K-443

Total Pages : 4 Roll No. ....

MT-510

MECHANICS-II

MA/MSC Mathematics (MAMT/MSCMT)

2nd Semester Examination, 2023 (Dec.)

Time : 2 Hours] **[Max. Marks : 35**

Note : This paper is of Thirty Five (35) marks divided into two (02) Sections A and B. Attempt the questions contained in these sections according to the detailed instructions given therein. Candidates should limit their answers to the questions on the given answer sheet. No additional (B) answer sheet will be issued.

SECTION–A

(Long Answer Type Questions)

Note : Section 'A' contains Five (05) long answer type questions of Nine and Half (9½) marks each. Learners are required to answer any Two (02) questions only.

(2×9½=19)

1. When the axis of a symmetrical top is stationary and then spin is large and equal to n, a blow J is applied perpendicular to the axis at a distance d from the fixed point. Prove that the maximum angular deflection of the axis is approximately $2 \tan^{-1}\left(\frac{\mathrm{J}d}{\mathrm{C}n}\right)$, C being the moment of inertia of the top about its axis of symmetry.

2. State and prove the principle of least action for a conservation holonomic system.

3. Derive the equation of continuity for a constant density fluid.

4. State and prove Bernoulli's theorem.

5. What arrangement of sources and sinks will give rise to the function

$$w = \log\left[z - \frac{a^2}{z}\right]_?$$

Draw a rough sketch of a stream line. Prove that two of the stream lines sub divide into the circle $r = a$ and the axis of y.

SECTION–B

(Short Answer Type Questions)

Note : Section 'B' contains Eight (08) short answer type questions of Four (04) marks each. Learners are required to answer any Four (04) questions only. (4×4=16)

1. Find the equation of the stream lines passing through the point (1, 1, 1) for an incompressible flow $\vec{q} = 2x\hat{i} - y\hat{j} - z\hat{k}$.

2. Show that ellipsoid

$$\frac{x^2}{a^2k^2t^4} + kt^2\left[\frac{y^2}{b^2} + \frac{z^2}{c^2}\right] = 1$$

is a possible form of the boundary surface of a liquid at time t.

3. A mass of fluid moves in such a way that each particle describes a circle in one plane about a fixed axis. Show that the equation of continuity is

$$\frac{\partial \rho}{\partial t} + \frac{\partial(\rho w)}{\partial \theta} = 0$$

Where w be the angular velocity of a particle whose azimuthal angle is θ at time t.

4. Determine the image of a source with respect to a circle.

5. Write the complex potential when a source of strength m and a sink of strength $(-m)$ at a point $(a, 0)$ and $(0, a)$ respectively.

6. Find the equation of the stream line for the flow where $u = -x$ and $v = y$.

7. Determine the acceleration of a fluid particle of the flow field

$$\vec{q} = xy^2 t\hat{i} + x^2 yt\ \hat{j} + xyz\hat{k}.$$

8. Give the physical significance implied in the equation of continuity in fluid motion.