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**SARDAR PATEL UNIVERSITY**  
**B.Sc. (5<sup>th</sup>- Semester) Examination**  
**Code No. US05CPHY21: [Classical Mechanics]**

Date: 23-11- 2021, Tuesday

Time: 3:00 p.m. to 5:00 p.m.

Note: (i) All the symbols have their usual meanings

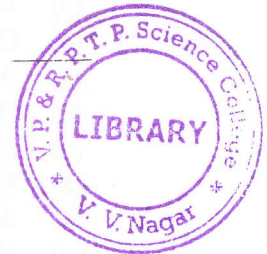
Total Marks: 70

(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 a two particle in space are \_\_\_\_\_.
  - (a) 3
  - (b) 4
  - (c) 6
  - (d) 0
- (2) The Lagrange's equations of motion for a system are equivalent to \_\_\_\_\_ equations of motion.
  - (a) Laplace's
  - (b) Poisson's
  - (c) Maxwell's
  - (d) Newton's
- (3) The Lagrangian function is define by \_\_\_\_\_.
  - (a)  $L = T + V$
  - (b)  $L = F - V$
  - (c)  $L = T - V$
  - (d)  $L = F + V$
- (4) \_\_\_\_\_ must be applied to maintain the rotation of the system about given axis
  - (a) force
  - (b) momentum
  - (c) velocity
  - (d) torque
- (5) Newton's laws of motion are valid in the two systems moving with a \_\_\_\_\_ relative velocity.
  - (a) uniform
  - (b) non uniform
  - (c) Accelerated
  - (d) double
- (6) The moment of inertia is a tensor of rank \_\_\_\_\_.
  - (a) one
  - (b) two
  - (c) three
  - (d) zero
- (7) The path of a particle is \_\_\_\_\_ when it is moving under constant conservative force field.
  - (a) cycloid
  - (b) hyperbolic
  - (c) parabolic
  - (d) straight line
- (8) The equation of constraints is \_\_\_\_\_ for a cylinder rolling on inclined plane.
  - (a)  $r d\theta - dx = 0$
  - (b)  $r d\theta - dx = 0$
  - (c)  $r dr - dx = 0$
  - (d)  $r dx - dx = 0$
- (9) For conservative system, the potential energy is a function of \_\_\_\_\_.
  - (a) position
  - (b) velocity
  - (c) force
  - (d) acceleration
- (10) In Hamiltonian formulation potion coordinate and \_\_\_\_\_ taken as independent variable
  - (a) acceleration
  - (b) momenta
  - (c) force
  - (d) velocity

**Q.2 Filling the blanks and True-False**

[08]

- (1) Scleronomous constraints are independent of time (True/False)
- (2) The Hamiltonian function is defined by  $H = T - V$  (True/False)
- (3) If  $I_1 = I_2 = I_3$ , then the body is called \_\_\_\_\_ top.
- (4) If  $I_1 \neq I_2 \neq I_3$ , then the body is called \_\_\_\_\_ top.

- (5) The 3N-dimensional space is called configuration space (True/False)
- (6) In variational principle the line integral of some function between two end points is zero (True/False)
- (7) The space depends on position coordinate and momenta is called phase space (True/False)
- (8) The Poisson brackets are commutative (True/False)

**Q.3 Short Questions (Attempt any Ten)**

[20]

- (1) Define Holonomic and non-holonomic constraints.
- (2) Define cyclic coordinates.
- (3) Write an advantage of Lagrangian formulation.
- (4) Define inertial and non-inertial frame of reference.
- (5) What are Euler's angles?
- (6) Define precessional velocity.
- (7) State the variational principle.
- (8) State the Hamilton's principle.
- (9) What is undetermined multiplier?
- (10) Write an assumption of Hamiltonian formulation.
- (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 the Lagrange's equation of motion for a conservative system using D'Alembert's principle.
- (2) Construct the Lagrangian of Atwood machine and derive its equation of motion.
- (3) Discuss the rotating coordinate systems and derive the expressions of velocity and acceleration of the particle.
- (4) Discuss the motion of the earth with necessary diagrams.
- (5) Discuss the technique of calculus of variation and derive the general Euler's equation.
- (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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