(6 pages)

Reg. No. : ....

Code No. : 6383 Sub. Code : ZPHM 11

M.Sc. (CBCS) DEGREE EXAMINATION,
NOVEMBER 2022

First Semester

Physics – Core

CLASSICAL MECHANICS

(For those who joined in July 2021 onwards)

Time : Three hours Maximum : 75 marks

PART A — (10 × 1 = 10 marks)

Answer ALL questions.

Choose the correct answer :

1. _____ constraints are those which are expressible in the form of equation $f(r_1, r_2, r_3 \ldots r_n, t) = 0$

   (a) Holonomic

   (b) Nonholonomic

   (c) Either holonomic and Nonholonomic

   (d) None

2. D'Alembert's principle is based on the principle of _____

   (a) Virtual power

   (b) Natural work

   (c) Virtual work

   (d) None

3. _____ between two particles are the most important examples of central force.

   (a) Gravitational and couloumb force

   (b) Gravitational and Vanderwalls force

   (c) Gravitational and Yukura force

   (d) None

4. Coriolos forces are _____ forces

   (a) intertial   (b) non fictions

   (c) nonintertial   (d) None

5. The Poisson bracket of x with $P_x[x, P_x]$ =

   (a) Zero   (b) one

   (c) $i\hbar$ (d) $-i\hbar$

6. The principle of least action states that ———

(a) $\Delta \int_{t_1}^{t_2} \frac{T}{2} dt = 0$ (b) $\Delta \int_{t_1}^{t_2} 2T dt = 0$

(c) $\Delta \int_{t_1}^{t_2} (T - v) dt = 0$ (d) $\Delta \int_{t_1}^{t_2} \sum_k p_k q_k dt = 0$

7. In small oscillators each oscillation with definite frequency is known as

   (a) Transverse vibration

   (b) Longitudinal vibration

   (c) Transverse and Longitudinal vibration

   (d) Normal vibration

8. In the case of a rigid body having N particles , the number of degrees of freedom is

   (a) N   (b) 3N

   (c) 3   (d) 0

9. Lorentz transformation are merely the orthogonal transform of four dimensional space and later recognized at space

   (a) Euclidian   (b) Hilbert

   (c) Monkowski's   (d) None

10. Which one of the following remains invariant under Lorentz transformations

(a) $\dfrac{\partial^2}{\partial x^2} + \dfrac{\partial^2}{\partial y^2} + \dfrac{\partial^2}{\partial z^2} - \dfrac{1}{c^2} \dfrac{\partial^2}{\partial t^2}$

(b) $\dfrac{\partial^2}{\partial x^2} + \dfrac{\partial^2}{\partial y^2} + \dfrac{\partial^2}{\partial z^2}$

(c) $\dfrac{\partial}{\partial x} + \dfrac{\partial}{\partial y} + \dfrac{\partial}{\partial z} - \dfrac{1}{c^2} \dfrac{\partial}{\partial t}$

(d) $\dfrac{\partial^2}{\partial x^2} + \dfrac{\partial^2}{\partial y^2} + \dfrac{\partial^2}{\partial z^2} + \dfrac{1}{c^2} \dfrac{\partial^2}{\partial t^2}$

PART B — (5 × 5 = 25 marks)

Answer ALL questions, choosing either (a) or (b).

Each answer should not exceed 250 words.

11. (a) Find the Lagrange's equation of motion for an electrical circuit comprising an inductance L and capacitance C. The capacitor is charges to q coulombs and current flowing in the circuit is "i;' Amp.

Or

(b) State and explain principle of virtual work.

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12. (a) Write short notes on coriolis force.

Or

(b) State and prove viral theorem.

13. (a) Deduce Hamilton's equation from variational principle.

Or

(b) Show that Lagranges bracket is unvariantunder canonical transformation?

14. (a) Derive Eulers equation of motion for a rigid body with fixed point.

Or

(b) Derive an expression for moment of inertia of Rigid body.

15. (a) Establish the mass-energy relation $E = mc^2$.

Or

(b) Discuss the relativistic Lagrangian formulation of relativistic mechanics.

PART C — (5 × 8 = 40 marks)

Answer ALL questions, choosing either (a) or (b).

Each answer should not exceed 600 words.

16. (a) The homogeneity of time implies that the total energy is constant of motion substantiate.

Or

(b) Derive Lagrange's equation from Hamilton's principle.

17. (a) Discuss a two body problem reduced into one body problem. Calculate reduced mass of Hydrogen atom.

Or

(b) State and prove the kepler's Law of planetary motion.

18. (a) Using poison bracket show that the transformation $q = \sqrt{2p} \sin Q$ $p = \sqrt{2p} \cos Q$

Or

(b) Describe Hamilton-Jacobi theory and use it to solve the problem of linear harmonic oscillator .

19. (a) Discuss the vibrations of a linear triatomic molecule.

Or

(b) Explain in detail general theory of small oscillations.

20. (a) What is a four vector potential? Express Maxwells field equations in four vector form.

Or

(b) Write the postulates of special theory of relativity. Also derive and expression for the variation of mass with velocity.

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Page 5   Code No. : 6383

Page 6   Code No. : 6383