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10ME/AU36B

Third Semester B.E. Degree Examination, June/July 2017

Fluid Mechanics

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Distinguish between the following:
i) Mass density and specific weight
ii) Newtonian and non-Newtonian fluid
iii) Absolute and kinematic viscosity **(06 Marks)**

b. Explain the phenomenon of capillarity. Obtain expression for capillary rise of a liquid. **(06 Marks)**

c. Calculate the dynamic viscosity of an oil, which is used for lubrication between a square plate of size 0.8 m × 0.8 m and inclined plane having a inclination of 30°. The weight of the square plate is 300 N and it slides down the inclined plane with a uniform velocity of 0.3 m/s. The thickness of the oil film is 1.5 mm. **(08 Marks)**

2 a. State: i) Pascal's law, ii) Hydro static law. **(02 Marks)**

b. Derive an expression for the total pressure for an inclined force and depth of center of pressure for an inclined surface submerged in water. **(08 Marks)**

c. A simple U tube manometer containing mercury is connected to a pipe in which a fluid of specific gravity 0.8 and having vacuum pressure is flowing. The other end of the manometer is open to atmosphere. Find the vacuum pressure in pipe, if the difference of mercury level in the two limbs is 40 cm and the height of fluid in the left from the center of pipe is 15 cm below. **(05 Marks)**

d. Determine the total pressure on a circular plate of diameter 1.5 m which is placed vertically in water in such a way that the center of the plate is 3m below the free surface of water. Find the position of center of pressure also. **(05 Marks)**

3 a. Define stream function and velocity potential function. **(04 Marks)**

b. The stream function for a two dimensional flow is given by $\Psi = 2xy$ calculate the velocity at the point P(2, 3). Find the velocity potential function ϕ. **(08 Marks)**

c. A block of wood of specific gravity 0.7 floats in water. Determine the meta-centric height of the block if its size is 2m × 1m × 0.8m. **(08 Marks)**

4 a. State Bernoulli's theorem for steady flow of an incompressible fluid and derive an expression for the same. State the assumptions for such a derivation. **(10 Marks)**

b. The water is flowing through a taper pipe of length 100 m having diameters 600 mm at the upper end and 300 mm at the lower end, at the rate of 50 liters/s. The pipe has a slope of 1 in 30. Find the pressure at the lower end if the pressure at the higher level is 19.62 N/cm^2. **(10 Marks)**

PART – B

5 a. Derive an expression for rate of flow through venturimeter. **(08 Marks)**

b. Define notch and classify them. **(04 Marks)**

c. Using Buckingham's π-theorem, show that the velocity through a circular orifice is given by $V = \sqrt{2gH}\,\phi\left[\frac{D}{H}, \frac{\mu}{\rho VH}\right]$ where H is the head causing flow, D is the diameter of the orifice, μ is coefficient of viscosity, ρ is the mass density and g is the acceleration due to gravity. **(08 Marks)**

6 a. Derive Darcy-Weisbach equation and deduce it to Chezy's equation. **(08 Marks)**

b. Define hydraulic gradient line and total energy line. **(04 Marks)**

c. Find the head lost due to friction in a pipe of diameter 300 mm and length 50 m, through which water is flowing at a velocity of 3 m/s using (i) Darcy formula, (ii) Chezy's formula for which C = 60. Take γ for water = 0.01 stoke. **(08 Marks)**

7 a. Prove that the velocity distribution for viscous flow between two parallel plates when both plates are fixed across a section is parabolic in nature. Also sketch the velocity distribution. **(10 Marks)**

b. A fluid of viscosity 0.7 N-S/m^2 and specific gravity 1.3 is flowing through a circular pipe of diameter 100 mm. The maximum shear stress at the pipe wall is given as 196.2 N/m^2, find:

i) The pressure gradient

ii) The average velocity

iii) Reynold's number of the flow. **(10 Marks)**

8 a. Define displacement thickness and momentum thickness. **(04 Marks)**

b. Derive an expression for velocity of sound wave in a fluid. **(10 Marks)**

c. Experiments were conducted in a wind tunnel with a wind speed of 50 km/hour on a flat plate of size 2m long and 1m wide. The density of air is 1.15 kg/m^3. The coefficients of lift and drag are 0.75 and 0.15 respectively. Determine:

i) The lift force

ii) The drag force

iii) The resultant force

iv) Direction of resultant force

v) Power exerted by air on the plate **(06 Marks)**

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