Name:

Enrolment No:

UPES

End Semester Examination, December 2023

Course: Classical Mechanics | **Semester : V**

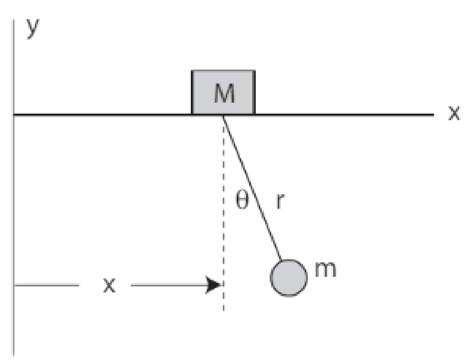
Program: Integrated MSc + BSc Physics | **Time : 03 hrs.**

Course Code: PHYS3030 | **Max. Marks: 100**

Instructions:

SECTION A

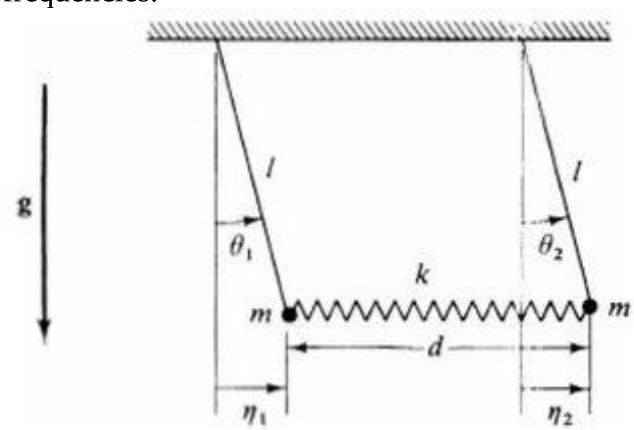
(5Qx4M=20Marks)

S. No.		Marks	CO
Q 1	Define the D'Alembert's principle for a dynamical system.	**04**	**CO1**
Q.2	Describe in short about. a) Degree of freedom b) Generalized coordinates	**04**	**CO1**
Q.3	Interpret the figure below to obtain the Lagrangian of the system.  The support M moves without friction on the horizontal plane. The parameter 'x' is variable.	**04**	**CO3**
Q.4	Determine the percentage contraction in the length of a meter rod moving along its length (along x) with a velocity, $\frac{c}{2}$.	**04**	**CO2**
Q.5	A particle of mass 'm' is moving in a potential $V(x) = -\frac{1}{2}ax^2 + \frac{1}{4}bx^4$ where a, b are positive constants. Determine the frequency of small oscillations about a point of stable equilibrium.	**04**	**CO1**

SECTION B

(4Qx10M= 40 Marks)

Q 6.	Obtain Hamilton's equations of motion from variational principle.	**10**	**CO3**

Q.7.	Determine the values of α and β for which the transformation equations as given below represent canonical transformations. $Q = q^{\alpha} Cos\beta p$ $P = q^{\alpha} Sin\beta p$	**10**	**CO4**
Q.8.	Describe the Relativistic expression of Hamiltonian for a particle moving under conservative forces.	**10**	**CO1**
Q.9.	Consider a circular orbit in a central force potential of form $V(r) = -\frac{k}{r^n}$, where k > 0, and 0 < n < 2. If the time period of a circular orbit of radius R is T_1 and that of radius 2R is T_2, determine the ratio $\frac{T_2}{T_1}$. OR Show that isotropy of space leads to conservation of angular momentum.	**10**	**CO2**
SECTION-C (2Qx20M=40 Marks)			
Q.10	Illustrate the Lagrangian formalism to determine Kepler's laws of motion of planetary bodies.	**20**	**CO2**
Q.11	Apply the theory of small oscillations to obtain the secular equation for two coupled oscillators as shown below and hence determine its normalized frequencies.  OR Discuss the theory of vibrations in a linear triatomic molecule and hence obtain its secular equation and determine the normalized frequencies.	**20**	**CO3**