BA-003-1161006 Seat No. ________

M. Sc. (Sem. I) (CBCS) Examination

March – 2021

EMT - 1001 : Mathematics

(Classical Mechanics - I)

Faculty Code : 003
Subject Code : 1161006

Time : $2\frac{1}{2}$ Hours] [Total Marks : **70**

Instructions : (1) Attempt any five questions from the following.
(2) There are total ten questions.
(3) Each question carries equal marks.

1 Attempt the following : **14**

(1) Define : Linear momentum.
(2) State only the Linear momentum conservation theorem for a single particle.
(3) Define with example : Non-Holonomic constraints.
(4) Define with example : Rheonomuous constraints.
(5) Define with example : Degrees of freedom.
(6) What is monogenic system ?
(7) Define : Configuration space.

2 Attempt the following : **14**

(1) Define : Cyclic co-ordinate.
(2) What will be the shape of orbit of the planet mercury about the Sun ?
(3) State only the Kepler's first Law of planetary motion.
(4) Define Central Force.
(5) Define moment of force.
(6) State the equation of constraints acting on the rigid bodies.
(7) Define generalized momentum with respect to the coordinate x.

3 Attempt the followings : **14**

(a) Discuss in detail the Brachestochrone problem.

(b) State and prove angular momentum conservation theorem for a single particle.

4 Attempt the following : **14**

(a) Explain in detail the conservation of total energy for a system of particles.

(b) State and prove linear momentum conservation theorem for a system of particles.

5 Attempt the following : **14**

(a) Explain in detail principle of virtual work and derive the D'Alembert's principle.

(b) Using D'Alemberts principle derive the Lagrange's equations of motion for general system.

6 Attempt the following : **14**

(a) If the total mass of the system is concentrated about C.M. and moving with it then show that the total K.E. of the system is K.E. at the C.M. plus K.E. about C.M.

(b) Obtain the equations of the motion for a particle in space with reference to Cartesian as well as polar coordinate systems.

7 Attempt the following : **14**

(a) Discuss in detail the problem of Atwood machine and show that the tension of rope appears nowhere in the equation of motion.

(b) Derive Lagrange's equation of motion using Hamilton's variational principle.

8 Attempt the following : **14**

(a) Show that the central force motion of two bodies about their centre of mass can always be reduced to an equivalent one body problem.

(b) Discuss in detail the techniques of calculus of variations.

9 Attempt the following : **14**

(a) A particle of mass m moves under a central force then show that :

(i) Its orbit is a plane curve.

(ii) Its areal vector sweeps out equal area in equal time.

(b) Determine the nature of orbit of a particle moving under an attractive the force $F = {}^{-k}\!/_{r^2}$ (where $k =$ constant). Also derive the Kepler's third Law of planetary motion.

10 Attempt the following : **14**

(a) Define Euler angles and obtain the transformation matrix from space axes to body axes.

(b) Define Cayley-Klein parameters and obtain the orthogonal matrix of transformation in terms of Cayley-Klein parameters.