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[37]

SARDAR PATEL UNIVERSITY
B.Sc. (5th- Semester) Examination-2022
Code No. US05CPHY21: [Classical Mechanics]

Date: 10-11- 2022, Thursday
 Time: 10:00 a.m. to 1:00 p.m.



Total: 70 Marks

Note: (i) All the symbols have their usual meanings
 (ii) Figure to the right indicate full marks of the questions

Q-1 Multiple Choice Questions (Attempt All) [10]

- (1) The Lagrangian equations of motion are _____ order differential equations.
 (a) first (b) second
 (c) zero (d) forth
- (2) _____ constraints are independent of time .
 (a) Holonomic (b) Non-Holonomic
 (c) Scleronomous (d) Rheonomous
- (3) The generalized coordinates for motion of a particle moving on the surface of a sphere of radius 'a' are _____ .
 (a) a and θ (b) θ and ϕ
 (c) a and ϕ (d) 0 and ϕ
- (4) If the moving frame of reference is accelerated the effective force acting on the particle is _____ than the actual force .
 (a) zero (b) equal
 (c) smaller (d) higher
- (5) In the rotation of a rigid body the directions of the angular velocity and the angular momentum are _____ .
 (a) different (b) same
 (c) perpendicular (d) parallel
- (6) In a torque free motion of a rigid body, the _____ of the body is a constant vector .
 (a) angular velocity (b) angular momentum
 (c) linear velocity (d) angular acceleration
- (7) The n-dimensional space is called _____ space .
 (a) solar (b) real
 (c) configuration (d) zero
- (8) The equation of constraints for a simple pendulum is _____ .
 (a) $r - l = 0$ (b) $r + l = 0$
 (c) $r d\theta + l = 0$ (d) $r d\theta - l = 0$
- (9) Hamiltonian formulation is alternate to _____ formulation.
 (a) Laplace (b) Lagrangian
 (c) Poisson (d) Bessel
- (10) The space depends on position coordinate and momenta is called _____ space .
 (a) configuration (b) coordinate
 (c) phase (d) momentum

Q-2 Short Questions (Attempt any Ten) [20]

- (1) What is degree of freedom?
- (2) What is virtual displacement?
- (3) Construct the Lagrangian for Spherical pendulum .

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- (4) Define rigid body .
- (5) Find the angular velocity of the earth .
- (6) Define spherical top and asymmetric top .
- (7) State the Hamilton's principle .
- (8) Define geodesic line .
- (9) What is undetermined multiplier?
- (10) Write the advantages of Hamiltonian formulation over Lagrangian formulation .
- (11) What is Gauge transformation?
- (12) What is Poisson's bracket?

- Q-3**
- (a) Discuss the virtual work done for motion of a system and derive the mathematical statement of D'Alembert's statement. [06]
 - (b) Construct the Lagrangian of Atwood machine and derive its the equation of motion. [04]

OR

- (a) What are constraints? Explain, giving examples, the meaning of holonomic and nonholonomic constraints. [06]
- (b) What is cyclic coordinates? Show that total energy is conserved. [04]

- Q-4**
- (a) Discuss the rotating coordinate systems and derive the expressions of velocity and acceleration of the particle. [06]
 - (b) Write note on Coriolis force. [04]

OR

- (a) Derive the expressions of angular momentum and kinetic energy. [06]
- (b) State and prove Euler's theorem. [04]

- Q-5**
- (a) Discuss the technique of calculus of variation and derive the general Euler's equation. [06]
 - (b) To show that the shortest distance between two points in a plane is a straight line. [04]

OR

- (a) Construct the Lagrangian for series connection of inductance L, resistance R and capacitor C with an external electromotive force $\epsilon(t)$. [06]
- (b) Derive the Hamilton's principle from Newtonian formulation. [04]

- Q-6**
- (a) Deduce the Hamilton's equation of motion and show that H is a constant of motion and also give the total energy. [06]
 - (b) Construct the Lagrangian for simple pendulum with moving support and deduce the expression of Hamiltonian in terms of momenta. [04]

OR

- (a) Discuss the Canonical transformation and derive the Canonical transformation equation for $F_1 = F_1(q_i, Q_i, t)$. [06]
- (b) Write note on Poisson brackets. [04]

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