5544/MP2

MAY 2006

Paper II — CLASSICAL MECHANICS AND
STATISTICAL MECHANICS

Time : Three hours   Maximum : 100 marks

Answer ALL questions.

All questions carry equal marks.

$(5 \times 20 = 100)$

1. (a) (i) State D'Alembert's principle. Deduce Lagrange's equations of motion from D'Alemberts principle.

(ii) Apply Lagrange's equations to solve

(1) The Atwood's machine and

(2) Simple pendulum.

Or

(b) (i) State and explain Hamilton's principle. Deduce Lagrange's equations from Hamilton's principle.

(ii) Obtain the velocity of a loop rolling down an inclined plane.

2. (a) (i) How do you covert a two body problem into one body problem? Obtain expressions for position and time through equation of motion and first integral.

(ii) State and prove Virial theorem.

Or

(b) (i) Write the Euler's theorem on the motion of a Rigid body. Explain the idea of infinitesimal rotation.

(ii) What are Euler's angles? Explain the different rotations of it.

3. (a) (i) Explain the theory of small oscillations. Apply it to solve the linear molecule problem.

(ii) Write an account on normal coordinates.

Or

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

(ii) Derive the Hamilton's equations from variational principle.

4. (a) (i) Derive the canonical transformation equations.

(ii) Explain the canonical invariance of Lagrange bracket.

Or

(b) What are action-angle variables? Solve the Kepler problem based on action-angle variables.

5. (a) Discuss the types of statistics in detail. Derive the Sackur-tetrode equation for a mono atomic ideal gas.

Or

(b) Explain in detail the brownian motion.

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