15P106

Name: ……..

Reg. No…….

FIRST SEMESTER M.Sc. DEGREE EXTERNAL EXAMINATION FEB. 2016

(2015 Admission)

CC15P PHY1 C01 – Classical Mechanics

(Physics)

Time: 3:00 hours **Maximum Weight: 36**

SECTION A (Answer all questions)

1. What is meant by generalized coordinates? If the generalized coordinate has the dimension of momentum, what would be the dimension of generalized velocity?
2. What is meant by Legendre transformation? Give an example to show its application.
3. Define Poisson's bracket and hence obtain Hamilton's equation of motion in Poisson's bracket form.
4. Distinguish between Hamilton's Principal function and Hamilton's Characteristic function.
5. Show with suitable example that quantization principle has roots in classical mechanics.
6. Distinguish between centrifugal and Coriolis forces.
7. Discuss the torque free motion of a rigid body.
8. Explain the meaning of normal modes of vibration and normal coordinates.
9. Explain stable, unstable and neutral equilibria.
10. Explain singular point trajectories.
11. What is Feigenbaum diagram? What are Feigenbaum δ and α?
12. Explain the concept of attractors in chaos. What is the basis of attraction? What are strange attractors? **(12 × 1 = 12 Weightage)**

SECTION B (Answer any two questions)

13. Discuss the scattering of α-particle under a coulomb potential and hence obtain the expression for Rutherford scattering cross section.
14. Discuss the Action-Angle variable method. Hence solve the harmonic oscillator problem using this method.

15. Obtain the equations of the torque free motion of a symmetric top and explain the term body cone and space cone.

16. With reference to the standard quadratic map $x_{n+1} = Ax_n(1-x_n)$, discuss fixed points, stability of fixed points and periodic attractor. Explain how bifurcation leads to chaos.

(2 × 6 = 12 Weightage)

SECTION C (Answer any Four questions)

17. A particle of mass m is projected with initial velocity **u** at an angle θ with the horizontal. Use the Lagrange's equations to describe the motion of the projectile. The resistance of air is neglected.

18. Obtain the Lagrangian for a particle moving through an electromagnetic filed in terms of vector and scalar potentials

19. Show that the transformation $q = \sqrt{2P}\sin Q$ and $p = \sqrt{2P}\cos Q$ is canonical and find F_1.

20. Apply Hamilton-Jacobi theory to determine the motion of a body falling vertically in a uniform gravitational field.

21. Show that the components of angular velocity along space set of axes are given in terms of the Euler angles (ϕ, θ, ψ) by

$$\omega_x = \dot{\theta}\cos\phi + \dot{\psi}\sin\theta\sin\phi$$

$$\omega_y = \dot{\theta}\cos\phi - \dot{\psi}\sin\theta\sin\phi$$

$$\omega_z = \dot{\psi}\cos\theta + \dot{\phi}$$

22. Find the normal modes of the system with Lagrangian,

$L = \frac{1}{2}(\dot{x}^2 + \dot{y}^2) - \frac{1}{2}(2x^2 + 2y^2 - 2xy)$ **(4 × 3 = 12 Weightage)**

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