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Reg. No. : .....

Name : .....

Second Semester B.Sc. Degree Examination, December 2021

First Degree Programme under CBCSS

Physics

Foundation Course II

PY 1221: CLASSICAL MECHANICS

(2014–2017 Admission)

Time : 3 Hours

Max. Marks : 80

SECTION – A

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

1. State Newton's second law of motion.

2. What is frame of reference?

3. State conservation of linear momentum.

4. The homogeneity of time implies that the total energy is a constant of motion. Substantiate.

5. Define central force.

6. Write the differential equation for an orbit.

7. Define centre of mass reference frame

8. Define elastic scattering.

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9. What is meant by configuration space.

10. State D' Alemberts principle.

(10 × 1 = 10 Marks)

SECTION – B

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

11. Distinguish between holonomic and nonholonomic constraints.Give examples.

12. Compare Lagrangian approach with Newtonian approach.

13. Discuss the general features of motion in central force field.

14. What are the first integrals of motion?

15. Obtain the equation of motion of a particle under constant force.

16. What are generalized coordinates? If the generalized coordinate has the dimension of momentum ,what would be dimension of generalized velocity?

17. Briefly discuss the motion of a charged particle in an electromagnetic field.

18. What is a cyclic coordinate? When do we say that the generalized momentum conjugate to a cyclic coordinate is a constant of motion?

19. Briefly discuss the angular momentum of a system of particles.

20. Distinguish between conservative and nonconservative forces.

21. Explain the difference between real and virtual displacements.

22. In the case of inverse square law force field, if the orbit is circular prove that the potential energy is twice the total energy.

(8 × 2 = 16 Marks)

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SECTION – C

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

23. Find the potential energy associated with the force $F = -yz\vec{i} - xz\vec{j} - xy\vec{k}$.

24. A particle of mass m is projected vertically up with an initial velocity of v_0. If the force due to the friction of the air is directly proportional to its instantaneous velocity, calculate the velocity and position of the particle as a function of time.

25. Masses of 1,2 and 3 kg are located at positions $\vec{i} + \vec{j} + \vec{k}$, $4\vec{j} + 3\vec{k}$ and $2\vec{i} + 2\vec{k}$ respectively. If their velocities are $7\vec{i}, -6\vec{j}$ and $-3\vec{i}$, find the position and velocity of the centre of mass.

26. Show that Lagranges equation of motion reduce directly to Newton's second law.

27. Obtain the equation of motion of a particle of mass m in a potential V (x, y, z) in spherical polar coordinates.

28. Consider a system of N particles on which the external force is acting. Show that the centre of mass of the system behaves like a particle whose mass is equal to the total mass of the system and is acted upon by the total external force F.

29. Derive the equations for the Atwoods machine using the Lagrange equation

30. A particle of mass m is observed to move in an orbit given by $r = k\theta$, where k is a constant. Determine the form of force.

31. The mean distance of Earth from the Sun is 149.6×10^6 km and the mean distance of Mercury from the Sun is 57.9×10^6 km. The period of Earth's revolutions is 1 year, what is the period of Mercury's revolution?

($6 \times 4 = 24$ Marks)

SECTION – D

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

32. Discuss the Kepler's problem of planetary motion.

33. Bring out Lagranges equation from D'Alembert's principle.

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34. Demonstrate how a two body central force motion is reduced into one body problem.

35. Derive the differential equation for the orbit of a particle moving under central force.

(2 × 15 = 30 Marks)

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