

Reg. No. : .....

ae No. : 5675

Sub. Code : ZMAE 21

(CBCS) DEGREE EXAMINATION, APRIL 2022

Second Semester

Mathematics

Elective — CLASSICAL MECHANICS

For those who joined in July 2021 onwards)

Three hours

Maximum : 75 marks

PART A — (10 × 1 = 10 marks)

Answer ALL questions.

Choose the correct answer :

Angular momentum of a particle ———

- a)  $\vec{L} = \vec{r} \cdot \vec{P}$  (b)  $\vec{L} = \vec{r} \times \vec{P}$   
c)  $\vec{r} \cdot \vec{P} = 0$  (d)  $\vec{r} \times \vec{P} = \vec{0}$

If the total external force is zero, the total linear momentum is ———

- a) Conserved (b) Zero  
c) Negative (d) Positive

If  $q_j$  is cyclic, then  $\frac{\partial L}{\partial q_j} =$  ———

- (a) zero (b)  $q_j$   
(c)  $-q_j$  (d) conserved

For monogenic system, hamilton's principle  $I =$  ———

- (a)  $\int_{t_1}^{t_2} (T + V) dt$  (b)  $\int_{t_1}^{t_2} (TV) dt$   
(c) 0 (d)  $\int_{t_1}^{t_2} (T - V) dt$

The position  $E_0$  of the earth in its actual orbit around the sun when its nearest to sun is called ———

- (a) uphelian (b) helicoid  
(c) center of orbit (d) perihelion

Anne drawn from planet to sun sweeps equal areas in equal amounts of time. This is ———

- (a) Kepler's second law  
(b) Kepler's third law  
(c) Kepler's first law  
(d) Law of time constrain

3. Principle of virtual work ———

- (a)  $\sum_i F_i^{(a)} \times \delta r_i = 0$  (b)  $\sum_i F_i^{(a)} \cdot \delta r_i = a$   
(c)  $\sum_i F_i^{(a)} \cdot \delta r_i = 0$  (d)  $\sum_i F_i^{(a)} \times \delta r_i = a$

4. Canonical momentum is ———

- (a)  $P_j = \frac{\partial T}{\partial q_j}$  (b)  $P_j = \frac{\partial L}{\partial q_j}$   
(c)  $P_j = \frac{\partial U}{\partial q_j}$  (d)  $P_j = \frac{\partial P}{\partial q_j}$

5. The generalized momentum conjugate to a cyclic co-ordinate is ———

- (a) zero (b) negative  
(c) positive (d) conserved

6. If system is spherically symmetric, the components of ——— are conserved.

- (a) Linear momentum  
(b) Energy  
(c) Angular momentum  
(d) Kinetic energy

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PART B — (5 × 5 = 25 marks)

Answer ALL questions, choosing either (a) or (b).

11. (a) State and prove conservation theorem for the angular momentum for a particle.

Or

- (b) Explain the types of constraints.

12. (a) State and prove D'Alembert's principle.

Or

- (b) Explain Atwood's machine.

13. (a) Explain about Hamilton's principle.

Or

- (b) Derive shortest difference between two points in a plane is straight line by applying Lagrange's equation.

14. (a) Explain about reduction to equivalent one body problem.

Or

- (b) Prove that the central force of motion is always motion in a plane.

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[P.T.O.]

15. (a) Discuss about the motion in time in Kepler's problem.

Or

- (b) Discuss about the Kepler problem : inverse square law of force.

PART C — ( $5 \times 8 = 40$  marks)

Answer ALL questions, choosing either (a) or (b).

16. (a) State and prove conservation theorem for the linear momentum of a system of particles.

Or

- (b) State and prove conservation theorem for the angular momentum of a system of particles.

17. (a) Derive Lagrangean equation for holonomic constraint.

Or

- (b) Explain about applications of Lagrangian formulation.

18. (a) Derive lagrange's equation from the Hamilton's principle.

Or

- (b) Discuss about some techniques of calculus of variation.

19. (a) State and prove virial theorem.

Or

- (b) Apply virial theorem, derive Boyle's law for perfect gases.

20. (a) Write a note on Laplace Runge Lenze vector.

Or

- (b) Derive the differential equation for the orbit.