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**R – 2332**

Reg. No. : .....

Name : .....

**Fourth Semester B.Sc. Degree Examination, July 2023**

**First Degree Programme under CBCSS**

**Physics**

**Core Course III**

**PY 1441 : CLASSICAL AND RELATIVISTIC MECHANICS**

**(2018 Admission onwards)**

Time : 3 Hours

Max. Marks : 80

PART – A (Very short answer type questions)

Answer all questions in a sentences or two. Each question carries 1 mark.

1. Write the Newton third law of motion.
2. Define centre of mass.
3. Express the law of conservation of linear momentum.
4. Define centre force.
5. Write the expression for reduced mass of a two-body system.
6. What is an elastic scattering?
7. Define generalized coordinates.
8. Define Hamiltonian.
9. State the postulates of special theory of relativity.
10. Write the relationship between mass and energy.

**(10 × 1 = 10 Marks)**

P.T.O.

## PART – B (Short answer type questions)

Answer any **eight** questions not to exceed a paragraph. Each question carries **2** marks.

11. Explain the force acting on a charged particle moving with a velocity 'v' in a magnetic field B and electric field E.

12. What are the advantages of Lagrangian formulation over Newtonian formulation?

13. Prove Kepler's second law from the law of conservation of angular momentum.

14. What is a laboratory coordinate frame?

15. Explain the term virtual displacement.

16. What are constraints? Name different types of constraints.

17. What are cyclic coordinates?

18. Explain the term "phase space".

19. Explain inertial frames of reference.

20. Write and explain the equations of velocity addition in relativity.

21. Explain the negative result of Michelson -Morley experiment.

22. What is twin paradox?

**(8 × 2 = 16 Marks)**

## PART – C (Short essays and problems)

Answer any **six** questions. Each question carries **4** marks.

23. From the definition of Newtons second law of motion, obtain the equation of motion of a particle.

24. State and prove the law of conservation of angular momentum of a system of particles.

25. Prove that a particle moving under a central force field is in a plane.

26. Derive the equation for scattering cross section in a central force field.

27. Solve the problem of Atwood's machine in Lagrangian formulation.

28. Derive the Lagrange's equations of motion of a simple pendulum.

29. Discuss the problem of one-dimensional harmonic oscillator in Hamiltonian formulation.

30. One of the twin brothers, Thomas went to the outer space in a spacecraft of velocity 0.8c at an age of 20 yrs. He returned back to earth on his twin brother Joseph's $40^{th}$ birthday. What would be the age of James at that time?

31. One space craft is moving with a velocity 0.99c and another spacecraft is moving in its opposite direction with a velocity 0.99c. What will be the velocity of the first spacecraft relative to the other? Explain the result in terms of the postulates of special theory of relativity.

**(6 × 4 = 24 Marks)**

## PART – D (Essay Type questions)

Answer any **two** questions, Each question carries **15** marks.

32. Explain the rotational invariance of space and law of conservation of angular momentum and homogeneity of time and conservation of energy.

33. From D' Alembert's principle, derive the Lagrange's equations of motion.

34. State Kepler's laws of planetary motion. Derive Kepler's first law of motion.

35. Derive Lorentz transformation equations.

**(2 × 15 = 30 Marks)**

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