CBCS SCHEME

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15MR46

Fourth Semester B.E. Degree Examination, Dec.2019/Jan.2020
Fluid Mechanics

Time: 3 hrs. Max. Marks: 80

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

Module-1

1 a. Define the following properties of fluid with a suitable sketches:
i) Newtonian and Non-newtonion fluids.
ii) Viscosity
iii) Compressibility and capillarity. **(06 Marks)**

b. State and prove Pascal law. **(05 Marks)**

c. A circular plate 3m diameter is immersed in water in such a way that its greatest and least depth below the free surface are 4m and 1.5m respectively. Determine the total pressure on face of the plate and position of the centre of pressure. **(05 Marks)**

OR

2 a. Derive an expression for the depth of centre of pressure from free surface of liquid of a vertical plane surface submerged in the liquid. **(08 Marks)**

b. A flat plate $0.1m^2$ area is pulled at 30cm/sec relative to another plate located at a distance of 0.01cm from it, the fluid separating them being water of viscosity 0.001 N-sec/m^2. Find the force and power required to maintain the velocity. **(04 Marks)**

c. State and prove Hydrostatic law. **(04 Marks)**

Module-2

3 a. Derive the expression for metacentric height for a floating body and state the conditions for stability of floating body. **(08 Marks)**

b. Explain Lagrangian and Eulerian method. **(04 Marks)**

c. Find the density of a metallic body which floats at the interface of mercury of specific gravity 13.6 and water such that 40% of its volume is submerged in mercury and 60% in water. **(04 Marks)**

OR

4 a. A stream function is given by $\varphi = 5x - 6y$. Calculate the velocity components and also magnitude and direction of the resultant velocity at any point. **(04 Marks)**

b. Derive Bernoulli's equation and state the assumptions made. **(06 Marks)**

c. A pipe of diameter 400mm carries water at a velocity of 25m/sec. The pressures at the points A and B are given as 29.43 N/cm^2 and 22.563N/cm^2 respectively while the datum head at A and B are 28m and 30m. Find the loss of head between A and B. **(06 Marks)**

Module-3

5 a. Derive an expression for flow through V-notch. **(08 Marks)**

b. A horizontal venturimeter with inlet diameter 20cm and throat diameter 10cm is used to measure the flow of water. The pressure at inlet is 147kPa and vaccum pressure at the throat is 40cm of mercury. Find the discharge of water through venturimeter. Take $C_d = 0.98$. **(06 Marks)**

c. Explain briefly pitot tube. **(02 Marks)**

OR

6 a. A partially submerged body is towed in water. The resistance 'R' to its motion depends on the density ρ, the viscosity μ of water, length L of the body, velocity V of the body and the acceleration due to gravity g. Show that the resistance to the motion can be expressed in the form $R = \rho L^2 V^2 \phi\left[\left(\frac{\mu}{\rho v L}\right), \left(\frac{Lg}{V^2}\right)\right]$. **(10 Marks)**

b. Explain following dimensionless number:
i) Mach's number (M) ii) Reynold's number iii) Euler's number. **(06 Marks)**

Module-4

7 a. Derive an expression for Darcy-Weisbach equation for loss of head due to friction. **(08 Marks)**

b. A horizontal pipe line 40m long is connected to a water tank at one end discharges freely into the atmosphere at the other end. For first 25m its length from the tank, the pipe is 150mm diameter and its diameter is suddenly enlarges to 30mm. The height of water level in tank is 8m above the center of pipe. Considering all losses of head which occur, determine the rate of flow. Take f = 0.01 for both sections of pipe. **(08 Marks)**

OR

8 a. Derive the Hagen-Poiseuille equation for lead loss in circular pipe through laminar flow. **(10 Marks)**

b. Determine:
i) Pressure gradient
ii) Shear stress at the two horizontal plates
iii) Discharge per meter width for laminar flow of oil with a maximum velocity of 2m/sec between two plates which are 150mm apart. Given μ = 2.5 pa-sec. **(06 Marks)**

Module-5

9 a. Explain the following: i) Momentum thickness ii) Energy thickness. **(06 Marks)**

b. Experiments were conducted in a wind tunnel with a wind speed of 50km/hr on a flat plate of size 2m long and 1m wide the density of air is 1.15kg/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) The direction of resultant force
v) Power exerted by air on the plate. **(10 Marks)**

OR

10 a. Obtain an expression for velocity of the sound wave in a compressible fluid in terms of change of pressure and change of density. **(08 Marks)**

b. An air plane is flying at an altitude of 15km where the temperature is -50°C the speed of the plane corresponds to mach number is 1.6. Assuming K = 1.4 and R = 287J/kg K for air. Find the speed of the plane and mach angle α. **(04 Marks)**

c. Differentiate between:
i) Stream body and bluff body
ii) Pressure drag and friction drag. **(04 Marks)**

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