MAR IVANIOS COLLEGE (AUTONOMOUS)
THIRUVANANTHAPURAM

Reg. No. :…… **Name :…….**

Second Semester B.Sc. Degree Examination, June 2015

First Degree Programme under CBCSS

Foundation Course – II: (for Physics)

AUPY221: Classical Mechanics

Time: **3** Hours Max. Marks: **80**

SECTION – A

*Answer **ALL** questions in a word or one or two sentences.*

1. What is conservative force ? Give one example.
2. Write down the equation of motion of particle under central force field.
3. State the principle of virtual work.
4. What is meant by Lagrangian function of a system ?
5. Explain the concept, "rotational invariance".
6. Calculate the reduced mass of positronium.
7. Discuss the superiority of Lagrangian approach over Newtonian approach.
8. What is meant by constraints ?
9. State conservation theorem for angular momentum of a particle.
10. State conservation theorem for generalized linear momentum.

(10 x 1 = 10 Marks)

SECTION – B

*Answer any **EIGHT** questions, not exceeding a paragraph.*

11. Prove that the work down by the external force is equal to the gain in kinetic energy of the particle.
12. Derive an expression for momentum of a charged particle accelerated to V volts.

13. What are the classifications of constraints ?
14. Show that angular momentum is conserved in motion under central force.
15. What are the two main features of motion of a particle under action of central force ?
16. What is generalized velocity ?
17. Show that the velocity of centre of mass of system remain constant in the absence of external force on the system.
18. State and explain D'Alembert's principle.
19. What is meant by frame of reference and name its two types ?
20. Define angular momentum and derive an expression for the same.
21. What is scattering ? Name three types of scattering.
22. Under what condition can the result of the lab and CM systems be taken to be same ?

(8 x 2 = 16 Marks)

SECTION – C

*Short essay type / Problems : Answer any **SIX** questions.*

23. Set up Lagrangian function for a simple pendulum and hence obtain equation of its motion and the expression for its period.
24. If the mean distance of Mars from Sun is 1.524 times that of Earth, Find out period of revolution of Mars about the Sun.
25. A particle is in the bound state with respect another particle exerting inverse square law of force on it. Discuss the nature of the motion. Under what condition will the trajectory be circular ?
26. A system of particles consists of three particles of masses 5gm, 3gm, and 2gm located at the points (1, 0, –1), (–2, 1, 3), and (3, –1, –1) respectively. Find the coordinates of the centre of mass.
27. Derive an expression for acceleration of Atwood's machine by Lagrangian method.
28. A satellite of radius 'a' revolves in a circular orbit about a planet of radius 'b' with period 'p'. If the shortest distance between their surfaces is 'c', prove that the mass of the planet is given by $M = 4\pi^2 (a + b + c)^3 / Gp^2$.

29. The eccentricity of the earth's orbit is 0.0186. Calculate the ratio of maximum and minimum speeds of the earth in its orbit ?

30. Find momentum and kinetic energy of an electron which is accelerated by the potential difference of 100 volts.

31. A particle of mass 'm' that moves in a central force field is defined by,

$$F = -k/r^3$$

Show that if E is the total energy to the particle, then its speed is given by

$$v = \left\{ \frac{k}{mr^2} + \frac{2E}{m} \right\}^{1/2}.$$

(6 x 4 = 24 Marks)

SECTION – D

*Long essay type / Problems : Answer any **TWO** questions.*

32. State and deduce Kepler's laws of planetary motion.

33. Using D'Alembert's principle, derive Lagrange's equation of motion for a conservative system.

34. Discuss the law of conservation of energy as it should be applied to elastic, inelastic and reactive collisions, giving their expressions in the lab system.

35. i). Derive expression for position vector of centre of mass of system of particles and also discuss the centre of mass in particular cases.

ii). Obtain the general equation of orbit of particle moving under central force.

(2 x 15 = 30 Marks)

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