MSCMAT-12 (M.Sc. Mathematics)
First Year Examination 2013
MAT-502
Mechanics

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

Note: The Question paper is divided into three sections A, B and C. Attempt Questions of each section according to given instructions.

नोट : यह प्रश्नपत्र 'क', 'ख' और 'ग' तीन खण्डों में विभाजित हैं प्रत्येक के निर्देशानुसार प्रश्नों का उत्तर दें।

Section-A
खण्डक-

Long Answers Question) (दीर्घ उततरीय प्रश्न)

Note : Answer any two questions. Each Question carries equal marks.   2 x 15 = 30
नोट र दीजिए। सभी प्रश्नों का उत्त दो प्रश्नोंकिन्हीं : के अंक समान है।

1. State and prove D' Alembert's Principle. Also deduce the general equations of motion of a rigid body by D' Alembert Principle.

2. Write Lagrange's equations for finite forces. Explain how Lagrange's equations are used in case of small oscillations.

3.   Discuss Hamilton's Principle and Principle of least action. Also deduce Lagrange's equations from Hamilton's Principle.

4. State Law of conservation of mass. Find the equation of continuity in Cartesian coordinates.

Section-B/खण्ड ख

(Short Answer's Question) (लघु उत्तरीय प्रश्न)

Note: Answer any 04 Question. Each question carries 5 marks.   4 x 5 = 20
नोट : किन्हीं <u>चार</u> प्रश्नों का उत्तर दीजिए। प्रत्येक प्रश्न 05 अंकों का है।

1. Show that the motion of a body about its centre of inertia is the same as it would be if the centres of inertia were fixed and the same forces acted on the body.

2. Show that the centre of suspension and centre of oscillation are convertible. Also define the term "Centre of Percussion".

3. Define Eulerian angles. Write Euler's Geometrical equations of motion.

4. A uniform square lamina of man M and side 2a, is moving freely about a diagonal with uniform angular velocity W. When one of the earners not in the diagonal becomes fixed, show that the new angular velocity is $\frac{W}{7}$.

5. Show that the $\frac{x^2}{a^2} \tan^2 t + \frac{y^2}{b^2} \cot^2 t = 1$. is a possible form for the boundary surface of a liquid and find an expression for the normal velocity.

6. Find Euler's dynamical equations of motion in Cartesian co-ordinates.

7. What are sources and sinks? Derive formula for complex potential due to a source.

8. Define stream lines and path lines. What are the differences between stream lines and path lines.

Section-C/खण्ड ग

Objective Question (Compulsory)/वास्तुनिष्ठ प्रश्न (अनिवार्य)

Note : Answer all questions. Each question carries 0.5 marks.   **10 x 1 = 10**
नोट : सभी प्रश्नों का उत्तर दीजिए। प्रत्येक प्रश्न 01 अंक का है।

Fill in the blanks:

1. Moment of momentum is called………………………………

2. …………………….. is the time of a complete small oscillation of a compound pendulum.

3. Integral $\int_{t_0}^{t_1} 2T dt$ is called ………………………

4. The relation between velocity potential and velocity of the fluid is ……………………

5. If W is the complex potential then magnitude of the velocity is ………………………

Choose the correct alternative

6. Motion of the fluid is irrotational if

   (A) grad $\underset{q}{\rightarrow} = 0$ (B) div $\underset{q}{\rightarrow} = 0$

   (C) curl $\underset{q}{\rightarrow} = 0$ (D) None

7. $\underset{F}{\rightarrow}$ and V are related in conservative field of force by

   (A) $\underset{F}{\rightarrow} = -\bar{v}\, v$ (B)) $\underset{F}{\rightarrow} = -div\, v$

   (C) V $= div \underset{F}{\rightarrow}$ (D) None

8. Angular momentum of the rigid body about a fixed line is

(A) $MK \left(\frac{dQ}{dt}\right)^2$

(B)) $MK^2 \left(\frac{dQ}{dt}\right)^2$

(C) $MK \left(\frac{dQ}{dt}\right)$

(D) $MK^2 \left(\frac{dQ}{dt}\right)$

9. The independent quantities which determine the position of a material system are called

(A) Spherical coordinates

(B) Cartesian coordinates

(C) Polar coordinates

(D) Generalized coordinates

10. Quantity T-V is called

(A) Eulerian

(B) Lagrangian

(C) Hamiltonian

(D) None