosity ' $\mu$ ', using Buckingham ' $\pi$ ' method. (10 Marks)
  
- 2
  - a. State the differences between the 'Pipe Flow' and 'Open Channel Flow'. (04 Marks)
  - b. Derive the relation between chezy's 'C' and Mannings 'n'. (06 Marks)
  - c. Derive the condition for maximum mean velocity of flow through a circular channel section. (10 Marks)
  
- 3
  - a. Define the terms 'specific energy' and 'critical flow'. (04 Marks)
  - b. A trapezoidal channel has a bottom width of 6m and side slopes of 2 horizontal to 1 vertical. If the depth of flow is 1.2m at a discharge of  $10\text{m}^3/\text{s}$ , compute the specific energy and the critical depth. (06 Marks)
  - c. Stating the assumptions made, derive the 'DEGVF' in the form.  

$$\frac{dY}{dX} = \frac{S_o - S_f}{1 - F_r^2}$$
(10 Marks)
  
- 4
  - a. State impulse momentum principle. Show that the efficiency of a free jet striking normally on flat plates mounted on the periphery of a wheel never exceeds 50%. (10 Marks)
  - b. A 15m/s velocity jet of water 5cm diameter strikes perpendicularly a flat smooth plate. Determine the force exerted by the jet on the plate if i) The plate is at rest ii) It moves in the direction of jet with a velocity of 5m/s. Also the work done in each case and the efficiency of the jet in the second case. (10 Marks)
  
- 5
  - a. Show that the maximum efficiency for the jet striking a single curved vane symmetrical about the axis of jet moving in the direction of jet is 16/27. (10 Marks)
  - b. A jet of water having a velocity of 45m/s impinges without shock a series of vanes moving at 15m/s, the direction of motion of vanes being inclined at  $20^\circ$  to that of jet. The relative velocity at outlet is 0.9 of that at inlet, and the absolute velocity of water at exit is to be normal to motion of the vanes. Find: i) Vane angles at entrance and exit ii) Work done on vanes per unit weight of water supplied by the jet iii) The hydraulic efficiency. (10 Marks)
  
- 6
  - a. Write a note on the classification of the turbines. (05 Marks)
  - b. Derive the expression for the specific speed of a turbine. (05 Marks)
  - c. Design a pelton wheel for a head of 80m and speed of 300rpm. The pelton wheel develops 110kW. Take coefficient of velocity = 0.98, speed ratio 0.48 and overall efficiency = 80%. (10 Marks)



- 7 a. Write a note on:
- Draft Tube
  - Cavitation
  - Unit Quantities. (10 Marks)
- b. A Kaplan turbine produces 60,000kW under a net head of 25m with an overall efficiency of 90%. Taking the value of speed ratio as 1.6 ( $K_u$ ), flow ratio  $\psi$  as 0.5 and the hub diameter as 0.35 times the outer diameter, find the diameter and speed of the turbine. (10 Marks)
- 8 a. With a neat sketch, explain the various components of a centrifugal pump. Also, explain the necessity of priming of such a pump. (10 Marks)
- b. Find the power required to drive a centrifugal pump which delivers 40 litres of water per second to a height of 20m through a 150mm diameter and 100m long pipe line. The overall efficiency of pump is 70% and Darcy's  $f = 0.06$  for the pipe line. Assume inlet losses in suction pipe equal to 0.33m. (10 Marks)

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