LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

M.Sc. DEGREE EXAMINATION – **PHYSICS**

FIRST SEMESTER – **NOVEMBER 2019**

PPH 1501 – CLASSICAL MECHANICS

Date: 30-10-2019 Dept. No. Max. : 100 Marks

Time: 01:00-04:00

PART A

Answer ALL Questions **(10×2=20)**

1. Write down the Lagrange's equation of motion for a particle of mass m falling freely under gravity near the surface of the Earth.
2. Determine the degrees of freedom in the following cases:
   a) 4 particles moving freely in space b) A particle moving on a space curve.
3. What do you mean by cyclic co-ordinate?
4. Show that the generating function $F=\Sigma qiPi$ generates the identity transformation.
5. Explain invariable plane? What is inertia ellipsoid?
6. In Rutherford's experiment 10^4 α-particles are scattered at an angle of 2°, Calculate the number of α-particles scattered at an angle of 20°.
7. Discuss Legendre transformation.
8. Could you relate Poisson bracket in classical mechanics to commutator in quantum mechanics?
9. What is phase space?
10. Differentiate Coriolis force and centrifugal force.

PART B

Answer ANY FOUR Questions **(4×7.5=30)**

11. Obtain D'Alembert's principle in generalized coordinates and use it to derive the Lagrange's equations of motion for a holonomic conservative system.
12. Derive Lagrange's expression for a harmonic oscillator. Obtain the Hamiltonian and an equation of motion of a harmonic oscillator.
13. What are canonical transformation?.Explain with examples.
14. Prove that $[J_X, J_Y]=J_Z$.
15. Calculate the inertia tensor for the system of four point masses 1 g, 2 g, 3 g and 4g located at the points (1,0,0), (1,1,0),(1,1,1) and (1.1.-1) cm.
16. For a rigid body consisting of N particles how many generalized co-ordinates will have to be specified? Derive Euler's transformation matrix for the orientation of rigid body.

PART C

Answer ANY FOUR Questions **(4×12.5=50)**

17. State and prove the conservation theorem for linear momentum, angular momentum and energy for a system of N particles.

18. Define Poisson's bracket and discuss their properties.

19. Explain how to obtain the frequencies of periodic motion by using action-angle variables.

20. Consider the case of two coupled pendulums. Determine a) T and V matrices.

    b) The normal frequencies. c) The normal coordinates. d)The equation of motion.

    e)The eigen vectors. f)The general solution.

21. Discuss the theory of a spinning symmetrical top under gravity.

22. a)Find Lagrange's equation of motion for an electrical circuit comprising an inductance L and capacitance C .The capacitor is charged to q coulomb and the current flowing in the circuit is I ampere.

23. b) Use Lagrange's equation, Derive equation of motion of a compound pendulum in a vertical plane about a fixed horizontal axis. Find the period of small amplitude oscillations of the compound pendulum.

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