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NIT Hamirpur, Mechanical Engg Department
End Semester Examination, December 2022
Fluid Mechanics and Machinery (ME-213)

Max marks 50 **Time 3 hrs**

Assume any missing data

1. Explain force of buoyancy and centre of buoyancy, show by a figure also. Define viscosity and its importance. A manometer containing oil (ρ = 850 kg/m^3) is attached to a tank filled with air. If the oil level difference between the two columns is 45 cm and the local atmospheric pressure is 98 kPa, draw a schematic diagram and determine the absolute pressure inside the tank.

(2,2,6)

2. What is velocity potential and stream function. What role these have played in solution of fluid flow problems. A velocity field is given as u = a(x^2-y^2); v = -2axy. Does it represent a valid flow field and whether the flow is irrotational. Determine the velocity potential function.

(2,2,6)

3. Two parallel plates are separated by a distance of h. The bottom plate is fixed and top plate is moving with a constant velocity, **V**. A constant pressure gradient (dp/dx) is applied along the flow direction. Assuming the flow to be one dimensional, steady, incompressible and viscous, obtain the velocity distribution, wall shear stress and distance from the bottom plate where velocity is maximum.
4. What is a boundary layer, how did it revolutionise the study of fluid mechanics. In a laboratory experiment, water flows through a 25 mm diameter, 2 m long pipe. The water flowing through the pipe is collected in a tank of cross sectional area of 30 cm by 40 Cm. Time taken for 10 cm rise in the tank is 9.31 seconds. The ends of the pipe are connected to a U tube manometer filled with mercury (density 13600 kg/m^3). The difference of mercury columns in two limbs is 7 cm. Determine the head loss and friction factor. Calculate the Reynolds number and find friction factor using appropriate formula relating Reynolds number to friction factor. (for water density and kinematic viscosity are ,ρ =1000kg/m^3, ν = 10^{-6} m^2/s)

(2,2,6)

5. Explain the growth of boundary layer on a surface with pressure gradient with appropriate figures. In a flow over a flat plate the velocity profile of the boundary layer can be approximated as u = A+ By+Cy^2, where A, B and C are constants. Determine the velocity profile and displacement thickness along the plate. Assume free stream velocity to be U_0.

(4,6)