Total No. of Questions : 8]

SEAT No. :

P604

[Total No. of Pages : 3

[5869]-219
S.E. (Mechanical & Automobile Engg.)
FLUID MECHANICS
(2019 Pattern) (Semester - IV)

Time : 2½ Hours] *[Max. Marks : 70*

Instructions to the candidates:

1) ***Answer Q.1 or Q.2, Q.3 or Q.4, Q.5 or Q.6, Q.7 or Q.8.***
2) ***Neat diagrams must be drawn wherever necessary.***
3) ***Figures to the right side indicate full marks.***
4) ***Use of electronic pocket calculator allowed.***
5) ***Assume suitable data if necessary.***

Q1) a) Define stream function & velocity potential function. **[4]**

b) Derive an expression for continuity equation in 3 dimensions. **[6]**

c) Find the velocity & acceleration at a point (1, 1, 2) for the following flow field. **[7]**

$$V = -x^2 y\hat{i} - y^2 2\hat{j} + (2xyz + yz^2)\hat{k}$$

OR

Q2) a) Explain path line & stream line. **[4]**

b) Discuss various types of flow with example. **[6]**

c) The velocity potential function ϕ is given as $\phi = -2xy$, **[7]**

i) Determine stream function.

ii) Determine the velocity at (2, 2)

Q3) a) State Bernoulli's theorem & the assumptions made in Bernoulli's equation. **[4]**

b) Derive expression for the pressure drop for a steady laminar flow through circular pipe. **[6]**

c) A 200mm × 100mm venturimeter is provided in vertical pipe carrying water flowing in horizontal direction. A differential mercury manometer connected to the inlet & throut gives a reading of 220mm. Find the velocity of fluid & rate of flow. **[8]**

OR

P.T.O.

Q4) a) Draw neat labelled sketch of shear stress & velocity distribution diagram across a section of pipe. **[4]**

b) Derive Eulers equation for flow along stream line & deduce the Bernoulli's equation from same. **[6]**

c) A 0.2m diameter pipe carries liquid in laminar region. A pitot tube placed in the flow at radial distance 15mm from the axis of pipe indicates velocity of 0.5 m/s. Calculate i) Maximum velocity ii) Mean velocityi ii) Discharge through pipe. **[8]**

Q5) a) Define the lift force & drag force on an object immersed in a fluid. **[4]**

b) Explain the boundary layer separation & discuss the methods to avoid boundary layer separation. **[6]**

c) Syphon of diameter 200mm connects two reservior having difference in elevation of 15m. Total length of syphon is 600m & summit is 4m above water level in upper reservior. If separation takes place at 2.8m water absolute. Find the maximum length of syphon from upper reservior to summit. Take coefficient of friction as 0.004 & atmospheric pressure as 10.3m of water. **[8]**

OR

Q6) a) Define & explain boundary layer thickness. **[4]**

b) Derive Darcy - weishbach equation for calculating loss of head due to friction in pipe. **[6]**

c) A kite has plan area of $0.25m^2$ & is flying in wind of velocity 25kmph. The kite has net weight of 1.2N. When string is inclined at angle of 15^o to the vertical , tension in string was found to be 3N. Evaluate coefficient of lift & drag. Take density of air as 1.5 kg/m^3. **[8]**

Q7) a) Explain Froude's Model Law. **[4]**

b) Define with examples : **[4]**

i) Reynolds Number

ii) Froude's Number

c) Using Buckingham's π theorem prove that the discharge over weir is given by **[9]**

$$Q = VL^2\left[\frac{gL}{V}, \frac{H}{L}\right]$$

OR

Q8) a) Explain Reynold's Model Law **[4]**

b) Define with examples. **[4]**

i) Euler's Number

ii) Mach Number

c) The pressure rise 'ΔP' generated by a pump is a function of the impeller diameter 'D', the rotational speed 'N', the fluid density 'ρ', viscosity 'μ' and the rate of discharge Q, show that **[9]**

$$\Delta P = SN^2D^2\phi\left[\frac{Q}{ND^3}, \frac{SND^2}{\mu}\right]$$ using Buckingham's Theorem.

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