

AJ-1550

M.A./M.Sc. (Final) Mathematics Term End Examination, 2021-22

FLUID MECHANICS (Paper-VI)

Time : 3 hours]

[Maximum Marks : 100

Note : Answer any five questions. All questions carry equal marks.

1. Determine the equation of continuity in Polar Co-ordinates.
2. Determine the restriction on f_1, f_2, f_3 if

$$\frac{x^2}{a^2} f_1(t) + \frac{y^2}{b^2} f_2(t) + \frac{z^2}{c^2} f_3(t) = 1$$

is a possible boundary surface of a liquid.

3. Stream is rushing from a boiler through a conical pipe, the diameters of the ends of which are D and d , if V and v be the corresponding velocities of the stream and if the motion be supposed to be that of divergence from the vertex of the cone. Prove that

$$\frac{v}{V} = \frac{D^2}{d^2} = e^{(v^2 - V^2) / 2k}$$

Where k is the pressure divided by the density and supposed constant.

4. Determine Image of a source in a circle.
5. Between the fixed boundaries $\theta = \frac{1}{6} \pi$ and $\theta = \frac{5}{6} \pi$ there is a two-dimensional liquid motion

due to a source at the point $(r = c, \theta = \alpha)$ and a sink at the origin, absorbing water at the same rate as the source produces it. Find the stream function and show that one of the stream lines is a part of the curve.

$$r^2 \sin 3\alpha = c^3 \sin 3\theta$$

6. To determine the motion of a circular cylinder moving in an infinite mass of the liquid at rest at rest infinity, with U along the x -axis.
7. A Circular Cylinder is placed in a uniform stream. Find the forces acting on the Cylinder.
8. Find the necessary and sufficient condition that vortex lines may be at right angles to the stream lines.
9. If $u = \frac{ax - by}{x^2 + y^2}$, $v = \frac{ay + bx}{x^2 + y^2}$ and $w = 0$ investigate the nature of the motion of the liquid.
10. Given $u = \frac{-c^2 y}{r^2}$, $v = \frac{c^2 x}{r^2}$, $w = 0$ where r denotes distance from z -axis. Find the surfaces

which are orthogonal to stream lines, the liquid being homogeneous.