



MCD-003-1162006

Seat No. _____

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

April / May - 2018

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) Figures to the right indicate full marks.
(3) There are 5 questions.

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

- (1) State only the Galilean Transformation Equations when the reference frame S' is moving in the direction of positive X-axis.
- (2) State only the Lorentz transformation equations when the reference frame S' is moving in the direction of positive X-axis.
- (3) State the postulates of special theory relativity.
- (4) State only the transformation equations when the generating function is of the type $F_2(q, P, t)$.
- (5) State only the Euler's equations of motion for a rigid body with one point fixed.
- (6) State only the Hamilton - Jacobi equation.
- (7) State only the Hamilton's canonical equations.
- (8) Which equations are satisfied by cyclic coordinates in Routh's procedure ?
- (9) Which equations are satisfied by non- cyclic coordinates in Routh's procedure ?
- (10) Define Poisson bracket of two functions u and v .

2 Attempt the following : **14**

- (a) Show that the angular velocity vector is same in both the co-ordinate systems.

OR

- (a) Derive Galilean transformation equations.
- (b) Derive Euler's equations of motion for a rigid body with one point fixed.

- 3 Attempt the following : 14
- (a) Express the components of angular velocity ω of a rigid body along the space set of axes in terms of Euler angles.
- (b) Explain in detail the phenomenon of time dilation.

OR

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

- 4 Attempt the following : 14
- (a) Derive Hamilton's canonical equations.
- (b) (i) Discuss in detail the phenomenon of length contraction.

- (ii) A rod has proper length 1000 cm. is in a satellite which is moving with velocity $0.6c$. What will be the difference of lengths measured by an observer situated in the
- (a) laboratory
- (b) Satellite

- (c) (i) State all the four types of generating functions and derive the transformation equations if the generating function is $F_1(q, Q, t)$.

- (ii) Show that the transformations $Q = \log\left(\frac{1}{q} \sin p\right)$,
 $p = q \cot p$ are canonical and find the suitable generating function.

- 5 Attempt the following : (any **two**) 14
- (a) Prove in the usual notation the relation $E = mc^2$.
- (b) Find the analytic solution of a torque free motion.
- (c) Discuss in detail the Routh's procedure.
- (d) Obtain Hamilton's principal function for the problem of one dimensional simple harmonic oscillator.

- (e) Establish the relation $m = \frac{m_0}{\sqrt{1 - \frac{u^2}{c^2}}}$ where notations are being usual.