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**F-302**

**M.Sc. (First Semester)**  
**EXAMINATION, Dec. - Jan., 2021-22**  
**PHYSICS**  
**Paper Second**  
**(Classical Mechanics)**

*Time : Three Hours]**[Maximum Marks : 80***Note : Attempt all sections as directed****Section - A****(1 mark each)****(Objective/Multiple choice questions)****Note : Attempt all questions.**

Choose the correct answer:

1. A particle is constrained to move along a curve. The constraint is:
  - (A) Holonomic
  - (B) Non holonomic
  - (C) Both holonomic and nonholonomic
  - (D) None of these.

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2. In many particle system, if no torque is applied then:

- (A) Linear momentum is conserved
- (B) Angular momentum is conserved
- (C) Linear velocity is conserved
- (D) Angular velocity is conserved

3. Number of generalized co-ordinates of a system of N particles with n degrees of freedom are:-

- (A) N
- (B) 3N
- (C) n
- (D) zn

4. Lagrangian involves

- (A) Scalars
- (B) Vectors
- (C) Scaler & vector both
- (D) Tensor

5. For a system with one degree of freedom, hamiltonian is  $H = \sqrt{P^2 + 1} - x$ . The shape of x - t graph for the particle is:

- (A) Parabola
- (B) Hyperbola
- (C) Ellipse
- (D) Straight line

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6. Poisson's Bracket does not obey commutative law.
- (A) False  
(B) True
7. Write an expression for the Hamilton's principle function:
- (A)  $s = \int L dt + \text{constant}$   
(B)  $s = \int L^2 dt$   
(C)  $s = \int L dt + q^2$   
(D)  $s = \int L dt$
8. For orbital the central force field should be:
- (A) Constant  
(B) Repulsive  
(C) Attractive  
(D) None of these
9. In case of repulsive central force, the orbit of particle can be:-
- (A) Circular  
(B) Parabolic  
(C) Elliptical  
(D) Hyperbolic

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10. Poisson's Brackets are the classical analogues of commutation relations between operators in:
- (A) Statistical Mechanics  
(B) Quantum Mechanics  
(C) Relativistic Mechanics  
(D) Non-relativistic Mechanics
11. By definition the Jacobi integral of the system is a :
- (A) Constant of momentum  
(B) Constant of time  
(C) Constant of space  
(D) constant of motion
12. The Coriolis force is a :
- (A) Time dependent force  
(B) Energy dependent force  
(C) Velocity dependent force  
(D) Momentum dependent force
13. Angular momentum is conserved :
- (A) In absence of external torque  
(B) In presence of external torque  
(C) Presence of external force  
(D) None of these

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14. Impact parameter depends on :
- (A) Angle of scattering
  - (B) Target nuclei
  - (C) Projectile particle
  - (D) None of these
15. In for any rotation about origin of reference frame, the physical properties of closed system remains unaffected, then it is known as :
- (A) Homogeneity of space
  - (B) Isotropy of space
  - (C) Homogeneity of time
  - (D) None of above
16. Two systems are coupled to each other then the resulting oscillations are called :
- (A) Simple harmonic oscillations
  - (B) Damped oscillations
  - (C) Coupled oscillations
  - (D) Forced oscillations
17. According to Kepler, the relation between period of revolution and cube of the semi-major axis is :
- (A) Directly proportional
  - (B) inversely proportional
  - (C) Equal
  - (D) No relation

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18. The S-variation considered refers to variation :
- (A) Time
  - (B) Quantity
  - (C) Both (a) and (b)
  - (D) None
19. Rutherford's scattering experiment is related to the size of the :
- (A) Atom
  - (B) Neutron
  - (C) Electron
  - (D) Nucleus
20. When a particle is moving under constant conservative force field, the path of a particle is :
- (A) Cycloid
  - (B) Hyperbolic
  - (C) Parabolic
  - (D) Straight line

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**Section - B**

**(2 marks each)**

**(Very Ahort Answer Type Questions)**

**Note: Attempt all questions.**

1. What do you mean by virtual work.
2. Define generalized co-ordinates with two examples.
3. What are cyclic co-ordinate system?
4. Write a short note on covariant Hamiltonian formulation.
5. Derive Homilton-Jacobi equation.
6. What do you mean by central force?
7. Explain small oscillations in linear triatomic molecule.
8. What do you mean normal co-ordinates?

**Section - C**

**(3 marks each)**

**(Short Answer Type Questions)**

**Note: Attempt all questions.**

1. State and prove Hamilton's principle.
2. Discribe the conservation theorem.
3. Explain the principle of least action.

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4. What are action angle variables.
5. Explain the coronical transformation in brief.
6. Explain normal modes of vibration.
7. State and prove the virial theorem.
8. Explain the Euler equation of motion of rigid bodies.

**Section - D**

**(5 marks each)**

**(Long Answer Type Questions)**

**Note- Attempt any four questions.**

1. Derive lagrange's equation of motion from D'Alembert principle.
2. derive the Hamilton equation from a variational principle.
3. What are Poisson's brackets? Discus algebraic properties of Poisson's brackets.
4. Discuss kepler's problem and motion in attractive central force field.
5. Deduce Euler equation of motion for a rigid body.
6. discuss how the plane of oscillation of pendulum processes in northern hemisphere of earth due to coriolis force.

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