Examination Roll No. ……..

S.No of Question Paper : ……

Name of the Department : **Physics**

Question paper Set number : **C**

Unique Paper Code : **32227626**

Name of Paper : **Classical Dynamics**

Name of the Course : **B.Sc (Hons) Physics-DSE**

Semester : **VI**

Duration : **3 Hours** Maximum Marks : **75**

Instruction for Candidates

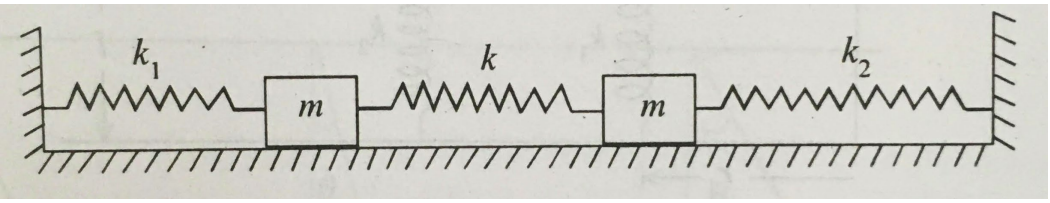
Attempt four questions in all.
All questions carry equal marks.

Q1. Derive the Lagrange's equation of motion and write the Lagrangian for a particle moving under the central force ($F= -k/r^2$). Identify the cyclic coordinate and corresponding canonical momenta. Write down the Hamiltonian with Hamilton's equation of motion for the system.

Q2. What are generalized co-ordinates. Derive an expression for generalized force and velocity. A particle of mass m is projected with initial velocity 'u' at any angle α with the horizontal axis, use Lagrangian equation to describe the motion of projectile and show that the path of the projectile will be parabola. Ignore the friction due to air.

Q 3. Explain Minkowski four dimensional space. Show that four dimensional volume element dxdydzdt is invariant under Lorentz transformation. In a frame S, two events have the space coordinates (0,0,0,0) and (10c,0,0,6). Find the space time interval between them. Calculate the velocity of a frame in which the first event occurs 8 sec earlier than the second.

Q4. For a system of two coupled oscillators as shown in figure, write the Lagrangian and Hamiltonian for the system. Find expressions for normal mode frequencies. If the force constant of the middle spring is geometric mean of the side springs, what are the modified expressions for the normal mode frequencies.



(figure)

Q5. Derive the expression, $E^2=p^2c^2+m_0^2c^4$. Show that a photon of energy $E=h\nu$ can not give rise to an electron-positron pair in free space in the absence of an external field. An excited nucleus of rest mass m_0 is at rest with respect to a chosen inertial frame. It goes over to the lower state whose energy is smaller by ΔE. As a result it emits a γ-ray photon and undergoes a recoil. Show that the frequency of the γ-ray photon is given by

$$\nu = \Delta E/h\,[1- \Delta E / 2m_0c^2\,]$$

6.Define Reynold's number and state its significance. Derive the equation of continuity for two dimensional flow in polar coordinates.

Consider the flow in a pipe. The pipe diameter is 50 mm, the density of fluid is 920 kg/m^3, the flow rate is 0.150 m^3/min, and the kinematic viscosity is 56 m Pa s. The critical Reynolds number is 2,320. Determine if the flow is laminar or turbulent.