CBCS SCHEME

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15AE35

Third Semester B.E. Degree Examination, July/August 2022
Mechanics of Fluids

Time: 3 hrs. Max. Marks: 80

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

Module-1

1 a. Two large plane surfaces are 24 cm apart. The space between the surfaces is filled with glycerin. What force is required to drag a thin plate of surface area 0.5 m^2 between the two large plane surfaces at a speed of 0.6 m/s, if:
(i) The thin plate is in middle of the two plane surfaces and
(ii) The thin plate is at a distance of 0.8 cm from one of the plane surfaces?
Take the dynamic viscosity of glycerin = 8.10×10^{-1} NS/m^2. **(08 Marks)**

b. Explain compressibility and bulk modulus. Derive a relationship between (K) and pressure (P) for a gas during isothermal and adiabatic process. **(08 Marks)**

OR

2 a. Derive an expression for total pressure and center of pressure for an inclined plane surface submerged in liquid. **(08 Marks)**

b. Explain conditions of equilibrium for a floating and submerged bodies. **(08 Marks)**

Module-2

3 a. Explain different types of fluid motion. **(08 Marks)**

b. In a two dimensional incompressible flow, the fluid velocity components are given by $u = x - 4y$ and $v = -y - 4x$. Show that velocity potential exists and determine its form. **(08 Marks)**

OR

4 a. Derive an expression for continuity equation in 3D, in differential form for steady incompressible flow. **(08 Marks)**

b. For a finite control volume fixed in space, derive momentum equation in integral form. **(08 Marks)**

Module-3

5 a. Derive an expression for discharge through venturimeter. **(08 Marks)**

b. A non uniform part of pipe line 5m long is laid at a slope of 2 in 5. Two pressure gauges each fitted at upper and lower ends read 20 N/cm^2 and 12.5 N/cm^2. If the diameter at the upper and lower ends are 15 cm and 10 cm respectively. Determine quantity of water flowing per second. **(08 Marks)**

OR

6 Using Buckingham's π theorem, shown that the discharge Q consumed by an oil ring is given by $Q = Nd^3\phi\left[\frac{\mu}{\rho Nd^2}, \frac{\sigma}{\rho N^2 d^3}, \frac{\omega}{\rho N^2 d}\right]$ where d is internal diameter of the ring. N is rotational speed, ρ is density, μ is viscosity σ is surface tension and ω is specific weight of an oil. **(16 Marks)**

Module-4

7 a. Explain Kutta-Joukowsky theorem. (06 Marks)
b. Derive an expression for drag and lift. (06 Marks)
c. Explain stream-lined body and Bluff body. (04 Marks)

OR

8 a. Derive Von Kerman integral equation for boundary layer flows. (10 Marks)
b. Find the displacement thickness, momentum thickness and energy thickness for velocity distribution in the boundary layer given by $\frac{u}{U} = \frac{y}{\delta}$, where μ is velocity at a distance y from the plate and u = U at y = δ, where δ = boundary layer thickness. Also calculate value of δ^*/θ. (06 Marks)

Module-5

9 a. Derive an expression for velocity of sound wave in a fluid. (08 Marks)
b. Derive Bernoulli's equation for:
(i) Isothermal process
(ii) Adiabatic process in a steady compressible flow. (08 Marks)

OR

10 a. Derive expression for :
(i) Stagnation density
(ii) Stagnation temperature for a compressible fluid (10 Marks)
b. Explain propagation of disturbance in a compressible fluid for subsonic, sonic and supersonic mach numbers. (06 Marks)

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