# LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

**M.Sc.** DEGREE EXAMINATION – **MATHEMATICS**

THIRD SEMESTER – NOVEMBER 2016

**MT 3812 - CLASSICAL MECHANICS**

Date: 03-11-2016          Dept. No. [          ]          Max. : 100 Marks
Time: 09:00-12:00

Answer ALL Questions.

1. (a) (i) Derive the expression for principle of virtual work.

   OR

   (ii) Discuss the motion of a simple pendulum.                    (5)
   (b) (i) Derive the Lagrangian equation of motion.

   OR

   (ii) Discuss the equation of motion of a compound pendulum.      (15)


2. (a) (i) Derive the Hamilton's canonical equation.

   OR

   (ii) Find the Hamiltonian function of the particle moving under simple harmonic motion and hence deduce the equation of motion.                    (5)
   (b) (i) Derive the Hamilton's principle of least action.

   OR

   (ii) State and explain the Ruthian procedure.
   (iii) Derive Jacobi's form of principle of least action.          (8+7)


3. (a) (i) Explain the two types of periodic motion.

   OR

   (ii) What is Legendre's transformation of motion?                 (5)
   (b) (i) Discuss the motion of a top by Lagrange's method.

   OR

   (ii) State the necessity of Canonical transformation.
   (iii) Show that $Q = q \tan p$, $P = \log(\sin p)$ represent a canonical transformation. **(7+8)**

4. (a) (i) Express the canonical equation of motion in terms of Poisson brackets.

   OR

   (ii) State and prove Liouvilli's theorem in motion.               **(5)**


   (b)(i) State and prove the Jacobi's identity.

   OR

   (ii) Derive the relationship between Lagrangian and Poisson bracket.
   (iii) Derive the relation between angular momentum and Poisson bracket .          **(15)**

5. (a) (i) Derive the Hamilton-Jacobi equation for Hamilton's principle function.

   OR

   (ii) Prove that $W = \int \sum p_k \, \dot{q_k} \, dt$ , where W is the time dependent function.          **(5)**
   (b) (i) Derive and explain Harmonic Oscillator problem .

   OR

   (ii) Discuss the Kepler problem using Action angle variable.          **(15)**


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