8. Find the streamlines and pathlines of the particles of the velocity field :

$$u = \frac{x}{1+t}, v = y \text{ and } w = 0$$

9. Show that :

$$u = \frac{-2xyz}{(x^2+y^2)^2},\ v = \frac{(x^2-y^2)z}{(x^2+y^2)^2} \text{ and } w = \frac{y}{(x^2+y^2)}$$

are the velocity components of a possible fluid motion.

MA/MSCMT–05

December – Examination 2021

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

MATHEMATICS

(Mechanics)

Paper : MA/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.

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 vector form of Euler's equation.
   (ii) Define simple equivalent pendulum.
   (iii) Define Centre of Percussion.
   (iv) What do you mean by holonomous system ?
   (v) State the Bernoulli's theorem.
   (vi) What do you mean by Conservation forces ?
   (vii) Write the equations of motion of a top.
   (viii) Define stream function.

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. State and prove D'Alembert's Principle.

3. A uniform solid cylinder is placed with its axis horizontal on a plane, whose inclination to the horizon is α, show that the least coefficient of friction between it and the plane, so that is may roll and not slide, is $\frac{1}{3}\tan\alpha$.

4. A small insect moves along a uniform bar of mass equal to itself and of length $2a$, the ends of which are constrained to remain on the circumference of a fixed circle whose radius is $\frac{2a}{\sqrt{3}}$. If the insect starts from the middle point of the bar and move along the bar with relative velocity V, show that the bar in time t will turn through an angle $\frac{1}{\sqrt{3}}\tan^{-1}\frac{Vt}{a}$.

5. Derive the equation of motion of a simple pendulum by using Lagrange's equations.

6. Derive Euler's geometrical equations of motion.

7. A body moves under no forces about a point O, the principal moments of inertia at O being 6A, 3A and A. Initially the angular velocity of the body has components $w_1 = n$, $w_2 = 0$, $w_3 = 3n$ about the principal axes. Show that at any later time $w_2 = -\sqrt{5}n\tanh\sqrt{5}nt$ and ultimately the body rotates about the mean axis.