LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

M.Sc.DEGREE EXAMINATION – **PHYSICS**

FIRSTSEMESTER – APRIL 2017

16PPH1MC01/ PH 1817 - CLASSICAL MECHANICS

Date: 02-05-2017 Dept. No. Max. : 100 Marks
TIME 09:00-12:00

PART A

Answer ALL questions **(10X2 = 20 marks)**

1. Find out whether the given force $F = (y^2z^3 - 6xz^2)\hat{\imath} + 2xyz^3\hat{\jmath} + (3xy^2z^2 - 6x^2z)\hat{k}$is conservative or not.
2. What is differential scattering cross section?
3. What is a body coordinate system?
4. Determine $[p_x, J_z]$
5. Prove that the generating function $F = \sum q_i P_i$ generates an identity transformation.
6. Show that Poisson bracket has antisymmetry property.
7. Establish the relation between Hamilton's principal function and Hamilton's characteristic function.
8. For the Lagrangian $= \frac{m}{2}\left(\dot{r}^2 + r^2\dot{\theta}^2\right) - \frac{V}{r}$. Determine the generalized momenta.
9. What are action angle variables?
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. Obtain the Lagranges's equation of motion from variational principle.
13. Derive an expression for the rotational kinetic energy of a rigid body.
14. Explain how action angle variables are used to obtain the frequencies of periodic motion.
15. Prove the invariance of Poisson bracket in canonical transformation.
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. Hence deduce the Lagrange's equation of motion for a non conservative system.
18. Discuss how a two body problem is reduced to a one body problem. What is meant by equations of motion and first integrals? Show that the areal velocity is a constant.
19. Prove by Hamilton Jacobi theory that the orbit of a planet around the sun is an ellipse.
20. Define canonical transformation and obtain the transformation equations corresponding to F1 and F2 generating functions.

21. Applying the theory of small oscillations, determine the eigenvalues and eigenvectors for a linear triatomic molecule. Discuss the different modes of vibrations of the molecule.

22. a) Show that the shortest distance between two points in a plane is a straight line.

b) If $[\emptyset, \rho]$ be the poisson bracket, then prove that $\frac{\partial\,[\emptyset,\rho]}{\partial t} = \left[\frac{\partial \emptyset}{\partial t},\ \rho\right] + \left[\emptyset, \frac{\partial \rho}{\partial t}\right]$