M.Sc. DEGREE (PGCSS) EXAMINATION

Faculty of Science

First Semester

Applied Physics

AP1C04 Classical Mechanics and Nonlinear Dynamics

[For 2012 admission Students]

Time: Three Hours Maximum Weight: 30

Part A

(Answer any **SIX** questions. Each question carries a weightage of **ONE**)

1. What do you mean by inertia tensor?
2. What are normal coordinates and normal modes?
3. Show that Hamiltonian is a constant of motion if Lagrangian does not depend on time explicitly.
4. Why are direction cosines not considered as generalized co-ordinates?
5. What is meant by velocity-dependent potential?
6. What are canonical transformations? What is its importance?
7. Explain the significance of Lagrangian Density.
8. Distinguish between time dependent perturbations and time independent perturbations quoting an example each.
9. State and explain KAM theorem?
10. What do you understand by chaos? Explain with examples.

(6 x 1 = 6 weights)

Part B

(Answer any **FOUR** questions. Each question carries a weightage of **TWO**)

11. The Langrangian of two coupled oscillators of mass m each is $L = \frac{1}{2}m\left(\dot{x}_1^2 + \dot{x}_2^2\right) - \frac{1}{2}m\omega_0^2\left(x_1^2 + x_2^2\right) + m\omega_0^2\mu x_1 x_2$. Find out the equations of motions and the normal modes of the system.
12. Show that infinitesimal rotation will commute.
13. Obtain the Langrangian, Hamiltonian and equations of motion for a projectile near the surface of the earth.
14. Show that the transformation Q = 1/p and P = qp^2 is canonical.
15. Show that angular acceleration is the same in fixed and rotating co-ordinate systems.
16. Discuss the Kepler problem within the framework of the classical perturbation theory.

(4 x 2 = 8 weights)

Part C

(Answer any **ALL** questions. Each question carries a weightage of **FOUR**)

17. (a) Discuss the theory of a spinning symmetrical top under gravity.

OR

(b) Develop the dynamics of a crystal lattice in one dimension having a diatomic basis. Hence explain acoustic and optical phonon modes

18. (a) Formulate the Hamilton's least action principle. Derive Lagrange's equation from Hamilton's principle.

OR

(b) Define Poisson bracket. Show that (i) invariant under canonical transformations (ii) Poisson bracket of two constants of motion is itself a constant of motion.

19. (a) Outline the Lagrangian formulation of a continuous system and discuss sound vibrations in a gas.

OR

(b)What are Einstein's field equations? Explain their importance.

20. (a) Discuss the formulation of canonical perturbation theory. Apply the same to the case of a simple pendulum with finite amplitude.

OR

(b)Using logistic map as an example, explain the route to chaos in dissipative system.

(4 x 4 = 16 weights)