CBCS SCHEME

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17ME44

Fourth Semester B.E. Degree Examination, Feb./Mar. 2022
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. Define the following terms with their units
   i) Weight density
   ii) Mass density
   iii) Specific gravity
   iv) Absolute Viscosity
   v) Capillarity **(10 Marks)**

b. State and prove Pascal law. **(06 Marks)**

c. An open container has water to a depth of 2 meter and above this is oil of specific gravity 0.9 for a depth of 1 meter. Find intensity of pressure at inter phase of liquid and at the bottom of the tank. **(04 Marks)**

OR

2 a. Derive expression for total pressure and centre of pressure for a plane surface immersed vertically in a static mass of fluid. **(06 Marks)**

b. A circular plate of diameter 3m is immersed in water, the greatest depth and least depth below the surface of water is 3m, and 1m respectively. Calculate :
   i) Total pressure
   ii) Location of center of pressure. **(08 Marks)**

c. Explain clearly conditions of equilibrium of a submerged and floating bodies. **(06 Marks)**

Module-2

3 a. Differentiate between :
   i) Steady flow an unsteady flow
   ii) Viscous flow and turbulent flow
   iii) Uniform and nonuniform flow
   iv) Compressible and incompressible flow. **(08 Marks)**

b. Derive continuity equation in Cartesian coordinates for a fluid flow in 3-dimensions. **(06 Marks)**

c. Calculate the unknown velocity component so that the following velocity component represent a possible case of incompressible flow
   i) $u = 2x^2$ $v = xyz$ $w = ?$
   ii) $u = ?$ $v = 2yz$ $w = 2xyz$. **(06 Marks)**

OR

4 a. Obtain the Euler's equation of motion along a stream line and hence derive Bernoulli's equation for a steady incompressible fluid flow. State the assumptions made. **(10 Marks)**

b. An venturimeter has an area ratio of 9 to 1. The larger diameter being 300mm. During the flow the recorded pressure head in the larger section on 6.5m and that at the throat 4.25m. If the venturi coefficient (C_d) = 0.99, compute the discharge through the meter. **(06 Marks)**

c. Derive an expression for discharge through a rectangular notch. **(04 Marks)**

Module-3

5 a. Prove that the ratio of maximum velocity to average velocity for laminar flow between two stationary parallel plates is 1.5. **(10 Marks)**

b. A laminar flow is taking place in a pipe of diameter of 200mm. The maximum velocity is 1.5m/s. Find the mean velocity and the radius at which this occurs. Also calculate the velocity of 4cm from the wall of the pipe. **(10 Marks)**

OR

6 a. Derive Darcy-Weisbach relation for a fluid flow through a pipe. **(10 Marks)**

b. Three pipes of 400mm, 200mm, 300mm diameters have lengths of 400m, 200m, 300m respectively. They are connected in series to make a compound pipe. The ends of this compound pipe are connected with two tanks whose difference of water levels is 16m. If coefficient of friction for these pipes is same and equal to 0.005, determine the discharge through the compound pipe, neglecting first the minor losses and then including them. **(10 Marks)**

Module-4

7 a. Define the terms :

i) Boundary layer thickness
ii) Energy thickness
iii) Left
iv) Drag. **(04 Marks)**

b. A flat plate 1.5m × 1.5m moves to 50km/hr in stationary air of density 1.15kg/m^3. If the coefficients of drag and left are 0.15 and 0.75 respectively. Determine :

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

c. Write short note on boundary layer separation and methods to control it. **(06 Marks)**

OR

8 a. State and explain Buckingham π theorem **(04 Marks)**

b. The efficiency of a fan depends on density 'ρ' dynamic viscosity 'μ' angular velocity 'ω' diameter 'D' and discharge 'Q'. Express efficiency in terms of dimensionless groups. **(10 Marks)**

c. Explain :

i) Geometric similarity
ii) Kinematic Similarity
iii) Dynamic similarity. **(06 Marks)**

Module-5

9 a. Show that velocity of propagation of elastic wave in an adiabatic medium is given by $C = \sqrt{rRT}$ starting from fundamentals. **(10 Marks)**

b. Find the velocity of bullet fired in standard air, if the mach angle is 30°. Take R = 287.14J/kg and K = 1.4 for air. Assume temperature as 15°C. **(10 Marks)**

OR

10 a. Define stagnation properties. Obtain an expression for stagnation pressure of a compressible fluid in terms of mach number and pressure. **(10 Marks)**

b. Define computational fluid dynamics and mention their limitations and applications of CFD. **(10 Marks)**

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