17P108 (Pages:2) Name: .....
Reg. No.....

FIRST SEMESTER M.Sc. DEGREE EXAMINATION, DECEMBER 2017
(Regular/Supplementary/Improvement)
(CUCSS-PG)
CC15P PHY1 C01/ CC17P PHY1 C01 – CLASSICAL MECHANICS
(Physics)
(2015 Admission onwards)

Time: Three Hours Maximum:36 Weightage

PART A

Answer ***all*** questions. Each question carries 1 weightage.

1. Show that the areal velocity is a constant for any central force motion.
2. Obtain Hamilton's equations of motion from Lagrangian using Legendre transformation.
3. What is meant by infinitesimal canonical transformation? Explain how motion of a particle can be described using this.
4. Briefly explain action and angle variables.
5. Show that Hamiltonian is a constant of motion if Lagrangian is not an explicit function of time.
6. Show that rigid bodies have six degrees of freedom.
7. Show that kinetic energy of a rotating body can be expressed as $T = \mathbf{J}.\boldsymbol{\omega}$
8. What are normal coordinates and normal frequencies?
9. Explain stable and unstable equilibria on the basis of potential function.
10. What are limit cycles? Distinguish between stable limit cycle and semi-stable limit cycle.
11. What is meant by period doubling?
12. Explain the principles of Least action.

(12 × 1 = 12 Weightage)

PART B

Answer any ***two*** questions. Each question carries 6 weightage.

13. Define Scattering cross section. Discuss the Rutherford's scattering problem and obtain the expression for scattering cross section
14. Obtain Hamilton Jacobi equation in Hamilton's Principal function and Hamilton's characteristic function and discuss the separation of variables. Discuss the one dimensional harmonic oscillator problem using H-J equation
15. Define Euler's angles and obtain complete set of transformation matrix.
16. Obtain the non-linear equation for a simple pendulum. Derive the exact solution of the equation in terms of elliptic integral.

(2 × 6 = 12 Weightage)

PART C

Answer any ***four*** questions. Each question carries 3 weightage.

17. A pendulum of mass m is attached to a block of mass M. The block slides on a horizontal frictionless surface. Find the Lagrangian and equation of motion of the pendulum. For small amplitude oscillation, derive the expression for period of oscillations.
18. Obtain the Lagrangian of a charged particle moving in an electro-magnetic field, in terms of scalar and vector potentials.
19. Show that $[L_i, L_j] = \varepsilon_{ijk} L_k$, where i, j, k = x, y or z
20. Find the values of α and β if the transformation given by $Q = q^{\alpha} \cos \beta p$ and $P = q^{\alpha} \sin \beta p$ is canonical.
21. Find the horizontal component of the Coriolis force acting on a body of mass 1.5kg moving northward with horizontal velocity of 100 m/s at 30 deg latitude on earth.
22. Show that eigen vectors corresponding to the two distinct eigen frequencies are orthogonal.

(4 × 3 = 12 Weightage)

****