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SARDAR PATEL UNIVERSITY, V.V. NAGAR
B.Sc. SEMESTER:5 Examination
PHYSICS

PHYSICS CODE : US05CPHY51

DATE:- 04/10/2025

Classical Mechanics

TIME:- 10 AM to 1 PM

Total Marks: 70

- N.B :** (1) All the symbols and notations have their usual meanings.
 (2) Figure at the right hand side of questions indicate full marks.

Q-1) Choose the correct option for the following questions. [10]

- (1) The Lagrangian function is defined by _____
 (a) $L = F + V$ (b) $L = T - V$ (c) $L = T + V$ (d) $L = F - V$
- (2) _____ Constraints are independent of time.
 (a) Scleronomous (b) Rheonomous (c) Holonomic (d) Nonholonomic
- (3) The Coriolis force is maximum at _____.
 (a) poles (b) equator (c) tropics (d) none of these
- (4) A frame of reference moving with a constant velocity relative to a fixed frame is called _____ frame of reference.
 (a) non-inertial (b) an inertial (c) rotational (d) none of these
- (5) If the three components of the moment of inertia about the principal axes are equal i.e. If $I_1 = I_2 = I_3$ then the body is called _____.
 (a) rotor (b) Symmetrical top (c) Asymmetrical top (d) Spherical top
- (6) The shortest distance between two points in a plane is _____.
 (a) circular (b) hyperbolic (c) parabolic (d) straight line
- (7) Hamiltonian formulation is alternate to _____ formulation
 (a) Laplace (b) Poisson (c) Lagrangian (d) Bessel
- (8) The variational principle is also called _____ principle.
 (a) linear (b) differential (c) integral (d) logarithmic
- (9) The Poisson bracket of a function with itself is identically _____.
 (a) positive (b) negative (c) zero (d) undefined
- (10) According to definition of the Poisson brackets $[u, v] =$ _____.
 (a) $-[v, u]$ (b) $[v, u]$ (c) $-[v, v]$ (d) $-[u, u]$

Q-2 Answer the following short questions. (Any TEN) [20]

- (1) What is constraints ?
- (2) State the Lagrange's equation of motion for a conservative holonomic system.
- (3) State the principle of virtual work.
- (4) State the Euler's theorem.
- (5) Write down the inertia tensor in matrix notation.
- (6) What is Euler's angle?
- (7) Define : Geodesic line.
- (8) State the Hamilton's principle.
- (9) What is configuration space ?
- (10) State the advantages of the Hamiltonian formulation.
- (11) Show that the poisson brackets are invariant under canonical transformation in the phase space
- (12) State the condition for transformation to be canonical.



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(P.T.O.)

- Q-3 (A) Discuss D'Alembert's principle in details. [6]
(B) Define holonomic and non-holonomic constraints. [4]

OR

- (A) Discuss Atwood's machine and derive equation of motion of the machine. [6]
(B) What is Generalised coordinates? [4]

- Q-4 (A) Discuss the rotating coordinate systems and show that the angular acceleration ($\dot{\omega}$) is the same in the fixed and the rotating systems. [6]
(B) Explain the coordinate systems with relative translational motions. [4]

OR

- (A) Explain effect of coriolis force on freely falling particle under the action of gravity. [6]
(B) Derive the Euler's equations of motion of a rigid body. [4]

- Q-5 (A) Derive Euler's equation using variational principle. [6]
(B) Discuss the Brachistochrone (shortest time) problem. [4]

OR

- (A) Find the acceleration for cylinder rolling on inclined plane using undetermined multiplier. [6]
(B) Obtain Newton's law of motion from Lagrange's equation. [4]

- Q-6 (A) Obtain Hamilton's equations of motion. [6]
(B) What is phase space? Discuss the concept of the phase space of a one dimensional simple harmonic oscillator with diagram [4]

OR

- (A) Construct the Lagrangian L for a simple pendulum with moving support and also deduce an expression of Hamiltonian in terms of momenta [6]
(B) Explain Gauge transformations ?. [4]

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