Total No. of Questions : 8]

SEAT No. :

PF4827

[Total No. of Pages : 3

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S.E. (Mechanical & Automobile)
FLUID MECHANICS
(2019 Pattern) (Semester - IV) (202049)

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 indicate full marks.***
4) ***Assume suitable data wherever necessary.***

Q1) a) Discuss **[8]**

i) Compressible flow

ii) Incompressible flow

iii) Rotational flow

iv) Irrotational flow

b) The velocity vector in a fluid flow is given by, **[9]**

$$V = 4x^3 i - 10x^2 yj + 2tk$$

Find the velocity and acceleration of a fluid particles at (2, 1, 3) at $t = 1$.

OR

Q2) a) Explain **[8]**

i) stream function

ii) velocity potential

iii) Stream Line

iv) Path Line

b) The stream function for a two-dimensional flow is given by $\psi = 2xy$, calculate the velocity at point P (2, 3). Find the velocity potential function ϕ. **[9]**

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Q3) a) Derive an expression of Bernoulli's equation. Also write assumptions made while deriving it. **[9]**

b) A pitot-tube is inserted in a pipe of 300 mm diameter. The static pressure in pipe is 100 mm of Mercury (Vacuum). The stagnation pressure at the center of pipe recorded by the pitot tube is 0.981 N/cm^2. Calculate the rate of flow of water through pipe, if the mean velocity of flow is 0.85 times the center velocity. Take $C_V = 0.98$. **[9]**

OR

Q4) a) Derive Hagen-Poiseuille equation for laminar flow in the circular pipes. **[9]**

b) Two parallel plates are kept 3 mm apart, for a steady laminar flow of oil between these plates, there was a pressure drop of 10 kN/m^2 per meter length of plates. If the viscosity of the oil is 5×10^{-2} Ns/m^2, Determine the discharge per meter width of plates, maximum shear and maximum velocity of flow. **[9]**

Q5) a) Derive an expression for power transmission through pipe. Find also condition for maximum power transmission. **[9]**

b) Three Pipes of lengths 800 m, 500 m and 400 m and of diameters 500 mm, 400 mm and 300 mm repectively are connected in series. These pipes are to be replaced by a single pipe of length 1700 m. Find the diameter of the single pipe. **[8]**

OR

Q6) a) A kite of area 0.25 m^2 and 1.2 N weight is flying in wind of velocity 20 km/hr. When the string is inclined at angle of 15° to the vertical the tension in the string was found to be 3N. Evaluate the coefficient of lift and drag. Take density of air = 1.15 kg/m^3 **[9]**

b) Write a short note on "Separation of boundary layer and its control". **[8]**

Q7) a) Explain the following dimensionless numbers and their significance **[8]**

i) Reynolds number

ii) Froude's number

iii) Mach number

iv) Weber number

b) Discharge Q of an centrifugal pump can be assumed to be dependent on density of liquid ρ, viscosity of liquid μ, pressure P, impeller diameter D and speed N rpm. Show that, **[10]**

$Q = ND^3\, \phi\, (g\, H/N^2\, D^2,\ V/N\, D^2)$

OR

Q8) a) Prove that the scale ratio for discharge for a distorted model is given as **[8]**

$Q_p / Q_m = (L_r)_H \times (L_r)_V^{3/2}$

Where

Q_p = Discharge through Prototype

Q_m = Discharge through model

$(L_r)_H$ = Horizontal scale ratio

$(L_r)_v$ = Vertical scale ratio

b) Explain the Weber's model law & Reynold's Model Law **[10]**

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