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Total Number of Pages: 03

Course: B.Tech/ IDD
Sub_Code: CIPC2005

4th Semester Regular Examination: 2024-25

SUBJECT: Fluid Dynamics

BRANCH(S): CIVIL

Time: 3 Hours

Max Marks: 100

Q.Code: S504

Answer Q1 (Part-I) which is compulsory, any eight from Part-II and any two from Part-III.
The figures in the right hand margin indicate marks.

Part-I

Q1 Answer the following questions: (2 x 10)

- Can you apply Bernoulli equation within a boundary layer for a steady incompressible flow? Write your comments.
- Why does the boundary layer increase with distance from the upstream edge.
- A jet of water having a velocity of 20 m/s strikes a series of plates fixed radially on a wheel revolving in the same direction of the jet at 15 m/s. What is the percentage efficiency of the plates?
- A horizontal water jet with a velocity of 10 m/s and a cross-sectional area of 10 mm² strikes a flat plate held normal to the flow direction. Determine the total force on the plate.
- What do you mean by friction and form drag?
- With the delay in boundary layer separation, does the form drag increase or decrease for a bluff body?
- Define the specific speed of a turbine. What is its significance?
- Discuss the difference between an impulse and a reaction turbine.
- Discuss why it is necessary to provide an air vessel in reciprocating pumps.
- What do you mean by supercritical flow in an open channel?

Part-II

Q2 Only Focused-Short Answer Type Questions- (Answer Any Eight out of Twelve) (6 x 8)

- Air is flowing over a smooth plate with a velocity of 10 m/s. The length of the plate is 1.2 m and the width is 0.8 m. If a laminar boundary layer exists up to a value of the Reynolds number of 2×10^5 , find the maximum distance from the leading edge up to which the laminar boundary layer exists. Find the maximum thickness of the laminar boundary layer if the velocity profile is given by:

$$\frac{u}{U} = 2 \left(\frac{y}{\delta} \right) - \left(\frac{y}{\delta} \right)^2$$

The kinematic viscosity of air is 0.15 stokes.

Part-III

Only Long Answer Type Questions (Answer Any Two out of Four)

- Q3** A single jet Pelton turbine is required to drive a generator to develop 10 MW. The available head at the nozzle is 762 m. Assuming electric generator efficiency 95 %, Pelton wheel efficiency 87 %, coefficient of velocity for nozzle 0.97, mean bucket reduces the relative velocity by 15 per cent, and find the following (a) the diameter of the jet, and (b) the rate of flow of water through the turbine (c) the force exerted by the jet on the buckets. **(16)**
- Q4** A Francis turbine has a diameter of 1.4 m and rotates at 430 rpm. Water enters the runner without shock with a flow velocity of 7 m/s. The difference between the sum of the static and potential heads at the entrance to the runner and at the exit from the runner is 62 m. The turbine develops 12.25 MW. The flow rate through the turbine is 12 m³/s for a net head of 115 m. **(16)**
- Q5** An irrigation channel of trapezoidal section, having side slopes 3 horizontal to 2 vertical is to carry a flow of 10 cumec on a tangential slope of 1 in 5000. The channel is to be lined for which the value of the friction coefficient in Manning's formula is $n = 0.012$. Find the dimensions of the most economical section of the channel. **(16)**
- Q6** An impeller with an eye radius of 51 mm and an outside diameter of 406 mm rotates at 900 rpm. The inlet and outlet blade angles are 15° and 7° respectively, while the depth of the blade is 64 mm. **(16)**
Assuming zero inlet whirl, zero slip, and hydraulic efficiency of 89%, calculate
(a) The volume flow rate through the impeller,
(b) The stagnation and static pressure rise across the impeller,
(c) The power transferred to the fluid and
(d) The input power to the impeller.