DCA-003-1162006 Seat No. _____

M. Sc. (Sem. II) Examination

July - 2022

Mathematics : EMT-2001

(Classical Mechanics - II)

Faculty Code : 003

Subject Code : 1162006

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

Instructions : (1) Attempt all the questions.

(2) There are total five questions.

(3) Each question carries equal marks.

1 Attempt the following : (any **seven**) **14**

(1) State both the postulates of special theory relativity.

(2) Define: Proper length and proper time.

(3) Does $c + c = 2c$? Justify your answer.

(4) State Lorentz- Fitzgerald contraction hypothesis.

(5) State only the transformation equations when the generating function is of the type $F_3\left(p_i, Q_i, t\right)$.

(6) Define: Poisson brackets of two functions u and v.

(7) State minimum three differences between Newtonian theory and Theory of relativity.

(8) Define: Action in mechanics.

(9) State only transformation equations of Newtonian relativity.

(10) Define : Generalized momentum.

2 Attempt the following : 14

(a) Obtain the expression for angular momentum for discrete rigid body and continuous rigid body.

(b) Derive Lorentz transformation equations of motion which connects a stationary reference frame S and a moving reference frame S'.

OR

(b) Discuss in detail the variation of time with velocity in relativistic mechanics.

3 Attempt the following : 14

(a) Prove that the moment of inertia about a given axis is equal to the moment of inertia about a parallel axis through the *C. M.* plus the moment of inertia of the body as if concentrated at the center of mass with respect to the original axis.

OR

(a) Express the components of angular velocity ω of a rigid body along the space set of axes in terms of Euler angles.

(b) Prove in the usual notations :

$$\left[u,\left[v, w\right]\right]+\left[v,\left[w, u\right]\right]+\left[w,\left[u, v\right]\right]=0$$

OR

(b) An electron is moving with a speed of 0.85 c in a direction opposite to that of moving photon. Calculate the relative velocity of electron and photon.

4 Attempt the following : **14**

(a) Explain in detail the variation of mass with velocity

and establish the relation $m = \frac{m_0}{\sqrt{1 - \frac{u^2}{c^2}}}$

(b) Derive Hamilton's canonical equations.

5 Attempt the following : (any **two**) **14**

(a) Prove in the usual notation the relation $E = mc^2$.

(b) Obtain Hamilton's principal function for the motion of one dimensional simple Harmonic oscillator and show that the Hamilton's principal function differs from indefinite time integral of Lagrangian only by a constant.

(c) Discuss in detail the motion of a heavy symmetrical top.

(d) Discuss in detail the principle of least action.