L – 2491

Reg. No. : .....

Name : .....

Fourth Semester B.Sc. Degree Examination, May 2021

First Degree Programme under CBCSS

Physics

Core Course III

PY 1441 – CLASSICAL AND RELATIVISTIC MECHANICS

(2019 Admission Regular)

Time : 3 Hours

Max. Marks : 80

SECTION – A

Answer **all** the questions. Each carries **1** mark.

1. What is centre of gravity?
2. What is Torque?
3. What are conservative and non conservative forces?
4. What are constraints of motion? Give an example?
5. Define D'Alembert's principle?
6. What are generalized coordinates?
7. Define inertial frame of reference.

8. State Kepler's second law.

9. Write an expression for the reduced mass of a two particle system

10. What do you mean by time dilation?

(10 × 1 = 10 Marks)

SECTION – B

Answer any **eight** questions. Each carries **2** marks.

11. "Law of conservation of linear momentum is a consequence of Newton's first law". Substantiate

12. Explain the probability of elastic scattering.

13. State the two postulates of the special theory of relativity.

14. What is central force field? Give examples

15. Distinguish between a centre of mass frame and a laboratory frame?

16. Distinguish between elastic and inelastic collisions. Give example

17. Explain the principle of virtual work.

18. What are the advantages of Lagrange's approach over Newton's approach?

19. Distinguish between Scleronomic and Rheonomic constraints.

20. What do you understand by Lorentz Fitzgerald contradiction?

21. Deduce an expression for the relativistic energy

22. What are Galilean transformations?

23. What are non inertial frames of references? Give any one example

24. What are cyclic coordinates?

25. What are perigee and apogee?

26. Define the term 'collision' and bring out the usefulness of the study of collisions in understanding the forces in nature

(8 × 2 = 16 Marks)

SECTION – C

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

27. Show that rotational invariance of space requires motion under a central force and leads to the conservation of angular momentum.

28. Prove that the kinetic energies of two colliding particles in the CM system are inversely proportional to their masses.

29. Construct a Lagrangian, and hence, equation of motion of a simple pendulum placed in a uniform gravitational filed.

30. Calculate the reduced mass of hydrogen atom and Positronium and H_2 molecule

31. Deduce the Kepler's third law of planetary motion

32. How will you reduce the two body problem into a one body problem? Hence explain the concept of reduced mass.

33. An aeroplane is moving with respect to earth with a speed of 600m/s. As determined by earth clocks, how long will it take for the aeroplane's clock to fall behind by two microseconds.

34. Prove that the circle $x^2 + y^2 = a^2$, in a frame S will be seen as a ellipse from another frame S' which is moving with a velocity v with respect to S.

35. What is the mass of an electron that has a kinetic energy of 2 MeV?

36. Calculate the velocity of an elementary particle whose mass is 10 times its rest mass

37. In an Atwood's machine, the pully is frictionless, so the system is holonomic. Write down the equation of motion using Lagrangian formalism.

38. In the Michelson —Morley experiment, what is the expected fringe shift according to the theory if the effective length of each path is 20m, $\lambda = 5000\ A^{\circ}$? Assume $c = 3 \times 10^{8}\, ms^{-1}$ and $v = 3 \times 10^{4}\, ms^{-1}$

(6 × 4 = 24 Marks)

SECTION – D

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

39. Explain about the motion of a charged particle in electromagnetic field.

40. Deduce the equation of the orbit and discuss the various special cases depending on the value of E and hence of $\in$.

41. Explain the terms configurational space, holonomic and non holonomic constraints and show that the constraints in a rigid body are conservative.

42. Briefly explain about Michelson Morley experiment, significance of its negative result and mention its applications

43. What is Hamiltonian function? Explain in detail about the conservation of energy and the Hamilton's equation

44. Comment on the linear uniformities of space and conservation of linear momentum.

(2 × 15 = 30 Marks)