

PA-561-M

M. Sc. Examination, 2012

(First Semester)

PHYSICS

Paper - II

(Classical Mechanics)

Time: Three Hours ]

[ Maximum Marks : 42

Note:- Attempt all questions

SECTION-A

(Objective Type Questions)

1x7=7

● Note: - Select the correct answer

1. Which represents D'Alembert's principle :

(a)  $\sum_i (F_i - \dot{p}) \cdot \delta r_i = 0$

(b)  $\sum_i (F_i - \ddot{p}) \cdot \delta r_i = 0$

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(c)  $\sum_i (F_i - p) \cdot \delta r_i = 0$

(d)  $\sum_i (F_i - \dot{p}) \cdot \delta r_i = 0$

2. Rutherford scattering cross section is given by :

(a)  $\sigma(\phi) = \frac{1}{4} \left( \frac{ZZ'e^2}{2E} \right)^2 \text{cosec}^3 \frac{\phi}{2}$

(b)  $\sigma(\phi) = \frac{1}{4} \left( \frac{ZZ'e^2}{2E} \right)^2 \text{cosec}^2 \frac{\phi}{2}$

(c)  $\sigma(\phi) = \frac{1}{4} \left( \frac{ZZ'e^2}{2E} \right)^2 \text{cosec}^1 \frac{\phi}{2}$

(d)  $\sigma(\phi) = \left( \frac{ZZ'e^2}{2E} \right)^2 \text{cosec}^2 \frac{\phi}{2}$

3. The expression of angle variable is given by :

(a)  $\omega_j = \frac{\partial W(q_j, \alpha_j)}{\partial q_j}$

(b)  $\omega_j = \frac{\partial W(p_j, \alpha_j)}{\partial p_j}$

$$\checkmark (c) \quad \omega_j = \frac{\partial W(q_j, \alpha_j)}{\partial J_j}$$

$$(d) \quad \omega_j = \frac{\partial W(q_j, \alpha_j)}{\partial p_j}$$

4. The coriolis force acting on a particle of mass 0.02 kg situated at a distance 10 cm from the axis of a rotating frame with angular speed 10 radian/sec is :

(a) 0.2 N

(b) 0.4 N

(c) 0.1 N

(d) 0.8 N

5.  $\Delta \int_{t_1}^{t_2} 2T dt = 0$  represents :

(a) D' Alembert's principle

(b) Variational principle

(c) Principle of least action

(d) Hamilton's principle

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6. Lorentz transformation change to Gallilean transformation when :

(a)  $v \ll c$

(b)  $v \gg c$

(c)  $v = c$

(d) None of these

7. According to Kepler's law of motion, the line joining the sun and the earth sweeps out equal area in equal time. This law implies that :

(a) Angular momentum remains conserved

(b) An inverse square force acts between the two

(c) Earth rotates around its own axis

(d) The force acting between the sun and the earth does not act along the line joining them.

### SECTION-B

(Short Answer Type Questions) 2x5=10

1. What is Hamilton's principle?

OR

Explain principle of virtual work.

2. What is a Canonical transformation?

OR

Explain generating function.

3. What are the Eulerian angular co-ordinates?

OR

What do you understand by the inertial tensor of a rigid body? <https://www.mcbuonline.com>

4. Define relativistic generalization of Newton's law.

OR

What are four vectors?

5. Write a short note on Poisson's brackets.

OR

Write a short note on a symmetry of space and time.

### SECTION-C

(Long Answer Type Questions) 5x5=25

1. Derive Lagrange's equation of a charged particle under the action of conservative force.

OR

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What are Constraints? How do they affect motion of a mechanical system? Take specific examples to explain the forces of constraints.

2. Give an account of the Hamilton Jacobi theory and illustrate it by applying it to the Kepler's problem (particle moving under central force).

OR

Deduce an expression for the Hamilton's canonical equation of motion by the simplest method and explain the physical significance of the Hamiltonian.

3. Discuss the theory of small oscillations. Find the equation of motion of small oscillation about the position of equilibrium.

OR

Obtain Euler's equations of motion for a rotating rigid body.

4. Discuss covariant four dimensional formulations.

OR

What is Lorentz transformation? Show that four dimensional volume element is invariant under Lorentz transformation.

5. Write any **two** of the following :
- (a) Generalised co-ordinates
  - (b) Rutherford scattering
  - (c) Rotating co-ordinates system
  - (d) Covariant Hamiltonian