6. Derive Langrange's equations from Hamilton's principle.

7. The velocity components for a two dimensional flow system can be given in the Eulerian system by $u = 2x + 2y + 3t;\ v = x + y + \frac{1}{2}t$. Find the displacement of a fluid particle in the Lagrangian system.

8. Derive equation of motion under impulsive forces in vector form.

9. A source S and a sink T of equal strength *m* are situated within the space bounded by a circle whose centre is O. If S and T are a equal distances from O an opposite side of it and on the same diameter AOA′. Show that the velocity of the liquid at any point P is :

$$2m.\frac{OS^2 + OA^2}{OS}.\frac{PA.PA'}{PS.PS'.PT.PT'}$$

where S′ and T′ are the inverse points of S and T with respect to the circle.

MAMT–05/MSCMT–05

June – Examination 2022

M.A./M.Sc. (Previous) Examination

MATHEMATICS

(Mechanics)

Paper : MAMT–05/MSCMT-05

Time : 1½ Hours] [*Maximum Marks : 80*

Note :– The question paper is divided into two Sections A and B. Write answers as per the given instructions. Use of non-programmable Scientific Calculator is allowed in this paper.

Section–A **4×4=16**

(Very Short Answer Type Questions)

Note :– Answer any *four* questions. As per the nature of the questions delimit your answer in one word, one sentence or maximum up to **30** words. Each question carries 4 marks.

1. (i) Write moment of inertia of a uniform rectangular lamina of mass M and sides of length $2a$ and $2b$ about a line through its centre and parallel to side $2a$.

(ii) What do you mean by instantaneous axis of rotation ?

(iii) Write vector form of Euler's equations of motion.

(iv) State principle of conservation of linear momentum under impulsive forces.

(v) State principle of conservation of angular momentum under finite forces.

(vi) Write equation of continuity in spherical polar coordinates.

(vii) Define Boundary surface.

(viii) State Bernoulli's theorem for steady fluid motion.

Section–B 4×16=64

(Short Answer Type Questions)

Note :– Answer any *four* questions. Each answer should not exceed **200** words. Each question carries 16 marks.

2. Two unequal masses m_1 and m_2 $(m_1 > m_2)$ are suspended by a light string passing over a circular pulley of mass M and radius a. There is no slipping and the friction of the axis may be neglected. If f be the acceleration, show that this is constant; and if k be the radius of gyration of the pulley about the axis, show that :

$$k^2 = \frac{a^2}{Mf}\{m_1(g-f) - m_2(g-f)\}$$

3. A cylinder rolls down a smooth plane whose inclination to the horizon is α, unwrapping as it goes a fine string fixed to the highest point of the plane, find its acceleration and the tension of the string.

4. If the earth be regarded as a solid of revolution, whose principal moments of inertia at its centre of gravity are A, A, C. Show that its axis of rotation describes a cone of very small angle about the axis of the figure in period $\frac{A}{C-A}$ siderial days.

5. A top is executing steady motion with angular velocity n about its axis which is vertical, show that the motion is stable.