USN | | | | | | | | | | 10ME46B/10AU46B/10MEB406/10AUB406

Fourth Semester B.E. Degree Examination, Aug./Sept.2020
Fluid Mechanics

Time: 3 hrs. Max. Marks:100

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

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

PART – A

1 a. Differentiate between:
(i) Liquids and Gases
(ii) Real fluids and ideal fluids.
(iii) Specific weight and specific volume of a fluid **(06 Marks)**

b. Why does the viscosity of a gas increases with the increase in temperature while that of a liquid decreases with increase in temperature. **(04 Marks)**

c. Two plates are placed at a distance of 0.15 mm apart. The lower plate is fixed while the upper plate having surface area of 1.0 m^2 is pulled at 0.3 m/s, find the force and power required to maintain this speed, if the fluid separating them is having viscosity of 1.5 poise. **(10 Marks)**

2 a. State and prove Hydrostatic law. **(04 Marks)**

b. Show that for a plane surface submerged in water, the centre of pressure lies below the centre of gravity of the submerged surface. **(08 Marks)**

c. A U tube differential manometer connects two pressure pipes A and B. Pipe A contains carbon tetrachloride having a specific gravity of 1.594 under a pressure of 120 kN/m^2 and pipe B contains an oil of specific gravity 0.8 under a pressure of 200 kN/m^2. The pipe A lies 2.5 m above pipe B. Find the difference of pressure measured by mercury as fluid filling U-tube. The level of mercury in the left limb is in level with centre of pipe B. **(08 Marks)**

3 a. Explain the analytical method of determining the metacentric height of a floating body. **(08 Marks)**

b. A body has cylindrical upper portion of 4 m diameter and 2 m deep. The lower portion is curved one which displaces a volume of 0.9 m^3 of water. The centre of buoyancy of the curved portion is at a distance of 2.10 m below the top of the cylinder. The centre of gravity of the whole body is 1.5 m below the top of the cylinder. The total displacement of water is 4.5 tonnes. Find the metacentric height of the body. **(08 Marks)**

c. The velocity vector in a fluid flow is given by,
$V = 2x^3 i - 5x^2 yj + 4tk$
Find the velocity and acceleration of a fluid particle at (1, 2, 3) at time t = 1. **(04 Marks)**

4 a. Derive Euler's equation of motion along a streamline for an ideal fluid. How Bernoulli's equation is obtained from Euler's equation? Also state the assumptions made. **(10 Marks)**

b. A pipe line carrying oil of specific gravity 0.8, changes in diameter from 300 mm at a position A to 500 mm diameter to a position B which is 5 m at a higher level. If the pressures at A and B are 19.62 N/cm^2 and 14.91 N/cm^2 respectively, and the discharge is 150 lit/s, determine the loss of head and direction of flow. **(06 Marks)**

c. Name the different forces present in a fluid flow. Which forces are considered while deriving Euler's equation of motion? **(04 Marks)**

PART – B

5 a. With a neat sketch, derive an equation for the discharge through an orifice meter. **(10 Marks)**

b. The force exerted by a flowing fluid on a stationary body depends upon the length (L) of the body, velocity (V) of the fluid, viscosity (μ) and density (ρ) of the fluid and acceleration (g) due to gravity of the fluid. Find an expression for the force F using dimensional analysis. **(10 Marks)**

6 a. Show that the loss of head due to friction for a fluid flowing through a pipe of diameter d is given by,

$$h_f = \frac{4fLV^2}{2g.d}$$

Where L = length of the pipe, V = Velocity of the fluid and f = coefficient of friction. **(10 Marks)**

b. Find the head loss due to friction in a pipe of diameter 250 mm and length 60 m through which water is flowing at a velocity of 3.0 m/s, using (i) Darcy formula and (ii) Chezy's formula for which C = 55. Take kinematic velocity of water = 0.01 stoke. **(06 Marks)**

c. Sketch the total energy line and the hydraulic gradient line for a pipe line connecting two reservoirs. Also define both. **(04 Marks)**

7 a. What is Hagen Poiseulle's formula? Derive an expression for the viscous flow through a pipe. **(12 Marks)**

b. An oil of viscosity 10 poise flows between two parallel fixed plates which are kept at a distance of 50 mm apart. Find the rat of flow of oil between the plates if the drop of pressure in a length of 1.2 m be 0.3 N/cm^2, width of the plates is 200 mm. **(06 Marks)**

c. What is critical Reynold number? **(02 Marks)**

8 a. Define the following terms:
(i) Lift (ii) Drag (iii) Boundary layer thickness
(iv) Displacement thickness and (v) Momentum thickness. **(10 Marks)**

b. Explain the propagation of pressure waves in a compressible fluid. **(06 Marks)**

c. An aeroplane is flying at an height of 15 km where the temperature is -50°C. The speed of the plane is corresponding to M = 2.0. Assuming K = 1.4 and R = 287 J/kg.K, find the speed of the plane. **(04 Marks)**

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