Set A

Examination Roll No. ……

S. No. of Question Paper	:	**……..**
Unique Paper Code	:	**32227626**
Name of Paper	:	**Classical Dynamics**
Name of the Course	:	**B. Sc. (Hons.) Physics – DSE**
Semester	:	**VI**

Duration : **2 +1 Hours** Maximum Marks : **75**

Instructions for Candidates

1. Attempt ***four*** questions in all.
2. All questions carry equal marks

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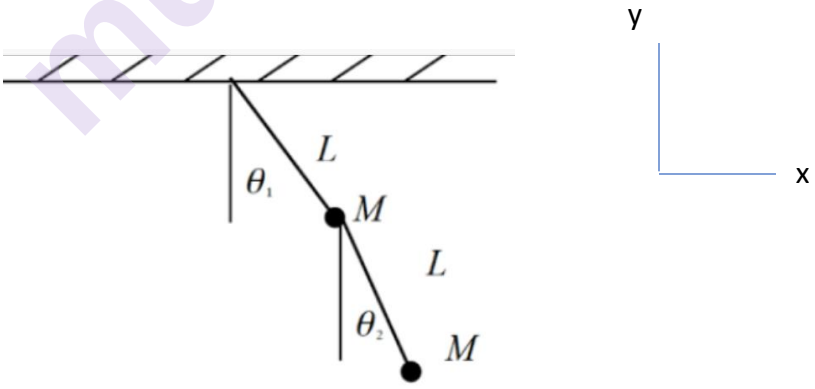
1. Stating the Hamilton's Principle, write the Lagrangian for a double pendulum consisting of two massless rods of equal length L and point masses M as shown in the figure. Obtain the equations of motion and identify the cyclic coordinates.



2. Using Hamilton's Principle, obtain the Lagrangian of a particle moving on the surface of the earth in presence of earth's gravity. Obtain it's equations of motion. Using generalized coordinates find the expression for the Hamiltonian.

3. Two identical simple pendulums of length l and point mass m are coupled by a massless spring of constant k. The unstretched length, d of the spring is equal to the distance between the supports. Write the Lagrangian of the system in appropriate generalized coordinates. Find the normal coordinates and normal frequencies of small oscillations about the equilibrium. Obtain the complete solution for the case when there is an initial horizontal velocity, v towards right imparted to the mass on the left.

4. Obtain the rule for transformation of 3-D velocity vector ($\vec{v}$) under Lorentz Transformations from a frame S to a frame S', moving w.r.t S with velocity $\vec{V}$ along the x-direction. Define a four vector (v^{α}) corresponding to this velocity vector. Show that $v^{\alpha} v_{\alpha}$ is an invariant under Lorentz transformation.

5. Write the Lagrangian for a particle moving at relativistic speeds. From the Lagrangian obtain the expression for its vector momentum ($\vec{p}$) and energy, E. Find the value for $p^{\alpha} p_{\alpha}$, where p^{α} is the momentum four vector.

6. Consider an ideal fluid with volume density ρ(x,y,z,t) moving with velocity $\vec{v}$(x,y,z,t). Obtain the equation of motion for such a fluid in presence of uniform gravitational field. How this equation does gets modified in presence of viscosity? Obtain the modified equation.