NCG-003-1162006 Seat No. _____

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

April / May - 2017

EMT - 2001 : 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.

(3) Figures to the right indicate full marks.

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

(1) (i) Define cyclic co-ordinate.

(ii) State Hamilton's variational principle.

(2) Define Poisson bracket of the functions u and v.

(3) State the postulates of special theory relativity.

(4) State only the transformation equations when the generating function is of the type $F_4(p, P, t)$.

(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 minimum two differences each between Lagrange's procedure and Hamilton's procedure.

(8) A body has the dimensions represented by $7i + 6j$ *mt.* in reference frame S. What will be these dimension will be represented in the system S' moving with velocity $0.6\ c$ along positive X-axis?

(9) The half life of a radioactive particle is 10^{-7} sec when it is at rest. What will be the half life when it is traveling with the speed of $0.99\ c$?

(10) State only the Jacobi's identity for the Poisson bracket.

2 Attempt the following : 14

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

OR

(a) Derive Lorentz transformation equations.

(b) Define moment of inertia of a rigid body about some axis. Prove that 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 C.M. with respect to the original axis.

3 Attempt the following : 14

(a) Derive Hamilton's canonical equations.

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

OR

(b) For the problem of simple harmonic oscillator prove that

$$q = \sqrt{\frac{2E}{m\omega^2}} \sin(\omega t + \alpha)$$

4 Attempt the following : 14

(a) Obtain Hamilton's principal function for the problem of one dimensional simple harmonic oscillator.

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

(ii) A rod has proper length 100 cm. is in a satellite which is moving with velocity. *0.6 c*. 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 $F_2(q, P, t)$.

(ii) Show that the transformations $Q = \log\left(1 + q^{\frac{1}{2}} \cos p\right)$, $p = 2\left(1 + q^{\frac{1}{2}} \cos p\right) q^{\frac{1}{2}} \sin p$ are canonical and find the suitable generating function.

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

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

(b) Find the analytic solution of a torque free motion

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

(d) For the Poisson bracket of two function prove that

(i) $[au + bv, w] = a[u, w] + b[v, w]$

(ii) $[uv, w] = [u, w]v + u[v, w]$
