NOVEMBER/DECEMBER 2019

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) Deduce the equations of motion for a double pendulum using Lagrangian formulation.

Or

(b) Derive the equation of motion for a particle in a central force field using Hamiltonian formulation.

2. (a) Obtain an expression for the rotational kinetic energy of a rigid body rotating about an axis passing through a fixed point in the body with an angular velocity 'w'.

Or

(b) Deduce the Euler's equation of motion of a rigid body using Lagrange's method.

3. (a) Derive the Hamilton-Jacobi equation and obtain its solution.

Or

(b) What are action-angle variables? Obtain an expression for the frequencies of periodic motion using action-angle variables.

4. (a) Explain the Langevin's theory of Brownian motion.

Or

(b) Show that by mixing of two different gases, the entropy of the joint system increases by an amount $2Nk\log_e 2$.

5. (a) Describe the Pauli's theory of paramagnetism.

Or

(b) Prove that the one dimensional using model cannot be ferromagnetic.

SECTION B — (3 × 15 = 45 marks)

Answer any THREE questions.

Each question carries equal marks.

6. (a) Discuss in detail about scattering of particles in a central force field.

(b) Obtain the Rutherford scattering formula for a positively charged particle scattered by a heavy nucleus.

7. Discuss in detail about the spinning motion of a symmetrical top in a uniform gravitational field.

8. Give the general theory of small oscillations. Obtain the eigen value equation of small oscillations and find its solution.

9. State and prove Liouville's theorem.

10. Derive the Richardson-Dushmann equation for thermionic emission.

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