NCG-003-016206 Seat No. _____

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

April / May - 2017

EMT - 2001 : Classical Mechanics - II

(Old Course)

Faculty Code : 003

Subject Code : 016206

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) Name the physical motion related to the process to get desired transformation through Eulerian angles.

(2) (i) Define cyclic co-ordinate.
(ii) State Hamilton's variational principle.

(3) Define Poisson bracket of two functions u and v.

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

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

(6) State only the Hamilton-Jacobi equation.

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

(8) What is "Line of Nodes"?

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

(10) Which equations are satisfied by non-cyclic coordinates in Routh's procedure?

2 Attempt the following : **14**

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

OR

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

(b) Discuss in detail the use of direction cosines to describe the orientation of any rigid body.

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) State and prove Euler's theorem for the motion of a rigid body.

(b) Define Euler angles and derive the transformation matrix from space axis to body axis.

(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 generationg function.

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

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

(b) Find the analytic solution for the motion of a heavy symmetrical top

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

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

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

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