

18. (a) Discuss in detail about Coriolis forces.

Or

- (b) State and prove the principle of Least Action.
19. (a) What are action-angle variables? Explain how they can be used to obtain the frequencies of periodic motion. Hence determine the frequency of linear harmonic oscillator.

Or

- (b) Discuss in detail about the separation of variables in the Hamilton's Jacobi equation.
20. (a) Enunciate the principle of the special theory of relativity and derive Lorentz transformation.

Or

- (b) A particle with charge  $q$  and mass  $m$  has the covariant Lagrangian given by  $L = -1/2 m u_\nu u_\nu - q A_\nu u_\nu$

Where  $u_\nu$  and  $A_\nu$  are the velocity and potential four-vectors respectively. Find out the Hamiltonian of the particle and show that it is Lorentz invariant.

Reg. No. : .....

Code No. : 8125

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M.Sc. (CBCS) DEGREE EXAMINATION,  
NOVEMBER 2011.

First Semester

Physics

CLASSICAL MECHANICS

(For those who joined in July 2009 and afterwards)

Time : Three hours

Maximum : 75 marks

PART A — ( $10 \times 1 = 10$  marks)

Answer ALL the questions.

1. What are constraints?
2. What is D' Alemberts principle?
3. How will you reduce a two body problem into one body problem?
4. What are Kepler's laws of planetary motion?
5. What do you mean by inertia tensor?
6. What is a cyclic coordinates?
7. Define canonical transformation.
8. What are fundamental Poisson brackets?

9. Give examples of four vectors.  
 10. What are Lorentz transformations?

PART B — ( $5 \times 5 = 25$  marks)

Answer ALL the questions, choosing either (a) or (b).

11. (a) What are generalized coordinates and generalized velocities? Set up the Lagrangian for a spherical pendulum.

Or

- (b) Obtain the equation of motion of a system of two masses, connected by an inextensible string passing over a small smooth pulley.

12. (a) State and prove virial theorem.

Or

- (b) Derive the differential equation for the orbit of a particle moving under central force.

13. (a) Derive Hamilton's equations from variational principle.

Or

- (b) Deduce the eigen value equation for small oscillations.

14. (a) Show that the fundamental Poisson brackets are invariant under canonical transformation.

Or

- (b) Explain Hamilton Jacobi equation for Hamilton's Principle function.

15. (a) Show how Lorentz transformation equations are superior to Galilean transformations.

Or

- (b) Prove that to the stationary observer, the moving clock appear to go slow.

PART C — ( $5 \times 8 = 40$  marks)

Answer ALL the questions, choosing either (a) or (b).

16. (a) Using Newton's laws of motion, deduce the conservation laws for a system of particles. Discuss the assumptions involved and failure of Newton's third law.

Or

- (b) Set up the Lagrangian and obtain the Lagrange's equation for a simple pendulum. Deduce the formula for its time period.

17. (a) What is differential scattering cross-section? Discuss the problem of scattering of charged particles by a Coulomb field and obtain Rutherford's formula for the differential scattering cross - section.

Or

- (b) If the particles of a system attract each other according to the inverse square law of force, prove that  $2\bar{T} + \bar{V} = 0$ , where  $\bar{T}$  is the average kinetic energy and  $\bar{V}$  the average potential energy.