

SEAT No. \_\_\_\_\_

No. of Printed Pages : 2

[72]

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

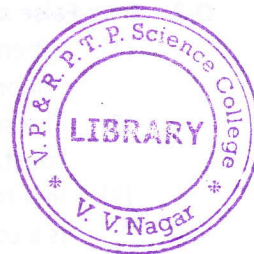
Thursday, 24<sup>th</sup> December, 2020

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

Subject: PHYSICS

Course: US05CPHY21

Title: Classical Mechanics



Total Marks: 70

**N.B:** (i) All the symbol have their usual meanings

(ii) Figures at the right side of questions indicate full marks

**Q-1 Multiple Choice Questions (Attempt All)**

(10)

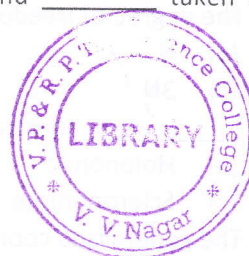
- (1) The degree of freedom for N particles in plane are \_\_\_\_\_  
(a) N (b) 2N  
(c) 3N (d) 2
- (2) \_\_\_\_\_ constraints are independent of time  
(a) Holonomic (b) Non-Holonomic  
(c) Scleronomous (d) Rheonomous
- (3) The generalized coordinates for spherical pendulum are \_\_\_\_\_  
(a)  $\alpha$  &  $\theta$  (b)  $\theta$  &  $\phi$   
(c)  $\alpha$  &  $\phi$  (d)  $\theta$  &  $\phi$
- (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 have \_\_\_\_\_ 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 position 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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