PAU-003-1162006 Seat No. _____

M. Sc. (Sem. II) Examination

August / September - 2020

EMT - 2001 : Mathematics

(Classical Mechanics - II)

(New Course)

Faculty Code : 003

Subject Code : 1162006

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

Instructions : (1) Attempt all the questions.

(2) There are 5 questions.

1 Attempt the following : (Any **Seven**)   **14**

(1) Define inertial frame of reference.

(2) State only the Transformation Equations of Newtonian Relativity when the reference frame S is moving in the direction of positive X–axis.

(3) State the postulates of special theory relativity.

(4) State minimum two differences between Newtonian Relativity and Einstein's Relativity.

(5) State only the Euler's equations of motion for a rigid body with one point fixed.

(6) State minimum four differences between Lagrangian formulation and Hamiltonian formulation.

(7) Are Poisson brackets commutative ? Justify your answer.

(8) Which equations are satisfied by cyclic coordinates in Routh's procedure ?

(9) State only the transformation equations when the generating function is of the type $F_4(p_i, P_i, t)$.

(10) State only the Hamilton – Jacobi equation.

2 Attempt the following : (Any **Two**) **14**

(a) Prove in the usual notations the relation $\overline{L} = I\overline{\omega}$.

(b) Derive Galilean transformation equations.

(c) Derive Euler's equations of motion for a rigid body with one point fixed.

3 Attempt the following : **14**

(a) State and prove Jacobi's identity for the Poisson bracket of two functions.

(b) Explain in detail the phenomenon of time dilation.

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 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.

4 Attempt the following : **14**

(a) (i) Discuss in detail the phenomenon of length contraction.

(ii) A rod has proper length 100 cm. is in a frame which is moving with velocity 0.6c. What will be the difference of lengths measured by the observers situated in the (a) laboratory (b) the moving frame.

(b) (i) State all the four types of generating functions and derive the transformation equations if the generating function is $F_1\left(q_i, Q_i, t\right)$.

(ii) Show that the transformations,

$$Q = \log\left(1 + q^{\frac{1}{2}}\cos p\right), P = 2\left(1 + q^{\frac{1}{2}}\cos p\right)\sin p \quad \text{are}$$

canonical and find the suitable generating function.

5   Attempt the following : (Any **Two**)   **14**

   (a)   Discuss in detail the Routh's procedure.

   (b)   Discuss in detail the variation of mass with velocity in the context of special theory of relativity.

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

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

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