

SEAT No. _____

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SARDAR PATEL UNIVERSITY
B.Sc. EXAMINATION (Semester-5)

Thursday, 24th December, 2020

2:00 p.m. to 4:00 p.m.

Subject: PHYSICS

Course: US05CPHY21

Title: Classical Mechanics

Total Marks: 70

N.B: (i) All the symbols have their usual meanings
(ii) Figures at the right side of questions indicate full marks

(10)

Q-1 Multiple Choice Questions (Attempt All)

- (1) The degree of freedom for N particles in plane are _____
(a) N (b) 2N
(c) 3N (d) 2
- (2) _____ constraints are independent of time
(a) Holonomic (b) Non-Holonomic
(c) Scleronomous (d) Rheonomous
- (3) The generalized coordinates for spherical pendulum are _____
(a) α & θ (b) θ & ϕ
(c) α & ϕ (d) θ & 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) A rigid body has _____ degree of freedom
(a) one (b) two
(c) three (d) six
- (6) The path of a particle is _____ when it is moving under constant conservative force field
(a) cycloid (b) hyperbolic
(c) parabolic (d) straight line
- (7) The equation of constraints for a simple pendulum is _____
(a) $r d\theta - l = 0$ (b) $r - l = 0$
(c) $r + l = 0$ (d) $r d\theta + l = 0$
- (8) For conservative system, the potential energy is a function of _____
(a) position (b) velocity
(c) force (d) acceleration
- (9) The space depends on position coordinate and momenta is called _____ space
(a) configuration (b) phase
(c) coordinate (d) momentum
- (10) The Poisson brackets are _____
(a) non-additive (b) non-distributive
(c) commutative (d) anti-commutative

Q-2 True-False and Filling the blanks**(08)**

- (1) When the constraints are depends on the time are known as Rheonomous constraints (True/False)
- (2) The study of conservation theorems for a system in motion provides the constants of motion (True/False)
- (3) In a torque free motion of a rigid body, the angular velocity of the body is a constant vector (True/False)
- (4) If $I_1 = I_2$ and $I_3 = 0$, then the body is called symmetrical top (True/False)
- (5) In variational principle the line integral of some function between two end points is _____
- (6) The Lagrangian for L-C-R series connection is $L =$ _____
- (7) For conservative system $H =$ _____
- (8) In Hamiltonian formulation potion coordinate and _____ taken as independent variable

Q-3 Short Questions (Attempt any Ten)**(20)**

- (1) What are generalised coordinates?
- (2) Write the advantages of Lagrangian formulation
- (3) Write the Maxwell's equations
- (4) Find the angular velocity of the earth
- (5) Show that the directions of the angular velocity and the angular momentum are different
- (6) Define inertial and non-inertial frame of reference
- (7) State the Hamilton's principle
- (8) What is necessity of undetermined multipliers?
- (9) What is configuration space?
- (10) Construct the Lagrangian for simple pendulum with moving support
- (11) What is a phase diagram?
- (12) What is Generating function?

Q-4 Long Questions (Attempt any four) All questions carry equal marks**(32)**

- (1) Derive $\frac{d}{dt} \left(\frac{\partial L}{\partial \dot{q}_j} \right) - \frac{\partial L}{\partial q_j} = 0$ using D'Alembert's principle
- (2) Derive the Lagrange's equation of motion for a Rayleigh's dissipation function
- (3) Explain the motion of the earth with necessary diagrams
- (4) Derive the expressions of angular momentum and kinetic energy for motion of rigid body
- (5) Discuss the technique of calculus of variation and derive the Euler's equation $\frac{\partial f}{\partial y} - \frac{d}{dx} \left(\frac{\partial f}{\partial y'} \right) = 0$
- (6) Construct the Lagrangian and derive the equations of motion for a cylinder rolling on inclined plane using undetermined multiplier
- (7) Deduce the Hamilton's equation of motion and show that H is a constant of motion and also give the total energy
- (8) Discuss the Canonical transformation and derive the Canonical transformation equation for $F_1 = F_1(q_i, Q_i, t)$

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