P-136

Total Pages : 4 Roll No. .....

MT-505

Mechanics-I

MA/MSC Mathematics (MAMT/MSCMT)

1st Semester Examination, 2023 (June)

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.

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. State and prove D' Alembert's Principle.

2. Find the length of simple equivalent pendulum in the following cases, the axis horizontal:

(a) Circular disc; axis a tangent it;

(b) Hemisphere; axis a diameter of the base.

3. Two equal cylinders each of mass *m* are bound together by an elastic string whose tension is T and roll with axis horizontal down a rough plane of inclination α. Show that their acceleration is $\frac{2}{3} g \sin \alpha \left[1 - \frac{2\mu T}{mg \sin \alpha} \right]$, where μ is the coefficient of friction between the cylinders.

4. State and prove Principal of conservation of Linear Momentum.

5. To establish Lagrange's equations for Impulsive Forces.

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. A partical of mass *m* within a rough circular tube, of mass M lying on a horizontal plane and initially the tube is at rest while particle has an angular velocity round the tube. Show that by the time relative motion ceases the friction $\frac{M}{M+2m}$ of the initial kinetic energy has been dissipated by friction.

2. Prove that a body moves under the action of a system of conservative forces, the sum of its Kinetic and Potential energies is constant throughout the motion.

3. 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 $w_2 = -\sqrt{5}\, n \tan h \sqrt{5}\, nt$ and ultimately the body rotates about the mean axis.

4. To deduce the general equations of motion of a rigid body from D' Alembert's Principle (when forces are finite).

5. If $2T = Aw_1^2 + Bw_2^2 + Cw_3^2$ and C be the moments of the impressed forces about the instantaneous axis of rotation and w be the resultant angular velocity, prove that

$$\frac{d\,T}{dt} = w\,G\,.$$

6. Derive the equation of translation motion.

7. A circular board is placed on smooth horizontal plane, and a boy runs round the edge of it at a uniform rate, what is the motion of the board?

8. Define the following :

(a) Moment of Inertia.

(b) Principle of Conservation of Energy.