Code No: 154AZ

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JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
B. Tech II Year II Semester Examinations, July/August - 2021
FLUID MECHANICS AND HYDRAULIC MACHINES
(Mechanical Engineering)

Time: 3 Hours **Max. Marks: 75**

Answer any five questions
All questions carry equal marks
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1.a) What is differential manometer? Explain how it works?
b) Find the pressure in N/m^2 represented by a column of 10 cm of water. 4 cm of oil of relative density 0.89 and 2 cm of mercury of specific gravity 13.6. Specific weight of water is 9810 N/m^3. [7+8]

2.a) Derive the continuity equation in Cartesian coordinates for one-dimensional flow.
b) Derive the expression for Bernoulli's theorem for steady incompressible fluid from first principle. What are the limitations of the Bernoulli's equation? [7+8]

3.a) Explain what do you understand by Hydraulic Grade Line and Total Energy Line. Discuss its practical significance in analysis of fluid flow problems.
b) Two pipes each 300m long are available for connecting to a reservoir from which a flow of 0.085 m^3/s is required. If the diameters of the two pipes are 300mm and 150mm respectively. Determine the ratio of head lost when the pipes are connected in series to the head lost when they are connected in parallel. Neglect minor losses. [7+8]

4. A 20m/s velocity jet of water 5cm in diameter strikes perpendicularly a flat smooth plate. Determine the force exerted by the jet on the plate, if
a) The plate is at rest.
b) Moves in the direction of jet with a velocity of 8m/s. Draw the relevant sketches in the two cases. Also determine the work done in each case and efficiency of jet in the second case. [7+8]

5.a) What do you understand by hydroelectric power station? What are its types?
b) A jet of water of diameter 7.5 cm strikes a curved plate at its centre with a velocity of 20 m/s. The curved plate is moving with a velocity of 8 m/s in the direction of the jet. The jet is deflected through an angle of 165^0. Assuming the plate smooth find:
i) Force exerted on the plate in the direction of jet.
ii) Power of the jet
iii) Efficiency of the jet. [7+8]

6.a) Define unit speed, unit power and specific speed as used in connection with the operation of a hydraulic machine.
b) A hydraulic turbine is to develop 845.6 kW power when running at 100 rpm under a head of 10 m. Work out the maximum flow rate and specific speed for the turbine if the overall efficiency at the best operating point is 92%. In order to predict its performance, a 1:10 scale model is tested under a head of 6 m. what would be the speed, power, output and water consumption of the model if it runs under the similar conditions to the prototype? [7+8]

7.a) Obtain an expression for the work done by impeller of a centrifugal pump on water per second per unit weight of water.

b) The internal and external diameters of the impeller of a centrifugal pump are 200 mm and 400 mm respectively. The pump is running at 1200 rpm. The vane angles of the impeller at inlet and outlet are 20^0 and 30^0 respectively. The water enters the impeller radially and velocity of flow is constant. Determine the work done by the impeller per unit weight of water. [7+8]

8.a) Obtain expression for head loss in a sudden expansion in the pipe. List all the assumptions made in the derivation.

b) Find the loss of head when pipe of diameter 200 mm is suddenly enlarged to a diameter of 400 mm. the rate of flow of water through the pipe is 250 litres/s. [7+8]

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