LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

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

FIRST SEMESTER – NOVEMBER 2016

PH 1809 - CLASSICAL MECHANICS

Date: 02-11-2016 Dept. No. Max. : 100 Marks

Time: 01:00-04:00

PART A

Answer ALL questions **(10x2 = 20 marks)**

1. State and prove the law of conservation of linear momentum for a system of particles.
2. What is a central force?
3. What are transformation equations?
4. Give the Lagrangian for a charged particle moving in an electromagnetic field.
5. What are Euler's angles?
6. Show that $[J_x, p_y] = p_z$
7. What are fundamental Poisson brackets?
8. What are action angle variables?
9. Explain the normal modes of vibration of oscillators.
10. What are coupled oscillators?

PART B

Answer any FOUR questions **(4 x 7.5 = 30 marks)**

11. State the Kepler's first law of planetary motion and deduce the same from the differential equation of the orbit.
12. Derive the Euler- Lagrange's equation of motion from calculus of variation.
13. Obtain the Euler's equations of motion for a rigid body acted upon by a torque N.
14. Prove that the Poisson brackets are invariant under canonical transformation.
15. Deduce the eigenvalue equation from the theory small oscillations.
16. Obtain the equation of motion of a system of two masses connected by an inextensible string passing over a small smooth pulley.

PART C

Answer any FOUR questions **(4 x 12.5 = 50 marks)**

17. What is D'Alembert's principle? Derive the Lagrange's equations of motion from D'Alembert's principle.
18. a) Obtain Hamilton's canonical equations of motion. b) Using the definition of Hamiltonian $H = \sum p_i \dot{q}_i - L$. Show that H = T+ V.
19. Discuss the harmonic oscillator problem using Hamilton Jacobi method.
20. Obtain the eigenvalues of a double pendulum from the theory of small oscillations.
21. The transformation equations between two sets of coordinates are $P = 2(1 + \sqrt{q}\cos p)\sqrt{q}\sin p$, $Q = \log(1 + \sqrt{q}\cos p)$. Show that the transformation is canonical and the generating function for this transformation is $F_3 = -(e^Q - 1)^2 \tan p$.
22. a) Evaluate the Poisson brackets (i) $[J_x, J_y]$ (ii) $[J_y, J_z]$
    b) Obtain the expression for frequency of a linear harmonic oscillator using action angle variables.

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