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M TECH
(SEM III) THEORY EXAMINATION 2018-19
ADVANCED FLUID MECHANICS

Time: 3 Hours ***Total Marks: 100***

Note: 1. Attempt all Sections. If require any missing data; then choose suitably.

1. Attempt *any two parts*. 10 x 2 = 20

a. A source of strength 50π m^2/s is situated in a uniform stream flowing at – 40 m/s. At a distance of 2m downstream from the source, there is an equal sink. Locate points of zero velocity in the resultant field of flow and show how to trace the streamline passing through these points.

b. A fixed cylinder is placed in a liquid which is moving steadily and irrotationally given by the relation $w = f(z)$. Derive an expression for the hydrodynamic moment acting on the body, when the hydrodynamical pressure on the contour of fixed cylinder is known.

c. Explain the following:
(i) D'Abmbert's Paradox
(ii) Biot-Savart Law.

2. Attempt any *two* of the following: 10 x 2 = 20

a. Derive the equation of continuity for 2 Dimensional flows, stating all assumptions made during the derivation.

b. Sketch and explain horse-shoe vortex. How will you determine the velocity field of vortex lines?

c. Under what condition, a three-dimensional source and sink combination will behave as three-dimensional doublet? Calculate the velocity potential and velocity components. Is Laplace equation satisfied at all points?

3. Attempt any *two* part of the following: 10 x 2 =20

a. Define Stokes stream function. Calculate the values of Stokes stream function for a simple source placed on the X-axis.

b. Determine the values of velocity potential and stream function when a sphere is moving along the X-axis with a certain velocity in an infinite mass of liquid at rest (at infinity).

c. Write short notes on:
(a) Karman Vortex Sheet.
(b) Joukauski Transformation.

4. Attempt any two part of the following: 10 x 2 = 20

a. A soda straw is 28 cm long and 4 mm in diameter. It delivers cold, so is approximated as water at 8°C, at a rate of 2 cm^3/s. What is the heat loss through the straw? What is the axial pressure gradient $\frac{\partial p}{\partial x}$, if the flow is (i) Vertically up on (ii) Horizontal?

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b. A 3 mm diameter capillary tube is used as a viscometer for oils. When the flow rate is 0.067m^3/h, the measured pressure drop per unit length is 390 kPa/m. Estimate the viscosity of the fluid. Is the flow laminar?

c. Write short notes:
(a) Karman Pohlhousen Method
(b) Fanno Flow.

5. Write short notes of any four of the following: 4 x 5 = 20

(a) Rayleigh flow
(b) Hele-Shaw flow
(c) Form drag and skin friction drag
(d) Velocity distribution curves for fluid flow
(e) Hagen–Poiseuille flow through pipes

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