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Mechanical Engg. Department  
NIT Hamirpur  
End Term Examination, 2023  
Heat and Mass Transfer ME-214

Attempt all questions. Assume any missing data

Max. Marks 50

Time 3 hrs

1. Water is flowing through a pipe having diameter 300 mm and 200 mm at the bottom and upper end respectively. The intensity of pressure at the bottom end is  $24.525 \text{ N/cm}^2$  and the pressure at the upper end is  $9.81 \text{ N/cm}^2$ . Determine the difference in datum head if the rate of flow through pipe is 40 lit/s. (5)
2. An oil of sp. gravity 0.8 is flowing through a venturi meter having inlet diameter 20cm and throat diameter 10 cm. the oil-mercury differential manometer shows a reading of 25 cm. calculate the discharge of oil through the horizontal venturi meter. Take  $c_d=0.98$ . (5)
3. A fluid flow field is given by  
 $V = x^2yi + y^2zj - (2xy+yz^2)k$   
Prove that it is a case of possible steady incompressible fluid flow. Calculate the velocity and acceleration at the point (2, 1, 3) (5)
4. Transform laminar Continuity equation and X-direction Navier-Stokes equation into Turbulent form. (3+5 = 8)
5. Apply Navier-Stokes equation for parallel flow in a straight channel to find out the ratio of shear stress and local skin friction coefficient. (7)
6. How can complete similarity between model and prototype can be achieved, discuss. The pressure drop due to friction in a long smooth pipe is a function of average flow velocity, density, dynamic viscosity, pipe length and pipe diameter. We wish to know how pressure drop varies with velocity. Choose density, viscosity and diameter as repeating variables and find dimensionless pi groups. (4,6)
7. Define boundary layer and draw a figure. What are boundary layer approximations, obtain boundary layer equations. For following velocity distribution determine displacement and momentum thickness. (2,3,5)

$$u(x,y) \cong U_0 \left( \frac{2y}{\delta} - \frac{y^2}{\delta^2} \right) \quad 0 \leq y \leq \delta$$