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15AE35

Third Semester B.E. Degree Examination, July/August 2021
Mechanics of Fluids

Time: 3 hrs. Max. Marks: 80

Note: *Answer any FIVE full questions.*

1 a. Calculate the dynamic viscosity of an oil, which is used for lubrication between a square plate of size 0.8m×0.8m and an inclined plane with angle of inclination 30° as shown in Fig Q1(a). The weight of the square plate is 300N and it slide down the inclined plane with a uniform velocity of 0.3m/s. The thickness of oil film is 1.5mm

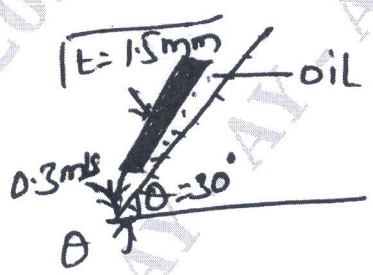

Fig Q1(a) **(08 Marks)**

b. Define the following with their SI unit.
i) Mass density
ii) Capilarity
iii) Surface Tension
iv) Specific weight. **(08 Marks)**

2 a. State and prove Pascal's law. **(08 Marks)**

b. A circular plate 3.0m 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 one face of the plate and position of the center of pressure. **(08 Marks)**

3 a. Differentiate between :
i) Steady and Unsteday flow
ii) Uniform and Non-uniform flow
iii) Laminar and Turbulant flow
iv) Compressible and Incompressible flow **(08 Marks)**

b. For a fluid flow derive an expression for continuity equation in 3-Diemensions in Cartesian coordinate. **(08 Marks)**

4 a. Obtain an expression for Doublet flow for stream function. **(08 Marks)**

b. The velocity potential function is given by $\phi = x(2y - 1)$. Calculate the velocity components at the point (4, 5). Determine also the value of stream function. **(08 Marks)**

5 a. State and prove Bernoulli's equation from the first principle and also state the assumption made for the same. **(08 Marks)**

b. Water is flowing through a pipe having diameter 300mm and 200mm at bottom and upper and respectively. The intensity of pressure at the bottom end is 24.525N/cm^2 and the pressure at the upper end is 9.81 N/cm^2. Determine the difference in datum head if the rate of flow through pipe is 40 litres/sec. **(08 Marks)**

6 a. Define and derive an expression for Reynold's, Eulers, Weber's and Mach number. **(08 Marks)**

b. The frictional torque T of a disc of diameter D rotating at a speed N in a fluid of viscosity μ and density ρ in a turbulent flow is given by $T = D^5N^2\rho\phi\left[\frac{\mu}{D^2N\rho}\right]$. **(08 Marks)**

7 a. Define Energy thickness. Derive an expression for Energy thickness. **(08 Marks)**

b. Define Lift, Drag and Derive the expression for the same. **(08 Marks)**

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

b. A kite 0.8m × 0.8m weighing 3.924N assumes an angle of 12° to the horizontal. The string attached to the kite make an angle of 45° to the horizontal. The pull on the string is 24.525N. When the wind is flowing at a speed of 30Km/hr. Find the corresponding coefficient of drag and lift. Density of air is given at 1.25kg/m^3. **(08 Marks)**

9 a. Define stagnation point and derive an expression for stagnation temperature. **(08 Marks)**

b. State the Bernoulli's theorem for compressible flow. Derive an expression for Bernoulli's equation when the process is isothermal. **(08 Marks)**

10 a. Derive an expression for velocity of sound wave in a fluid. **(10 Marks)**

b. Find the velocity of bullet fired in standard air if the Mach angle is 30°. Take R = 287.14 J/Kg-K and K = 1.4 for air. Assume temperature 15°C. **(06 Marks)**

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