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ST.JOSEPH'S COLLEGE (AUTONOMOUS), BANGALORE-27

M.Sc. - I SEMESTER

MID SEMESTER TEST - AUGUST 2016

PH 7115 : CLASSICAL MECHANICS

Time: 1.5 hours **Maximum Marks: 35**

This paper contains 2 parts and 2 printed pages.

PART – A

Answer any 2 questions. Each question carries 10 marks.

1 a) State and prove the conservation theorem for linear momentum of a system of particles.

b) A mass m with speed v approaches a stationary mass M. The masses bounce off each other elastically. What are the final velocities of the particles? Assume that the motion takes place in 1 dimension. (5+5)

2 a) What are generalized co-ordinates?

b) If the transformation equation between the position vector of a particle in a system and the generalized co-ordinates does not have an explicit time dependence, prove that the energy function h represents the total energy of the system.

c) Establish a link among cyclic co-ordinate, symmetry property and conservation theorem with respect to any system. (2+3.5+4.5)

3. a) What is a phase space plot?

b) Write the theorem of conservation of total energy.

c) Write the equation for total energy of a particle bouncing perfectly elastically off a hard surface at z=0. Draw its phase space plot in the z-p_z plane. (3+3+4)

PART – B

Answer any 3 questions. Each question carries 5 marks.

4. With the help of a figure, write the Lagrangian for a simple pendulum and hence derive the Lagranges equation of motion.

5. The differential equation for the orbit is given by $\frac{d^2u}{d\theta^2}+u=\frac{-m}{l^2u^2}\ f(\frac{1}{u})$. Find the force law for a central-force field that allows a particle to move in a logarithmic spiral orbit given by $r=ke^{\alpha\theta}$ where k and α are constants.

6. By the method of calculus of variations, find the shortest distance between two points in a plane.

(P.T.O)

7. A light pully can rotate freely about its axis of symmetry which is fixed in a horizontal position. A light inextensible string passes over the pulley. One end the string carries a mass 4m, while the other end supports a second light pulley. A second string passes over this pulley and carries masses m and 4m at its ends. Write the equation of motion for each of the masses without using Lagrangian.