CBCS SCHEME

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18AE/AS35

Third Semester B.E. Degree Examination, Aug./Sept. 2020
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. Define the following fluid properties, with units
i) Density
ii) Weight density
iii) Viscosity
iv) Bulk modulus
v) Capillarity. **(10 Marks)**

b. If the velocity profile of a fluid over a plate is parabolic with the vertex 20cm from the plate, where the velocity is 120cm/sec. Calculate the velocity gradient and shear stresses at a distance of 0, 10 and 20cm from the plate, If the viscosity of the fluid is 8.5 poise. **(10 Marks)**

OR

2 a. State and prove hydrostatic law. **(08 Marks)**

b. A U-tube monometer is used to measure the pressure of water in a pipe line, which is in excess of atmospheric pressure. The right limb of the monometer contains mercury and is open to atmosphere. The contact between water and mercury in the left limb. Determine the pressure of water in the main line, if the difference in level of mercury in the limbs of U-tube in 10cm and the pre-surface of mercury is in level with the centre of the pipe. If the pressure of water in pipe line is reduced to 9810 N/m^2, calculate the new difference in the level of mercury. Sketch the arrangements in both cases. **(12 Marks)**

Module-2

3 a. Water flows through a pipe AB 1.2m diameter at 3m/sec and then passes through a pipe BC 1.5m diameter. At C, the pipe branches. Branch CD is 0.8m in diameter and carries one-third of the flow in AB. The flow velocity in branch CE is 2.5 m/sec. Find the volume rate of flow in AB, the velocity in BC, the velocity in CD and the diameter of CE. **(10 Marks)**

b. Define velocity potential function, stream function and show that equipotential lines are orthogonal to the stream lines at all points of intersection. **(10 Marks)**

OR

4 a. For the finite control volume fixed in space, derive momentum equation in integral form. **(10 Marks)**

b. With neat sketches, explain different important cases of potential flow. **(10 Marks)**

Module-3

5 a. State the assumptions made in Bernoulli's equation and obtain Euler's equation of motion. **(10 Marks)**

b. Apply Bernoulli's equation for venturimeter and obtain Q_{act} for venturimeter. **(10 Marks)**

OR

6 a. Show that discharge Q consumed by an oil wing is given by

$$Q = Nd^3\phi\left[\frac{\mu}{\rho Nd^3}, \frac{\sigma}{\rho N^2 d^3}, \frac{\omega}{\rho N^2 d}\right]$$

$d \rightarrow$ internal diameter $\rho \rightarrow$ density $\sigma \rightarrow$ surface tension

$N \rightarrow$ rotational speed $\mu \rightarrow$ viscosity $\omega \rightarrow$ specific weight of oil. **(10 Marks)**

b. The ratio of lengths of a sub marine and its model its 30:1. The speed of sub marine (prototype) is 10m/s. The model is to be tested in a wind tunnel. Find the speed of air in wind tunnel. Also determine the ratio of the drug between the model and its prototype. Take the value of kinematic viscosities for sea water and air as 0.012 stokes and 0.016 stokes respectively. The density for sea water and air it given a 1030kg/m^3 and 1.24kg/m^3 respectively. **(10 Marks)**

Module-4

7 a. Define boundary layer, explain laminar boundary layer, turbulent boundary layer and laminar sub layer with neat sketch. **(10 Marks)**

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

$$\frac{u}{U} = 5\left(\frac{y}{\delta}\right) - \left(\frac{y}{\delta}\right)^2$$

(10 Marks)

OR

8 a. Derive an expression for Von-Karman's momentum integral equation for boundary layer flows. **(10 Marks)**

b. A flat plate 1.5m × 1.5m moves at 50km/hr in stationary air of density 1.15kg/m^3. If the co-efficient and drag and lift are 0.15 and 0.75 respectively, determine:

i) The left force
ii) The drag force
iii) The resistant force
iv) The power required to keep the plate in motion. **(10 Marks)**

Module-5

9 a. Derive an expression for energy equation for Adiabatic and isothermal compressible flows. **(10 Marks)**

b. Define and derive the following with a neat sketch.

i) Stagnation pressure
ii) Stagnation density
iii) Stagnation temperature. **(10 Marks)**

OR

10 a. Calculate the velocity and mach number of a supersonic aircraft flying at an altitude of 1000m where temperature in 280°K. Sound of the air craft in heard 2.15sec after the passage of aircraft on the head of an observer, take $\gamma = 1.4$, R = 287J/kg°K. **(10 Marks)**

b. Define the following with neat sketch.

i) Mach number
ii) Zone of silence and zone of action
iii) Mach cone
iv) Mach angle
v) Subsonic, sonic, supersonic flow. **(10 Marks)**

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