CBCS SCHEME

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18AE/AS35

Third Semester B.E. Degree Examination, July/August 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 fluid based on Newton's law. **(06 Marks)**

b. Give reasons for the following :
i) Rain drops, water droplets and Bubbles are spherical in shape.
ii) Viscosity of liquids decreases with increase in temperature by viscosity of gas increases with increase in temperature. **(06 Marks)**

c. If the velocity profile of a fluid over a plate is parabolic C with the vertex 20cm from the plate, where the viscosity is 120cm/sec. Calculate the velocity gradient and shear stresses at a distance of 0cm, 10cm and 20cm from the plate. Assume $\mu = 8.5$poise. **(08 Marks)**

OR

2 a. Prove that pressure intensity at a point in static fluid is same in all directions. **(06 Marks)**

b. Write different types of manometers and explain any two types with neat sketch. **(06 Marks)**

c. A triangular plate of base 2m and height 3m which is immersed in water in such a way that plan of plate makes an angle of 60° with the free surface of water. Base of plate is parallel to water surface and at a depth of 2.5m from water surface. Find total pressure and position of centre of pressure. **(08 Marks)**

Module-2

3 a. Explain different types of fluid flow. **(06 Marks)**

b. Water flows through a pipe AB of 1.2m in diameter at 3m/s and then passes through a pipe BC of 1.5m diameter. At point C, the pipe branches as CD and CE where CD is 0.8m in diameter and carries one – third of the flow in AB. Flow velocity in CE is 2.5m/s. Find the volume rate of flow in AB, velocity in BC, velocity in CD and diameter of CE. **(08 Marks)**

c. Draw and explain about : i) Source ii) Sink iii) Doublet. **(06 Marks)**

OR

4 a. Define velocity potential and stream function and write its expression for velocity components prove that the product of equipotential lines and stream line is (–1). **(08 Marks)**

b. Derive energy equation in integral form and explain its application. **(12 Marks)**

Module-3

5 a. Derive Euler's equation and using that derive Bernoulli's equation. Also write the assumptions made for Bernoulli's equation. **(08 Marks)**

b. A vertical venturimeter has an area ratio 5. If has a throat diameter of 10cm. When an oil of specific gravity 0.8 flows through it, the mercury differential manometer in the differential gauge indicates a height difference of 12cm. Find the discharge through venturimeter if co-efficient of discharge is 0.98. **(06 Marks)**

c. Explain about pitot-tube and write about different types of arrangements needed for pitot-tube to measure velocity. **(06 Marks)**

OR

6 a. Find the expression for ΔP in a pipe which depends on diameter D, length 'ℓ', velocity V, Viscosity μ, density ρ and roughness 'K', using Buckingham's π - theorem. **(10 Marks)**

b. The pressure drop in an aircraft model of size 1/50 of its prototype is $4N/cm^2$. The model is tested in water. Find the corresponding pressure drop in prototype. Take $\rho_{air} = 1.24kg/m^3$, $\mu_{water} = 0.01$ Poise, $\mu_{air} = 0.0018$ Poise. **(06 Marks)**

c. Write about types of forces acting in a moving fluid. **(04 Marks)**

Module-4

7 a. Derive the relation for momentum thickness and energy thickness for boundary layer. **(08 Marks)**

b. A kite weighting 7.848N has an area of $0.8m^2$. It is flying in air at an angle of 10° to the horizontal. The string attached to the kite makes an angle of 45° to the horizontal and at this position the value of $C_D = 0.6$ and $C_L = 0.8$. Find the speed of the wind and tension in the string. **(08 Marks)**

c. State and explain Kutta – Joukowsky theorem. **(04 Marks)**

OR

8 a. Derive Von-Karman momentum Integral equation. **(10 Marks)**

b. Find the displacement thickness, momentum thickness and energy thickness for the velocity distribution in the boundary layer given by $\frac{u}{U} = \frac{y}{\delta}$. **(10 Marks)**

Module-5

9 a. Derive the expression for velocity of sound wave and velocity of sound for adiabatic process. **(08 Marks)**

b. Find the Mach number when an aircraft is flying at 1100km/hr through still air having a pressure of $7N/cm^2$ and temperature of –5°C. Calculate the pressure, temperature and density of air at stagnation point on the nose of the point aircraft. Take K = 1.4, R = 287.14 J/kg-K. **(08 Marks)**

c. Draw a normal shock wave and express the property changes before and after the shock. **(04 Marks)**

OR

10 a. Draw the propagation of pressure waves for different mach numbers and explain about Mach wave, Mach cone and Mach angle. **(10 Marks)**

b. For an adiabatic flow, A gas with a velocity of 300m/s is flowing through a horizontal pipe at a section where pressure is $6 \times 10^4 N/m^2$ and temperature 40°C. The pipe changes in diameter and at this section pressure is $9 \times 10^4 N/m^2$. Find the velocity of gas at this section. Take K = 1.4 and R = 287 J/kg-K. **(10 Marks)**

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