CBCS SCHEME

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17AU42

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

Time: 3 hrs. Max. Marks: 100

Note: ***Answer any FIVE full questions, choosing ONE full question from each module.***

Module-1

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

b. Distinguish between the following:
(i) Mass density and specific weight.
(ii) Newtonian and Non-newtonian fluid.
(iii) Absolute and kinematic viscosity.
(iv) Surface tension and vaccum pressure. **(08 Marks)**

c. Calculate the dynamic viscosity of an oil, which is used for lubrication between a square plate of size $0.8m \times 0.8m$ 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 MN. **(06 Marks)**

OR

2 a. Derive an expression for the total pressure for an inclined force and depth of center of pressure for an inclined surface submerged in water. **(10 Marks)**

b. 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 3 m below the free surface of water. Find the position of center of pressure also. **(06 Marks)**

c. State (i) Pascal's law (ii) Hydrostatic law. **(04 Marks)**

Module-2

3 a. A block of wood of specific gravity 0.7 floats in water. Determine the meta centric height of the block if its size is $2m \times 1m \times 0.8m$. **(10 Marks)**

b. Explain the method to find meta centric height experimentally. **(06 Marks)**

c. Determine the conditions of equilibrium for a floating body with neat sketches. **(04 Marks)**

OR

4 a. 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. **(10 Marks)**

b. Evaluate an expression for continuity equation for a three dimensional flow. **(06 Marks)**

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

Module-3

5 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. A pipe of diameter 30 cm carries water at a velocity of 20 m/s. The pressures at the points A and B are given as 34.34 N/cm^2 and 29.43 N/cm^2 respectively, while the datum head at A and B are 25 m and 28 m. Determine the loss of head between A and B. **(10 Marks)**

OR

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

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

c. A Pitot-static tube placed in the centre of a 300 mm pipe line has one orifice pointing upstream and other perpendicular to it. The mean velocity in the pipe is 0.80 of the central velocity. Find the discharge through the pipe if the pressure difference between the two orifice is 60 mm of water. Take the coefficient of pitot tube as $C_V = 0.98$. **(08 Marks)**

Module-4

7 a. Using Buckingham's π theorem, show that the velocity through a circular orifice is given by $V = \sqrt{2gH} \cdot \phi \left[\frac{D}{H}, \frac{\mu}{\rho VH}\right]$ where 'H' is the head causing flow, 'D' is the diameter of the orifice, μ is the coefficient of viscosity, ρ is the mass density and 'g' is the acceleration due to gravity. **(10 Marks)**

b. Explain the following terms: (i) Geometric similarity (ii) Kinematic similarity **(04 Marks)**

c. Determine the expression for the power P, developed by a pump, when 'P' depends upon the head 'H' ; the discharge 'Q' and specific weight 'W' of the fluid. **(06 Marks)**

OR

8 a. Develop Darcy-Weisbach equation for loss of head in a pipe due to friction. **(10 Marks)**

b. 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. **(10 Marks)**

Module-5

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

b. Explain the terms :

(i) Drag and lift.

(ii) Displacement, moment and energy thickness. **(10 Marks)**

OR

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

b. A projectile travels in air of pressure 15 N/cm^2 at 10°C, at speed of 1500 km/h. Determine the mach number and mach angle. Assume $\upsilon = 1.4$ and R = 287 J/kgK. **(10 Marks)**

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