CBCS SCHEME

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18AE/AS35

Third Semester B.E. Degree Examination, June/July 2025
Mechanics of Fluids

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. State and prove hydrostatic law. **(12 Marks)**

b. An aeroplane is flying at an altitude of 5000 m. Calculate the pressure around the aeroplane, given the lapse rate in the atmosphere as 0.0065° K/m. Neglect variation of g with altitude. Take pressure and temperature at ground level as 10.143 N/cm^2 and 15°C and the density of air as 1.285 Kg/cm^3, R = 274.09 J/K. **(08 Marks)**

OR

2 a. Derive the expression for hydrostatic forces on an inclined submerged plane surface and depth of centre of pressure. **(10 Marks)**

b. An inverted differential monometer is connected to two pipes A and B which convey water as shown in Fig Q2(b). The fluid in monometer is oil of specific gravity 0.8. For the monometer readings shown in figure, find the pressure difference between point A and B.

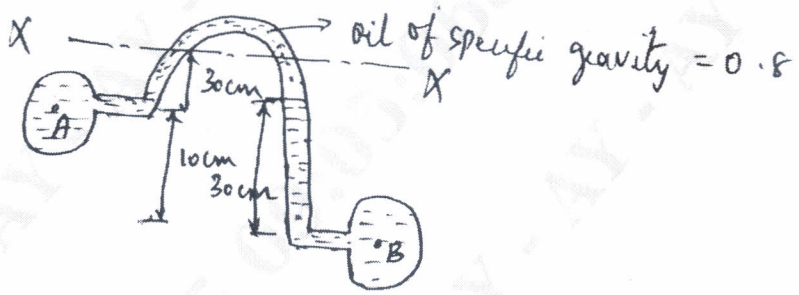

Fig Q2(b) **(10 Marks)**

Module-2

3 a. Obtain an equation of stream function and velocity potential function. Draw stream line and potential line for source and sink flow. **(10 Marks)**

b. Derive an expression for continuity equation for a three dimensional flow in Cartesian coordinates. **(10 Marks)**

OR

4 a. Derive the Navier - Stokes equation by control volume approach. **(08 Marks)**

b. Obtain an integral form and differential form of energy equation using control volume approach. **(08 Marks)**

c. The stream function for a z-dimensional flow is given by $\psi = 2xy$. Calculate the velocity at the point (2, 3). Find the velocity potential function 'ϕ'. **(04 Marks)**

Module-3

5 a. Derive the Euler's equation of motion for steady flow and obtain Bernoulli's equation from it. State the assumption made in the derivation of Bernoulli's equation. **(12 Marks)**

b. A venturimeter is to be placed in a virtical line to measure the rate of flow of benzene (Sp.gr = 0.899). The inlet diameter of venturimeter is 200 mm and throat diameter of is 87.5 mm. Benzene Mercury differential gauge is used to measure difference of pressure between inlet and the throat diameter. When gauge reading is 100 mm. Find :
i) Gauge reading in mm of benzene ii) Velocity at throat and discharge **(08 Marks)**
Take $C_d = 0.98$ and specific gravity of mercury = 13.5.

OR

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

b. Derive an expression for discharge through venturimeter. **(10 Marks)**

Module-4

7 a. With the help of a neat sketch, explain the concept of boundary layer. **(08 Marks)**

b. Define and obtain an expression for :
i) Displacement thickness (δ^*)
ii) Momentum thickness (θ)
iii) Energy thickness (δ^{**}) **(12 Marks)**

OR

8 a. With a neat sketch, explain the airfoil characteristic. **(08 Marks)**

b. Derive an expression for a lift force on rotating cylinder which represents Kutta-Jourkowsky equation. **(12 Marks)**

Module-5

9 a. Obtain the expression for velocity of sound wave in a fluid. **(10 Marks)**

b. Explain the propagation of pressure wave in a compressible fluid with neat sketch. **(10 Marks)**

OR

10 a. Derive Bernoulli's equation for compressible flow undergoing isothermal and adiabatic process. **(10 Marks)**

b. Find the Mach number where an aeroplane is flying at 1100 Km/hr through still air having pressure of 7 N/mm^2 and temperature of -5°C wind velocity may be taken zero, R = 287.14 J/K. Calculate pressure, temperature and density of air at stagnation point on the nose of the plane, take K = 1.4. **(10 Marks)**

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