CBCS SCHEME

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18AE/AS35

Third Semester B.E. Degree Examination, Feb./Mar. 2022
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 Newton's law of viscosity and explain about types of fluids with Rheological diagram. **(08 Marks)**

b. Draw neat sketch and explain about surface Tension and capillarity. Also obtain expression for capillary rise. **(06 Marks)**

c. An oil of viscosity 5 poise is used for lubrication between a shaft and sleeve. The diameter of shaft is 0.5m at rotates at 200rpm. Thickness of oil film is 1mm. Calculate the power lost in oil for a sleeve length of 100mm. **(06 Marks)**

OR

2 a. Define Pascal's law and prove the Pascal's law by relation. **(06 Marks)**

b. Explain about pressure measurement devices used in fluid mechanics and aerospace applications. **(06 Marks)**

c. Obtain the relation for Hydrostatic forces for a curved surface submerged in liquid. **(08 Marks)**

Module-2

3 a. Briefly explain about types of fluid flow. **(06 Marks)**

b. Define velocity potential and stream function. Prove that the product of equipotential line and line of constant stream function is (-1). **(06 Marks)**

c. A pipe of 450mm diameter branches into two pipes of diameters 300mm and 200mm. The average velocity in 450mm pipe is 3m/s. Find
i) Discharge in a 450mm diameter pipe
ii) Velocity in 200mm diameter pipe if average velocity in 300mm pipe is 2.5m/s. **(08 Marks)**

OR

4 a. Derive Energy equation in differential form by explaining the basic principles. **(10 Marks)**

b. Derive Navier-Stokes equation and write the assumptions made for Navier-Stokes equation. **(10 Marks)**

Module-3

5 a. Derive Euler's equation of motion and write the Bernoulli's equation. **(10 Marks)**

b. A horizontal venturimeter with inlet diameter 20cm and throat diameter 10cm is used to measure the flow of water. The pressure at the inlet is 17.658N/cm^2 and the vacuum pressure at the throat is 30cm of mercury. Find the discharge through venturimeter if $C_d = 0.98$. **(10 Marks)**

OR

6 a. The pressure difference ΔP in a pipe of diameter 'D' and length 'ℓ' due to turbulent flow depends on velocity V, viscosity μ, density ρ and roughness K. Solve using Buckingham's π-theorem and obtain expression for ΔP, Use (D, V, ρ) as repeating variable. **(10 Marks)**

b. Derive expression for Reynolds's number and Mach number. **(06 Marks)**

c. A ship model of scale 1:50 is towed through a sea water at a speed of 1m/s. Force required to tow the model is 2N. If the prototype is subjected to wave resistance only determine the speed and propulsive force of the ship. **(04 Marks)**

Module-4

7 a. Derive the expression for Lift and Drag. **(06 Marks)**

b. A kite weighing 3.924N with area 0.8m × 0.8m makes an angle 12° to the horizontal. String attached to the kite makes an angle 45° to the horizontal. The pull on the string is 24.525N when the wind is flowing at a speed of 30km/hour. Find the co-efficient of lift and drag. Take density of air as 1.25 kg/m^3. **(08 Marks)**

c. Define : i) Boundary layer thickness ii) Displacement thickness. **(06 Marks)**

OR

8 a. Derive Von-Karman momentum Integral equation and write its application. **(10 Marks)**

b. Find the displacement thickness and momentum thickness for the velocity distribution in the boundary layer given by

$$\frac{u}{U} = 2\left(\frac{y}{\delta}\right) - \left(\frac{y}{\delta}\right)^2$$ **(10 Marks)**

Module-5

9 a. Explain about i) Isothermal process ii) Adiabatic process. **(04 Marks)**

b. Write the Bernoulli's equation for Incompressible flow and obtain the expression for Adiabatic process Bernoulli's equation. **(08 Marks)**

c. Draw neatly and explain about propagation of pressure waves in a compressible fluid. Also explain about Mach cone and Mach angle. **(08 Marks)**

OR

10 a. Derive the expression for stagnation pressure, stagnation temperature and stagnation density. **(10 Marks)**

b. An aircraft is flying at 1100km/hour through the stagnant air having pressure of 7N/cm^2 and temperature -5°C. Find the Mach number of an aircraft. Also calculate the pressure temperature and density of air at stagnation point on the nose of aircraft. Take R = 287.14J/Kg K, K = 1.4 **(10 Marks)**

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