January, 2017

CLASSICAL MECHANICS

Time : Three Hours] [*Maximum Marks* : 80

Answer from both the Sections as directed. The figures in the right-hand margin indicate marks.

SECTION-A

1. Answer any **four** of the following : 4×4

   (*a*) Write a note on Eulerian Angles.

   (*b*) Explain the torque free motion of a rigid body.

   (*c*) Explain Hamilton's principle.

   (*d*) State and explain Liouville's Theorem.

   (*e*) Explain action angle variables in systems of one degree of freedom.

   (*f*) Explain the terms normal modes and normal co-ordinates of vibration.

OR

2. Answer **all** questions from the following : 2×8

   (*a*) Define a rigid body.

   (*b*) Explain coriolis force.

(c) Explain physical significance of Hamiltonian.

(d) Explain the importance of Legendre transformations.

(e) Give the conditions for Canonical transformation.

(f) Explain conservation theorem.

(g) What do you mean by Small Oscillations ?

(h) What are reference points ? Explain.

SECTION-B

Answer all questions : 16×4

3. (a) Explain inertia tensor and the moment of inertia. Solve the Euler's equations of motion for a torque free motion of a rigid body.

OR

(b) What do you mean by Symmetrical Top ? Discuss the rotational motion of the body, assuming that there are no forces acting other than the reaction force at the fixed point.

4. (a) Explain Legendre transformation. Derive Hamiltons equations of motion from Legendre transformations.

OR

(b) Explain the Routh's procedure in Hamiltonian mechanics and explain the principle of least action.

5. (a) Define a canonical transformation and give an example for it. Show that the transformation $Q = \frac{1}{P}$ and $P = qp^2$ is canonical.

OR

(b) Solve the Kepler problem by Hamilton-Jacobi method and explain the action angle variables for completely separate system.

6. (a) Explain the formation of normal modes problem and obtain the eigen value equation for normal modes.

OR

(b) Explain the general theory of small oscillations and discuss the normal co-ordinates of vibration.

———