MAT–505

Mechanics

M. Sc. MATHEMATICS (MSCMAT–12)

First Year, Examination, 2017

Time : 3 Hours   **Max. Marks : 60**

Note : This paper is of **sixty (60)** marks containing **three (03)** sections A, B and C. Learners are required to attempt the questions contained in these sections according to the detailed instructions given therein.

Section–A

(Long Answer Type Questions)

Note : Section 'A' contains four (04) long answer type questions of fifteen (15) marks each. Learners are required to answer *two* (02) questions only.

1. Derive Cartesian equations of motion of a rigid body moving under the action of external forces by using D' Alembert's principle.

2. Find the moment of the effective forces of a lamina moving about a fixed axis.

3. Write a note on Lagrangian and Eularian methods for treating fluid motion mathematically.

4. State and prove Kelvin's circulation theorem.

Section–B

(Short Answer Type Questions)

Note : Section 'B' contains eight (08) short answer type questions of five (05) marks each. Learners are required to answer *four* (04) questions only.

1. A uniform rod of mass *m* and length 2 *a* can turn freely about a fixed end. Show that the least angular velocity with which is must be started from the lowest position so that it may just make complete revolutions is $\sqrt{\dfrac{3g}{a}}$.

2. Obtain the Lagrange equation of motion for a simple pendulum.

3. Write a note on types of flows of fluids.

4. Write a note on pressure at a point in a fluid at rest and in moving fluid.

5. Prove that the motion of a rigid body acted upon by external forces about center of inertia is same as the motion of a particle of mass having mass equal to the whole mass of the rigid body and situated at center of inertia under the same external forces.

6. Derive expression for kinetic energy of a rigid body moving about a fixed axis.

7. Show that equivalence of Eulerian and Lagrangian forms of the equation of continuity.

8. Find the image of a source with regard to a sphere.

Section–C

(Objective Type Questions)

Note : Section 'C' contains ten (10) objective type questions of one (01) mark each. All the questions of this section are compulsory.

Fill in the blanks :

1. The reversed effective forces acting on each particle of a rigid body and the external forces of the system are in ....

2. The effect of a force of large magnitude which acts for a very small duration is time is measured by its ....

3. If h be the distance of the C. G. of a body moving about a smooth fixed horizontal axis from this axis and k be the radius of gyration about this axis of rotation. Then length of simple equivalent pendulum is ....

4. If T be the kinetic energy and V be the potential energy of a dynamical system. Then the Lagrangian L is given by L = ...

5. The velocity $\vec{q}$ of the fluid particle in terms of velocity potential is given by $\vec{q}$ = ...

6. Image of a source + m w. r. t. a line is a source + m at an equal distance on the .... of the line.

7. When circular cylinder of radius a is in motion with velocity U along x-axis, then W = ...

8. Complex potential due to doublet μ at $z = a$, is ...., for inclination α of the axis of doublet with x-axis.

9. The operator $\dfrac{\partial}{\partial t} + u\dfrac{\partial}{\partial x} + v\dfrac{\partial}{\partial y} + w\dfrac{\partial}{\partial z}$ which is usually denoted by symbol $\dfrac{D}{Dt}$ is spoken of as '......... following the motion of the fluid'.

10. A line drawn in the fluid such that its tangent at any point is along the direction of the velocity vector at that point, is called a ....