LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034
M.Sc. DEGREE EXAMINATION - **MATHEMATICS**
THIRD SEMESTER – NOVEMBER 2011
MT 3812 - CLASSICAL MECHANICS

Date : 04-11-2011   Dept. No.   Max. : 100 Marks
Time : 9:00 - 12:00

Answer *ALL* the questions

1. a. State and prove the principle of virtual work

    OR

    b. How many different ways can an object move?

                                                                    [5]

    c. Derive the Lagrange's equation of motion and find the differential equation of motion
       of a simple pendulum of length l.

    OR

    d. Classify the constraints with reasons for the following cases
       i.   A bead moving on a circular wire.
       ii.   A sphere rolling down a rough inclined plane without slipping.
       iii.   The molecules moving inside a gas container.

                                                                    [15]

02. a. State and prove Legendre transformation

    OR

    b. Using the Routh's function find the equation of motion a particle in the central force field.

                                                                    [5]

    c. State Hamilton's principle and deduce Lagrange's equation from Hamilton's principle. And hence
       find the equation of one dimension Harmonic oscillator.

    OR

    d. Find the solution of the Brachistochrone problem by the method of calculus of variations and
        hence prove that shortest distance between two points in a plane is a straight line.

                                                                    [8+7]

3.a .Derive Hamilton's principle of least action.

    OR

  b**.** Derive canonical equation of motion in terms of Poisson bracket.

                                                                    [5]

  c. State and prove Jacobi's identity.

    OR

  d. Discuss about the motion of a top by using
       i. Lagrange's method
       ii. Hamilton's method

                                                                    [8+7]

04.a. Derive the transformation equation for infinite decimal contact transformation in terms of Poisson bracket

OR

b. State and prove Liouvilli's theorem.

[5]

c. Derive the conservation theorem of angular momentum using infinite decimal contact transformation and hence prove that $[L_x , L_y] = L_z$

OR

d. Derive the Hamilton – Jacobi equation for the Hamilton's principle function S

[8+7]

05. a. Distinguish between Principal function and Characteristic function.

OR

b. Find the action and angle variable for simple Harmonic Oscillator

[5]

c. Derive the Hamilton – Jacobi equation for the Hamilton's characteristic function

OR

d. Discuss Kepler's problem using action angle variable.

[15]

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