Name: **Enrolment No:**	

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES

End Semester Examination, December 2022

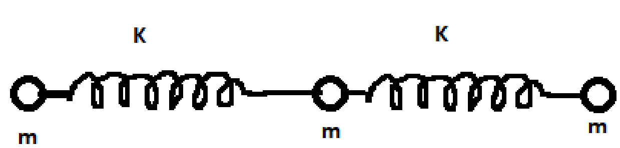
Course: Classical Mechanics **Semester: I**
Program: MSc Physics **Time : 03 hrs.**
Course Code: PHYS7001 **Max. Marks: 100**

Instructions: All questions in section A and B are compulsory there is internal choice in Q. 9
Section C Q. 11 has internal choice

SECTION A
(5Qx4M=20Marks)

S. No.		**Marks**	**CO**
Q 1	Obtain the Lagrangian equation of motion for the Atwood machine.	**4**	**CO3**
Q.2.	Define the geosynchronous orbits and obtain the height of a geostationary satellite.	**4**	**CO2**
Q.3.	A meter rod is moving with a velocity of 0.6 c in a direction inclined at 30^0 along its length. Determine the percentage contraction.	**4**	**CO1**
Q.4.	Two particles having identical masses move in circular orbits under a central potential $(r) = \frac{1}{2}kr^2$ with angular momenta l_1 and l_2, and corresponding radii r_1 and r_2. If the ratio of the angular momentum is given as 2:1 then determine the ratio of the radii.	**4**	**CO3**
Q.5.	An artificial satellite is orbiting round the earth close to its surface. Calculate the time taken by it to complete one round. Take the radius of earth to be 6400 km and g = 980cm/sec^2	**4**	**CO2**

SECTION B
(4Qx10M= 40 Marks)

Q.6.	Obtain the Lagrange's equation of motion from Hamilton's principle.	**10**	**CO1**
Q.7.	Derive the Kepler's third law of motion using Lagrangian dynamics	**10**	**CO2**
Q.8.	Three particles of equal masses 'm' are connected by two identical massless springs of stiffness constant 'K' as shown in the figure.  	**10**	**CO3**

	If x_1, x_2 and x_3 denote the horizontal displacements of the masses from there equilibrium positions. Determine the potential energy of the system		
Q.9.	Check whether the transformation as given below is canonical or not $$Q = \frac{1}{\sqrt{2}}(p+q) \; and \; P = \frac{1}{\sqrt{2}}(p-q)$$ OR Determine the values of α and β so that the equations $Q = q^{\alpha} Cos\beta p$ and $P = q^2 Sin\,\beta p$ represent canonical transformations.	**10**	**CO3**
SECTION-C (2Qx20M=40 Marks)			
Q.10.	a) Lagragian of a system is given by $L = \frac{1}{2}m\dot{q}_1^2 + 2m\dot{q}_2^2 - k\left(\frac{5}{4}q_1^2 + 2\,q_2^2 - 2q_1q_2\right)$ where m and k are positive constants. Determine the frequency of its normal modes. b) Obtain the expression for scattering cross-section of alpha particle scattered through a gold nucleus	**20**	**CO3**
Q.11.	Using the theory of small oscillations obtain the secular equation and the different modes of oscillations for Double pendulum. OR Describe the general theory of Small Oscillations and using it obtain the normal frequency modes of two coupled oscillators.	**20**	**CO2**