**A–0714**

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# MT-510

## MA/MSC Mathematics (MAMT/MSCMT)

**(Mechanics-II)**

Examination, June 2025

Time : 2:00 Hrs. Max. Marks : 70

***Note* :–** This paper is of Seventy (70) 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)** 2×19=38

***Note* :–** Section 'A' contains Five (05) Long-answer type questions of Nineteen (19) marks each. Learners are required to answer any *two* (02) questions only.

1. State and prove the Equation of Motion of a Top.

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

3. For a two-dimensional flow the velocities at a point in the fluid may be expressed in the Eulerian coordinates by :

$$u = x + y + 2t \text{ and } v = 2y + t$$

Determine the Lagrange coordinate as function of the initial position $x_0$ and $y_0$ and the time $t$.

4. Derive equation of Continuity (Vector Form) by Euler's Method.

5. Derive equation of continuity in cylindrical polar coordinates.

## Section–B

**(Short Answer Type Questions)** 4×8=32

***Note* :–** Section 'B' contains Eight (08) Short-answer type questions of Eight (08) marks each. Learners are required to answer any *four* (04) questions only.

1. Define the following :

   (a) Newtonian Fluid

   (b) Compressible Fluid

   (c) Unsteady Flow

2. Derive Euler's dynamical equations of motion in vector notation

3. Air, obeying Boyle's law, is in motion in a uniform tube of small section, Prove that if ρ the density and $v$ be the velocity at a distance $x$ from a fixed point at time $t$, then :

$$\frac{\partial^2 \rho}{\partial t^2} = \frac{\partial^2}{\partial x^2}\{(v^2 + k)\rho\}$$

4. State and prove equation of motion under Impulsive forces in vector form.

5. Define the following :

   (a) Lagrange's stream function

   (b) Strength of source

6. Establish Cauchy-Riemann equations in polar coordinates.

7. A circular disc, of radius a , has a thin rod pushed through its centre perpendicular to its plane, the length of the rod being equal to the radius of the disc. Show that the system can not spin with the rod vertical unless the angular velocity is greater than :

$$\sqrt{\frac{2og}{a}}$$

8. Deduce Lagrange's Equations from Hamilton's Principle.

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