MAHATMA GANDHI UNIVERSITY KOTTAYAM

First Semester MSc. Degree Examination

Model question paper

PH1C02-Classical Mechanics

Time: 3 hrs Total weightage: 30

Part A (Answer any 6 questions, weightage-1)

1. State the Hamiltonian conservation theorem.

2. State and explain the least action principle.

3. Derive the relationship between Poisson bracket and Lagrange bracket.

4. How does the short wavelength limit of Schroedinger equation leads to Hamilton-Jacobi equation?

5. Discuss the nature of Coriolis' force.

6. What are the advantages of Hamiltonian formalism over Lagrangian formalism?

7. State the Kepler's laws of planetary motion.

8. Outline the principle of equivalence.

9. What is meant by a linear system and a non linear system?

10. What is Lyapunov exponent? What is its significance?

Part B (Answer any 4 questions, weightage-2)

11. Using Hamilton's equations, show that the angular momentum is conserved in a central force problem.

12. Using Poisson brackets, check whether the transformation defined by $q = \sqrt{2P}\sin Q$, $p = \sqrt{2P}\cos Q$ is canonical.

13. Prove that the rotational kinetic energy is conserved in the torque free motion of a rigid body.

14. For a diatomic molecule consisting of masses m_1 and m_2 connected by a spring of force constant k vibrating along the line joining the masses, determine the normal frequencies and normal co-ordinates.

15. Solve the differential equation of a linear harmonic oscillator $\frac{d^2x}{dt^2} + \omega_0^2 x = 0$ by quadrature method.

16. Calculate the fractal dimensions of Cantor set and Sierpinski gasket.

Part C (Answer all questions, weightage-4)

17 (a) Obtain the Lagrangian for a charged particle moving in an electromagnetic field. What do you mean by the term, Rayleigh's dissipation function?

OR

(b) What is Hamilton's principle? Obtain Lagrange's equations from Hamilton's principle using the calculus of variation.

18 (a) Obtain the Lagrange's equations for small oscillations of a system of two coupled oscillators in the neighborhood of stable equilibrium. Obtain the normal modes and the normal co-ordinates.

OR

(b) (i) Derive Hamilton Jacobi equation. What is Hamilton's principal function? (ii). Solve the problem of Harmonic oscillator by Hamilton-Jacobi method.

19. Derive the equation for the orbit of a particle moving under the influence of an inverse square central force field.

OR

(b). Discuss the precessional motion with and without nutation of a spinning symmetrical top under gravity.

20. (a). (i). Derive Einstein's field equations. (ii). Write a note on gravitational red shift.

OR

(b) Discuss the phase portraits of (i) damped harmonic oscillator (ii) simple pendulum