Roll No. .....

MSCMAT-12 (M.Sc. Mathematics)

First Year Examination-2014

MAT-505

Mechanics

Time Allowed : Three Hours

Maximum Marks : 60

Note : This paper is of sixty (60) marks divided into three (03) sections. 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 any two (02) questions only. (2×15=30)

1. State and prove Euler's Dynamical equations of Motion.

2. State Lagrange equation and derive Lagrange equation for generalised co-ordinates Also write Lagrangian for simple pendulum.

3. A rigid body is rotating about a fixed axis, then find the moment of the effective forces about the axis of rotation, also find angular momentum about the axis of rotation.

4. Show that for any fluid if F (x, y, z, t) = 0 be a boundry surface then at every point on it $\frac{\partial F}{\partial t} + u\frac{\partial F}{\partial x} + v\frac{\partial F}{\partial y} + w\frac{\partial F}{\partial z} = 0$ Also find expression for normal velocity.

Section - B

(Short answer type Questions)

Note : Section 'B' contains eight (08) short-answer-type questions of five (5) marks each. Learners are required to answer any four (04) questions only. (4×5=20)

1. Find Minimum time of oscillation of a compound pendulum. Also find Minimum length of simple equivalent pendulum.

2. A rectangular plate swings in a vertical plane about one of its corners. If its period is one second, find the length of the diagonal.

3. Show that the total Kinetic energy of a rigid body mouing in two dimensions is equal to the kinetic energy of particle of mass M placed at centre of inertia and moving with it plus the kinetic energy of the body relative to the centre of inertia.

4. Explain the following terms :

   (a) Generalised velocity

   (b) Generalised momentum

   (c) Generalised forces

5. Disucss Principle of least Action what is the difference between Hamilton's Principle and Principle of least action.

6. Define stream function in two dimension, also find velocity in terms of stream times.

7. Find the equation of the stream lines passing through the point (1, 1, 1) for an incompressible flow

$$\vec{q} = 2x\hat{i} + y\hat{j} + z\hat{k}$$

8. Show that the image of a simple source with respect to a straight line in two dimension is an equal source at equidistant from the straight line opposite to the source.

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. (10×1=10)

Fill in the blanks :

1. Total vector sum of the moments of external impulses about any point O is equal to the .....

2. Degrees of freedom of the system is the same an number of ..... .

3. $\frac{D}{Dt}$ i.e. material derivative is equal to the ..... .

4. Equation of continuity in lagrangian form is ..... .

5. If ϕ is velocity potential then $\vec{q}$ is equal to the ..... .

Find the correct alternative :

6. Complex potential due to doublet at origin is :

(a) $\frac{u}{z}$ (b) $\frac{u}{z^2}$

(c) uz (d) uz^2

7. When motion is irrotational then :

(a) only ↗ satisfy Laplace equation

(b) only ● satisfy Laplace equation

(c) Both satisfier Laplace equation

(d) None satisfy Laplace equation

8. Generalised Momentum is :

(a) $\frac{\partial L}{\partial q}$ (b) $\frac{\partial L}{\partial \dot{q}}$

(c) $\frac{d}{dt}\left(\frac{\partial L}{\partial q}\right)$ (d) $\frac{d}{dt}\left(\frac{\partial L}{\partial \dot{q}}\right)$

9. If body moves under no forces then 1st Euler's dynamical equation is :

(a) $A\frac{dw_1}{dt} + (B + C)\, w_2 w_3 = 0$

(b) $A\frac{dw_1}{dt} + (B - C)\, w_2 w_3 = 0$

(c) $A\frac{dw_1}{dt} - (B + C)\, w_2 w_3 = 0$

(d) $A\frac{dw_1}{dt} - (B - C)\, w_2 w_3 = 0$

10. Locus of the invariable line is :

(a) Sphere (b) Cone

(c) Cylinder (d) None