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MA/MSCMT–05

December – Examination 2020

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

MATHEMATICS

(Mechanics)

Paper : MA/MSCMT-05

*Time : **2** Hours*] [*Maximum Marks : **80***

Note :– The question paper is divided into two Sections A and B. Write answer as per the given instruction.

Section–A **8×2=16**

(Very Short Answer Type Questions)

Note :– Answer all questions. Each question carries 2 marks.

1. (i) Write the general equation of motion of rigid body.

   (ii) State the Hamilton's principle.

   (iii) Write expression for Kinetic Energy of a rigid body in a two-dimensional motion under finite forces.

(iv) Write Euler's Equations of Motion.

(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 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. 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.
7. Derive the equation of continuity by Euler's method.
8. State and prove Bernoulli's theorem.
9. Show that the velocity potential :

$$\varphi = \frac{1}{2}\log\frac{(x+a)^2 + y^2}{(x-a)^2 + y^2}$$

gives a possible motion. Determine the stream lines.