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06ME46B

Fourth Semester B.E. Degree Examination, June/July 2011
Fluid Mechanics

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions, selecting at least TWO questions from each part.***

PART – A

1 a. Define the following terms and mention their SI units:
i) Specific weight ii) Dynamic viscosity iii) Kinematic viscosity
iv) Surface tension v) Capillarity. **(10 Marks)**

b. A differential U-tube manometer is used to measure the pressure difference between two points in a horizontal water pipe line. If the manometer shows a difference in mercury levels as 25 cm, find the pressure difference between the points in bar. **(10 Marks)**

2 a. State and prove Pascal's law. **(08 Marks)**

b. A wooden cylinder having specific gravity 0.7 is required to float in water. If the diameter of the cylinder is 'd' and the length '*l*'. Show that '*l*' cannot exceed 0.7715 d for the cylinder to float with its longitudinal axis vertical. **(08 Marks)**

c. Differentiate between stable, unstable and neutral equilibrium of a floating body. **(04 Marks)**

3 a. Define continuity equation and derive the same for a 3-dimensional fluid flow in Cartesian co-ordinates. **(10 Marks)**

b. The stream function for a 2-D flow is given by $\psi = 8xy$. Calculate the velocity at a point P(4, 5). Find also the velocity potential function. **(10 Marks)**

4 a. State and explain Buckingham π theorem. **(05 Marks)**

b. Explain kinematic and dynamic similarity. **(05 Marks)**

c. Velocity of fluid flow through a circular orifice, is dependent on head of flow 'H', orifice diameter 'D', absolute viscosity 'μ', mass density 'ρ' and gravitational acceleration 'g'. Using Buckingham's π theorem show that

$$V = \sqrt{2gH}\phi\left\{\frac{D}{H}, \frac{\mu}{\rho VH}\right\}$$ **(10 Marks)**

PART – B

5 a. Derive Euler's equation of motion along a stream line and hence reduce Bernoulli's equation. **(10 Marks)**

b. A vertical pipe currying oil of specific gravity 0.8 tapers uniformly from 20 cm diameter at the lower section to 10 cm diameter at the upper section. The vertical distance between the sections is 1 m. The pressure gauges installed at the lower and upper sections read 6 N/cm^2 and 8 N/cm^2 respectively, when the discharge is 30 litres/sec. Calculate the loss of head between the two sections and determine the direction of flow. **(10 Marks)**

6 a. With the help of a neat sketch, explain how a pilot tube is used to find the velocity in an open channel. **(04 Marks)**

b. Derive the expression for discharge through a venturimeter. **(08 Marks)**

c. Derive Darcy's equation for loss of head between the two sections. Determine the direction of flow. **(08 Marks)**

7 a. Derive Hagen Poiselli's equation for laminar flow through a circular pipe. **(12 Marks)**

b. Fuel is pumped up in a 30 cm diameter and 15 km long pipeline at the rate of 750 kg/min. The pipe is laid at an upgrade of 1:300. The specific gravity of fuel oil is 0.95 and its kinematic viscosity 20 stokes. Find the power required to pump oil. **(08 Marks)**

8 a. Explain the following :

i) Lift
ii) Drag
iii) Displacement thickness
iv) Mach number
v) Isentropic flow. **(10 Marks)**

b. A flat plate 1.8m×1.8m moves at 36 km/hr in a stationary air of mass density 1.2 kg/m^3. If the coefficients of drag and lift are 0.15 and 0.75 respectively. Determine

i) Drag force
ii) Lift force
iii) Resultant force
iv) Power required to keep the plate in motion. **(10 Marks)**

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