

Time: 3 Hours

[MARKS: 80]

Question no.1 is compulsory.

Attempt any three from question no. 2 to 6.

Use illustrative diagrams where ever possible.

Q1 Solve any **FOUR**

- A With neat sketch explain working and construction of a Elbow Meter 5
- B Define Mach Number. What is the significance of Mach Number in compressible fluid flow? 5
- C Explain Eulerian and Lagrangian method of fluid flow. 5
- D Write short note on Boundary layer separation 5
- E A plate 0.05 mm distant from fixed plate moves at 1.2 m/s and requires a force of 2.2 N/m² to maintain this speed. Find the viscosity of the fluid between the plates 5

Q2 A Using the laminar boundary layer velocity distribution: 20

$$\frac{u}{U} = 2 \left(\frac{Y}{\delta} \right) - 2 \left(\frac{Y}{\delta} \right)^3 + \left(\frac{Y}{\delta} \right)^4$$

- I. Determine Boundary layer thickness (In terms of Re)
- II. Shear stress.
- III. Local coefficient of drag.
- IV. Average coefficient of drag
- V. Check whether flow is attached or detached or on the verge of separation.

Q3 A A horizontal pipeline 40 m is connected to water tank at one end and discharges freely into atmosphere at the other end. For the first 20 m of its length from the tank, the pipe is 15 cm in diameter and its diameter is suddenly enlarged to 30 cm. The height of water level in the tank is 8 m above the axis of the pipe. Considering all losses of head, determine rate of flow through the pipe. Take $f = 0.01$ for the both sections of the pipe. 10

B A pipe of 300 mm diameter carrying 0.3 m³/s of water has a right angle bend in a horizontal plane. Find the resultant force exerted on bend if the pressure at inlet and outlet of the bend are 24.525 N/cm² and 23.544 N/cm². Also find the angle made by resultant force with x axis. 10

Q4 A The Reynolds no for flow of oil through a 50 mm diameter pipe is 1700. If the kinematic viscosity of oil is 0.744 stoke, what is the velocity at a point 6.25 mm from the wall? 07

B The velocity vector in an incompressible flow is given by 07
 $\mathbf{V} = (6xt + yz^2)\mathbf{i} + (3t + xy^2)\mathbf{j} + (xy - 2xyz - 6tz)\mathbf{k}$
 Verify whether the continuity equation is satisfied
 Determine the acceleration vector at point A(1,1,1) at $t = 1$

- C A roller gate of cylindrical form 3 m in diameter has a span (width) of 10 m. find the magnitude and direction of resultant force acting on the gate, when it is placed on the dam and the water level is such that it is going to spill. **06**
- Q5** A Aeroplane is flying at 1000 km/hr through still air having a pressure at 78.5 kN/m^2 and temperature -8°C . calculate on the stagnation point on the nose of the plane **10**
- Stagnation pressure
 - Stagnation temperature
 - Stagnation density
- Take $R = 287.14 \text{ J/kg.K}$. Take $\gamma = 1.4$
- B Consider a two dimensional viscous incompressible flow of a Newtonian fluid between 2 parallel plates, separated by a distance 'c'. One of the plates is stationary and the other is moving with a uniform velocity V. Obtain the velocity equations from the general Navier stokes equation. **10**
- Q6** A Write short notes on (any FOUR) **20**
- Prandtl mixing length theory for turbulent fluid flow.
 - Classification of the fluids
 - Reynolds's transport theorem.
 - Compressible flow through the Convergent Divergent Nozzle
 - Stream function and velocity potential function
