SE/Sem IV/CBSGS/MECH & RTC/FM & AUTO/28-11-2017

Q. P. Code: 13610

Instructions: Question no.1 **is compulsory**.

Attempt any **THREE** from question no. 2 to 6.

Use illustrative diagrams where ever required.

Q1 **Solve any four**

a An oil film of thickness 1.5 mm is used for lubrication between a square plate of size 0.9 m x 0.9 m & inclined plane having an angle of inclination 20°. The weight of the square plate is 392.4 N & it slides down the plane with uniform velocity of 0.2 m/s. 05

Find the dynamic viscosity of the oil.

b Define i) Irrotational Vortex ii) Circulation 05

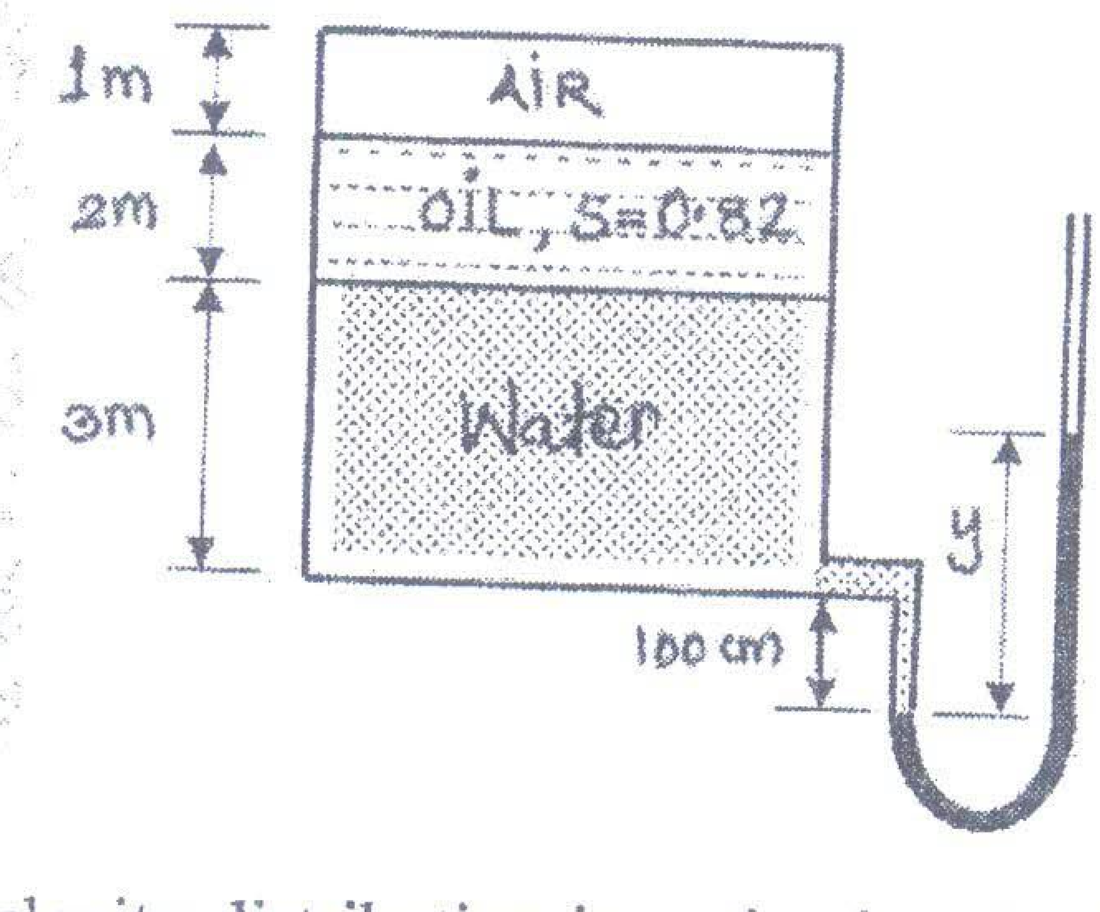
c Explain the working principle of the Pitot tube 05

d Water in a reservoir A is at a level 6m above the water level in reservoir B. The reservoirs are connected by a 5cm diameter horizontal pipe 200m long. The pressure in reservoir B is 70 kPa gauge while the reservoir A is exposed to atmosphere. Assuming the Darcy friction factor of the pipe to be 0.02 and neglecting minor losses, determine the direction of flow. 05

e Examine the following profile for Boundary layer separation 05

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

Q2 a A manometer is attached to a tank containing 3 different fluids as shown fig. What will be the deflection of mercury column 'y' for the given configuration? 08



b Derive the equation of velocity distribution in a circular pipe for Laminar Steady flow, incompressible fluid. 12

Q3 a A two dimensional flow is described in Lagrangian system as 10

$x = x_0 e^{-tk} + y_0(1 - e^{-2tk})$ and $y = y_0 e^{tk}$

Find :

i) The equation of fluid particle in flow field

ii) The velocity components in Eulerian system

b The velocity profile within a laminar boundary layer over a flat plate is given by 10

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

Where U is the mean stream velocity and δ is the boundary layer thickness.

Determine the i) Displacement thickness and

ii) Momentum Thickness.

Q4 a Using N-S Equation find, the velocity distribution, maximum velocity, average velocity, discharge and shear stress for Plane Poiseuille's flow. State the assumptions made. 10

b In a normal shock wave occurring in a Helium (k=1.66) the density downstream of the shock is three times that on the upstream. Calculate the corresponding pressure ratio and velocity ratio. What are the Mach numbers upstream and downstream of the shock? 10

Q5 a A reducing bend is placed in a pipe line such that the direction of flow of water is turned through 60^0 upward and the pipe diameter is reduced from 0.25 m to 0.15 m. The volume of the bend is 0.015 m^3. The exit of the bend is 15 cm above the inlet. The velocity and pressure at the entry to the bend are 1.5 m/s and 300kN/m^2 gauge respectively. it is desired to determine the force exerted by the bend on the water using Reynold's Transport Theorem. 10

i) With the help of neat figure, show the control volume
ii) List all the assumptions considered while solving the problem
iii) Determine the required force
iv) What would be the force of the water on the bend?

b Three pipes with details as following are connected in parallel between two points 10

When the total discharge of 0.3 m^3/s flows through the system. Calculate distribution of discharge and head loss between the junction.

Pipe	Length (m)	Diameter (cm)	Friction factor f
1	1500	20	0.02
2	2000	30	0.015
3	1000	15	0.02

Q6 a Air flows steadily though a long, straight round pipe of radius R. At a plane wall downstream the entrance, the velocity u varies with radius r according to the equation 10

$$\frac{u}{U_{max}} = 1 - \left(\frac{r}{R}\right)^2$$

Where U_{max} is the maximum velocity at the centre line of the pipe.

Evaluate the ratio

$\frac{U_{avg}}{U_{max}}$ if U_{avg} is the average velocity in the pipe.

b **Solve any 2** 10

i) Write a short note on Aerofoil theory

ii) Find the speed of sound in oxygen at a pressure of 100 k Pa absolute and 25^0 C. Take R= 260 J/kg K and k =1.4

iii) Write a short note on Stability of floating bodies.

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