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S.E. (Mechanical/Auto.) (Second Semester)

EXAMINATION, 2018

FLUID MECHANICS

(2015 PATTERN)

Time : Two Hours

Maximum Marks : 50

N.B. :— (i) Neat diagram must be drawn wherever necessary.

(ii) Figures to the right indicate full marks.

(iii) Use of logarithmic tables, slide rule, Mollier charts, Electronic pocket calculator, Steam tables and p-h chart is allowed.

(iv) Assume suitable data, if necessary.

1. (a) Explain types of fluid using stress strain diagram. [6]

(b) Find the acceleration and vorticity components at a point (1,1,1) for the following flow field : [6]

$$u = 2x^2 + 3y, v = -2xy + 3y^2 + 3cy, w = -3/2z^2 + 2xz - 9y^2z$$

Or

2. (a) Define various types of flows with mathematical expressions. [6]

P.T.O.

- (b) A 400 mm diameter shaft is rotating at 200 RPM in a bearing of length 120 mm. If the thickness of oil film is 1.5 mm and the dynamic viscosity of the oil is 0.7 N.s/m^2 , determine : [6]
- Torque required to overcome friction in bearing
 - Power utilized in overcoming viscous resistance.
3. (a) Discuss various arrangements of Pitot tube used in pipes. [6]
- (b) A 0.2 m diameter pipe carries liquid in laminar region. A pitot tube placed in the flow at a radial distance of 15 mm from the axis of the pipe indicates velocity of 0.5 m/s. Calculate : [6]
- the maximum velocity
 - the mean velocity
 - the discharge in the pipe.
- Or*
4. (a) Derive an expression of velocity and shear stress distribution for laminar flow through pipe. [6]
- (b) A 300 mm \times 150 mm venturimeter is provided in a vertical pipeline carrying oil of specific gravity 0.9, flow being upward. The difference in elevation of the throat section and entrance section of the venturimeter is 300 mm. The differential U-tube mercury manometer shows a gauge deflection of 250 mm. Calculate : [6]
- The discharge of oil, and

- (ii) The pressure difference between the entrance section and the throat section.

Take $C_d = 0.98$ and specific gravity of mercury as 13.6.

5. (a) A 3000 m long pipeline is used for transmission of power. 130 kW power is to be transmitted through the pipe in which water having a pressure of 40 bar at inlet is flowing. If the pressure drop over the length of pipe is 800 kN/m^2 and $f = 0.024$, find : [6]

- (i) Diameter of the pipe
(ii) Efficiency of transmission.

- (b) Explain : [6]

- (i) Reynolds Number
(ii) Weber Number
(iii) Euler Number.

Or

6. (a) Torque T of propeller depends on density of liquid ρ , viscosity of liquid μ , speed of shaft N rpm, linear velocity V , diameter of the propeller shaft D . Using Buckingham π -theorem, show that : [7]

$$T = \rho N^2 D^5 \phi \left[\frac{ND}{\theta}, \frac{\rho ND^2}{\mu} \right]$$

- (b) A siphon of dia 200 mm connects two reservoirs having a difference of elevation of 15 m. The total length of siphon is 400 m and the summit is 3 m above the water level in the upper reservoir. The length of siphon from upper reservoir to summit is 120 m. Take friction factor = 0.02,

Determine :

[6]

- (i) Discharge through the siphon, and
- (ii) Pressure at the summit. Neglect minor losses.

7. (a) Write a short note on “Separation of Boundary Layer its Control.” [7]

(b) For the following velocity profiles in the boundary layer. Show that whether the boundary is attached, detached or on the verge of separation : [6]

(i) $u/U = 2\eta - \eta^2 + 3\eta^3$

(ii) $u/U = -2\eta + \eta^3 + 2\eta^4$

(iii) $u/U = 2\eta^2 + 5\eta^3 + 2\eta^4$

where $\eta = y/\delta$.

Or

8. (a) Derive an expression for displacement, momentum and energy thicknesses. [9]

(b) A plate length 450 mm and width 150 mm has been placed longitudinally in a stream of crude oil (specific gravity 0.925 and kinematic viscosity of 0.9 stokes) which flows with velocity of 6 m/s. Calculate the friction drag on the plate. [4]