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C – 3938

Reg. No. : .....

Name : .....

Fourth Semester B.Sc. Degree Examination, July 2017
Career Related First Degree Programme under CBCSS
PHYSICS WITH COMPUTER APPLICATIONS
Core Course
PC 1441 : Classical Mechanics and Theory of Relativity
(2015 Admission)

Time : 3 Hours

Max. Marks : 80

SECTION – A

Answer **all** questions in **one** or **two** sentences **each**. **Each** carries **1** mark.

1. What are non-inertial frames of reference ? Give an example.
2. Write down the Lorentz transformation equations.
3. Explain the ether concept.
4. Discuss time dilation in Relativity.
5. What are inverse square law forces ? Give two examples.
6. What is meant by proper length of a body ?
7. Write down the differential equation for damped harmonic motion and explain the terms.
8. State and explain Kepler's third law of planetary motion.
9. Explain generalized coordinates.
10. State D^1 Alembert's principle.

(10×1=10 Marks)

SECTION – B

Answer **any 8** questions. **Each** carries **2** marks.

11. Explain the conditions for maximum and minimum time periods of a compound bar pendulum.
12. Discuss the variation of mass with velocity of a moving body.

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13. Describe the equivalence of mass and energy.
14. What is Coriolis force ? How does it vary in the two hemispheres of the earth ?
15. Explain spacelike and timelike intervals.
16. How is time dilation effect proved in the case of atmospheric mesons ?
17. Explain the Lagrange's equations for the simple pendulum.
18. Distinguish between scleronomic and rheonomic constraints, with an example each.
19. Explain the concept of centre of mass.
20. Explain the hypothesis of Galilean invariance.
21. Compare elastic and inelastic collisions.
22. Explain the terms :
    i) generalized momentum
    ii) cyclic coordinate. **(8×2=16 Marks)**

SECTION – C

Answer **any 6** questions. **Each** carries **4** marks.

23. Show that the relativistic expression for kinetic energy reduces to the classical one for $v << c$.
24. A particle moves in a potential energy field $U = U_0 - Px + Qx^2$. Find :
    a) the expression for force
    b) the force constant
    c) the time period
    d) the point where the force vanishes.
25. A particle of mass 2 g moves along the x-axis and is attracted towards the origin by a position dependent force 0.008x. If it is initially at rest at x = 10 cm, find :
    a) the differential equation of motion
    b) the position at any time
    c) the velocity of the particle at any time
    d) the amplitude and frequency of vibration.

26. Show that the average kinetic energy and average potential energy over one time period of a simple harmonic oscillator are equal.

27. The mean lifetime of mesons in their rest frame is 2×10^8 s. Consider mesons moving at a velocity of 0.73c. Find :

    a) the distance travelled during one mean lifetime

    b) the distance travelled without relativistic effects.

28. The centre of mass of a system of three particles of masses 10, 20 and 30 g is at the point (1, 1, 1). Where should a fourth particle, of mass 40 g, be placed so that the resulting centre of mass of the system of four particles is at the point (0, 0, 0) ?

29. A stone of mass 100 g is revolved at the end of a string of length 50 cm at the rate of 2 revolutions per second. Determine its angular momentum. If the stone makes only one revolution per second after 25 seconds, find the torque applied.

30. Calculate the speed of a proton of mass 1.67×10^{-27} kg for the cases when :

    a) the kinetic energy is half the total energy

    b) the kinetic energy is half the rest energy.

31. Discuss the constraints and degrees of freedom for the following systems :

    a) a simple pendulum

    b) a system of two particles moving in a plane. **(6×4=24 Marks)**

SECTION – D

Answer **any 2** questions. **Each** carries **15** marks.

32. Discuss the Michelson – Morley experiment and explain the significance of its result.

33. Solve the equations of motion for motion under an inverse square law force and describe the possible orbits.

34. Describe the theory of compound pendulum. Explain the concepts of centre of suspension and centre of oscillation and hence show that they are interchangeable.

35. Derive the expression for relativistic variation of mass with velocity. **(2×15=30 Marks)**
