CBCS SCHEME

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17AE35

Third Semester B.E. Degree Examination, Jan./Feb. 2021
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. **(10 Marks)**

b. An aeroplane is flying at an altitude of 5000m. Calculate the pressure around the airplane 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 1.285Kg/cm^3 R = 274.09J/k. **(10 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.

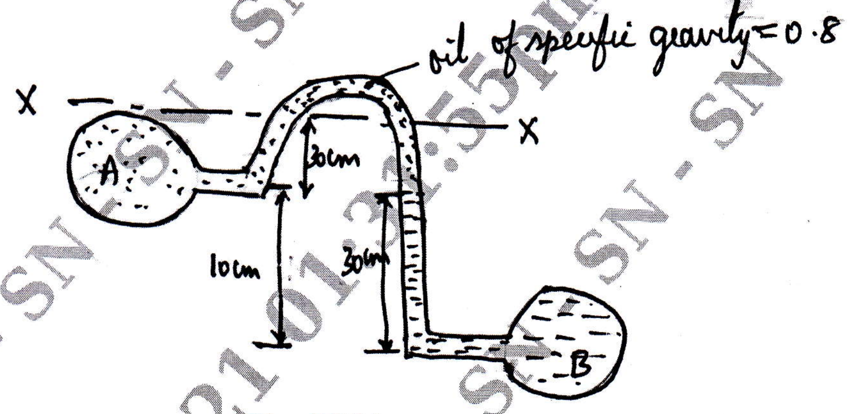

Fig. Q2(b) **(10 Marks)**

Module-2

3 a. Obtain an equation of stream function and velocity potential function. Draw steam 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 co-ordinate. **(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 2-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 venturemeter is to be placed in a vertical line to measure the rate of flow of benzene (Sp. gr = 0.899). The inlet diameter of venturimeter is 200mm and throat diameter is 87.5mm. Benzene mercury differential gauge is used to measure the difference of pressure between inlet and the throat meter. When gauge reading is 100mm. Find :

i) Gauge reading in mm of benzene

ii) Velocity at throat and discharge

Take $C_d = 0.98$ and Sp. Gravity of mercury = 13.5. **(08 Marks)**

OR

6 a. Using Buckingham's π-theorem, show that the velocity through a circular orifice is given by $V = \sqrt{2gH}\ \phi\left[\frac{D}{H}, \frac{\mu}{\rho VH}\right]$ where H is head causing flow 'd' is diameter of orifice, μ is co-efficient 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. **(05 Marks)**

b. Define and obtain an expression for

i) Displacement thickness (δ^*)

ii) Momentum thickness (θ)

iii) Energy thickness (δ^{**}). **(15 Marks)**

OR

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

b. Derive an expression for a lift force on rotating cylinder which represents Kutta – Joukowsky equations. **(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 waves 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 if flying at 1100 Km/hr through still air having pressure of $7N/m^2$ and temperature of -5°C. Wind velocity may be taken as zero, R = 287.14J/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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