Exam.Code:0940
Sub. Code: 7051

1079

B.E. (Mechanical Engineering)
Fourth Semester
MEC-406: Fluid Mechanics

Time allowed: 3 Hours

Max. Marks: 50

NOTE: Attempt five questions in all, including Question No. I which is compulsory and selecting two questions from each Part.

x-x-x

Q.1 i) Show that equipotential lines and streamlines are orthogonal to each other.

ii) Differentiate between simple manometer and differential manometer.

iii) Explain Prandtl mixing length concept.

iv) Explain the principle of dimensional homogeneity. Is a dimensionally homogeneous equation applicable in all system of units?

v) Write a brief note on wind tunnel

(02x05=10)

Part-A

Q.2 a) An inverted U-tube of the form shown in Fig. 1is used to measure the pressure difference between two points A and B in an inclined pipeline through which water is flowing. The difference of the level h=0.3 m, a=0.25 m and b=0.15 m. Calculate the pressure difference P_B-P_A, if the top of the manometer is filled with **(a)** air, **(b)** oil of relative density=0.8.

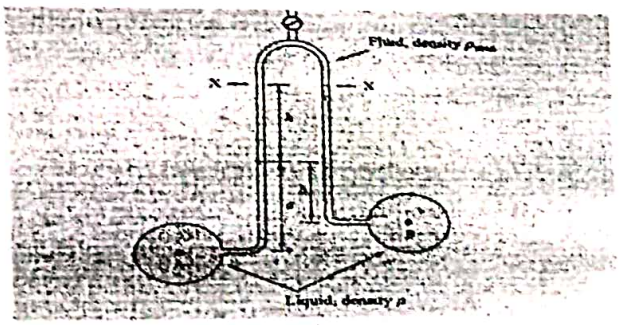

Fig. 1

b) An Annular plate 4 m external diameter and 2 m internal diameter with its greatest and least depths below the surface being 3 m and 1.5 m respectively. Calculate the magnitude, direction and location of the force acting upon one side of the plate due to water pressure.

(05+05)

Q.3 a) Derive Continuity equation in Cartesian coordinates and also list the assumptions made while deriving the same.

b) Define Reynolds number, Froude Number and Weber number. **(07+03)**

Q.4 a) A 30 cm diameter pipe carries water under a head of 20 m with a velocity of 3.5 m/s. If the axis of the pipe turns through 450, find the magnitude and direction of the resultant force on the bend. **(07)**

b) Write a short note on: venturimeter. **(03)**

P.T.O.

Part- B

Q.5 Laminar flow of a fluid of viscosity=0.9 Ns/m^2 and density=1260 kg/m^3 occurs between a pair of parallel plates of extensive width, inclined at 45^0 to the horizontal, the plates being 10mm apart. The upper plate moves with a velocity of 1.5 m/s relative to lower plate and in a direction opposite to the fluid flow. Pressure gauges, mounted at two points 1 m vertically apart on the upper plate, record pressures of 250 kN/m^2 and 80 kN/m^2 respectively. Find the velocity and shear stress on the upper plate **(Fig. 2).** **(10)**

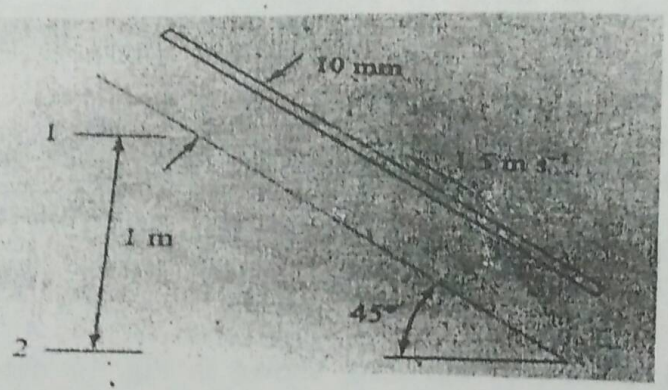

Fig. 2

Q.6 Derive the Von-Karman momentum integral equation for the flow past a flat plate. Based upon this equation, find boundary layer thickness, wall shear stress, local skin friction coefficient and overall drag coefficient for laminar flow over a flat plate. The velocity profile is

$$\frac{u}{U_0} = \sin\left(\frac{\pi y}{2\delta}\right)$$

(10)

Q.7 Show that for horizontal isentropic flow Bernoulli's equation takes the form:

$$\frac{\gamma}{\gamma - 1}\frac{p}{\rho} + \frac{v^2}{2} = Cons\tan t$$

Calculate, from the above equation, the stagnation pressure, temperature and density for an airstream at Mach number=0.7 and density=1.8 kg/m^3 and temperature of 75^{0}C. Take R=287 J/kgK. **(10)**

x-x-x