Paper / Subject Code: 39602 / FLUID MECHANICS Date - 9|12|19

S.E. (Mechanical) (Sem - IV) (CBSGS)

Time : 3 Hours **Marks: 80**

1) Question no.1 is compulsory.
2) Attempt any three from question no. 2 to 6.
3) Use illustrative diagrams where ever possible.

Q1 Solve any 4 out of 5 questions

a Define the following : i) Sonic Velocity ii) Stagnation Temperature 5

b A plate having an area of 0.6 m^2 is sliding down the inclined plane at 30^0 to the horizontal with a velocity of 0.36m/s^2. There is a cushion of fluid 1.8mm thick between the plate and the plane. Find the viscosity of the fluid if the weight of the plate is 280N. 5

c Define i) Circulation ii) Vorticity 5

d Define : i) Drag Force ii) Lift Force. Write their formulae. 5

e An isosceles triangular plate of base 3m and altitude 3m is immersed vertically in an oil of specific gravity 0.8. The base of the plate coincides with the free surface of the oil. Determine i) Total pressure on the plate ii) Centre of pressure 5

Q2 a The velocity profile within a laminar boundary layer over a flat plate is given by 10

$$\frac{u}{U} = \frac{y}{\delta}$$

where u is the velocity at a distance y from the plate and u = U at y= δ, δ being boundary layer thickness. Find i) Displacement thickness and ii) Momentum Thickness iii) Energy Thickness

b Derive the continuity equation in Cartesian co-ordinates. 10

Q3 a An oil of viscosity 0.1 N.s/m^2 and relative density 0.9 is flowing through a circular pipe of diameter 50 mm and length 300 m. The rate of flow of fluid through the pipe is 3.5 lit/sec. Find the pressure drop in length of 300 m and also the shear stress at the pipe wall. 10

b In a two dimensional incompressible flow, the fluid velocity components are given by $u = x\text{-}4y$ and $v = -y\text{-}4x$. Show that the velocity potential exists and hence derive, both, the velocity potential and the corresponding Stream function. 10

Q4 a Two reservoirs have a constant difference of levels of 70m and are connected by a 250mm diameter pipe which is 4 km long. The pipe is tapped mid-way and water is drawn at the rate of 0.04 m^3/s. Assuming a friction factor = 0.04 determine the rate at which water enters the lower reservoir. 10

b Air at a pressure of 220 kN/m^2 and temperature of 27^0 C is moving at a velocity of 200m/s. Calculate the stagnation pressure if 10
i) Compressibility is neglected ii) Compressibility is accounted for
For air take R = 287 J/kg K and $\gamma = 1.4$.

Q5	a	In a pipe of diameter 300mm the maximum velocity of flow is found to be 2m/s. If the flow in the pipe is LAMINAR, find i) the average velocity ii) the radius at which it occurs iii) velocity at 50 mm from the wall of the pipe.	10
	b	Starting from Navier-Stokes equation for incompressible fluid and laminar flow, derive the equation for velocity profile for Couette flow. State the assumptions made.	10
Q6	a	An oil of dynamic viscosity 1.5 Poise and relative density 0.9 flows through a 3cm diameter vertical pipe. Two pressure gauges are fixed 20m apart. The gauge A fixed at the top records 200kPa and the gauge B fixed at the bottom records 500kPa. Find the direction of flow and the rate of flow.	10
	b	Write short notes on : i) U tube Manometer. ii) Boundary Layer theory.	10
