APRIL/MAY 2018

MPH12 — CLASSICAL AND STATISTICAL MECHANICS

Time : Three hours Maximum : 75 marks

SECTION A — (5 × 6 = 30 marks)

Answer ALL questions.

Each question carries equal marks.

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 of a rotating rigid body is $J = I\omega$, where 'I' is a moment of inertia tensor of second rank and 'ω' is the angular velocity.

Or

(b) Show that Poisson's brackets are invariant under canonical transformation.

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

Or

(b) Show by Hamilton-Jacobi theory that the orbit of a planet around the sun is an elliptic one with 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 — ($3 \times 15 = 45$ marks)

Answer any THREE questions.

Each question carries equal marks.

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

(b) Explain the physical significance of Hamiltonian.

(c) Discuss about the advantage 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 AB_2.

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

10. Under what conditions Bose-Einstein distribution function tend to Maxwell-Boltzmann function? Prove it.

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