



APRIL/MAY 2019

MPH12 CLASSICAL AND STATISTICAL
MECHANICS

Time : Three hours

Maximum : 75 marks

SECTION A — (5 × 6 = 30 marks)

Answer ALL questions.

1. (a) Using Lagrangian calculate the velocity of a cylinder at the bottom of the inclined plane when rolled down.

Or

- (b) State and prove the principle of least action.

2. (a) Prove that the angular momentum J of a rotating rigid body is given by $J = I\omega$, where T is a tensor of second rank and ' ω ' is the angular velocity.

Or

- (b) Show that Poisson's brackets are invariant with respect to canonical transformation.

3. (a) Using Hamilton-Jacobi method obtain the solution for a linear harmonic oscillator.

Or

(b) Show by Hamilton - Jacobi theory that the orbit of a planet round the sun is an elliptic one with the sun at one of its foci.

4. (a) Explain the three different types of ensembles.

Or

(b) Show that the translational partition function for a gas molecule is $\frac{V}{h^3} (2\pi mkT)^{3/2}$.

5. (a) Using Bose - Einstein statistics, derive Planck's radiation law in terms of frequency and wavelength.

Or

(b) Describe the Pauli's theory of paramagnetism.

SECTION B — (3 × 15 = 45 marks)

Answer any THREE questions

6. (a) Deduce the Hamilton's canonical equations of motion.

(b) Explain the physical significance of Hamiltonian.

(c) Discuss the advantages of Hamiltonian approach.

7. Explain generating function. Derive the canonical transformation equations corresponding to all the four forms of generating function.

8. Deduce expressions for the frequencies for the longitudinal normal modes of a linear triatomic molecule of the type AB₂.

9. What are first and second order phase transitions? Obtain the Ehrenfest's equations for the first and second order phase transitions.

10. Show that Bose - Einstein distribution function tend to Maxwell - Boltzmann function.

