LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

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

FIRST SEMESTER – **NOVEMBER 2017**

PH 1809– CLASSICAL MECHANICS

Date: 09-11-2017 Dept. No. Max. : 100 Marks

Time: 01:00-04:00

PART A

Answer ALL questions **(2x10 = 20 marks)**

1. What are constraints? Give its classification.
2. Find out whether the given force $F = (y^2z^3 - 6xz^2)\hat{\imath} + 2xyz^3\hat{\jmath} + (3xy^2z^2 - 6\,x^2z)\hat{k}$ is conservative or not.
3. How many generalized coordinates are needed to specify the motion of a rigid body?
4. What is a body coordinate system?
5. Determine $[p_x, J_z]$
6. Prove that the generating function $F = \sum q_i P_i$ generates an identity transformation.
7. Show that Poisson bracket has antisymmetry property.
8. Define a canonical transformation.
9. What is meant by normal modes of vibration?
10. What are coupled oscillators?

PART B

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

11. Using Lagrange's equation of motion determine the time period of oscillation of a simple pendulum.
12. Derive an expression for the rotational kinetic energy of a rigid body.
13. Explain how action angle variables are used to obtain the frequencies of periodic motion.
14. Prove the invariance of Poisson bracket in canonical transformation.
15. Obtain the eigenvalues of a two coupled pendulum from the theory of small oscillations.
16. Prove the conservation of linear momentum and angular momentum for a system of particles.

PART C

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

17. Derive the Lagrangian for a charged particle moving in an electromagnetic field.
18. Define Euler's angles and obtain an expression for the complete transformation matrix.
19. What are canonical transformations? Discuss how the transformation equations can be obtained for generating functions of type F1 and F3.
20. Discuss the harmonic oscillator problem using Hamilton Jacobi method.
21. Obtain the eigenvalues and eigenvectors of a double pendulum from the theory of small oscillations.
22. Discuss the scattering of alpha particles under a central force field and hence obtain the expression for Rutherford scattering cross section.

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