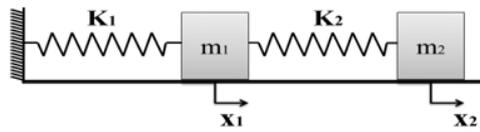**Series N05:vibration with two Degrees of Freedom.**

Exercise 1

Consider the mechanical system shown in the figure above. The two masses oscillate on the horizontal axis.

1- What is the number of degrees of freedom? and give the type of coupling.

2- Calculate the kinetic and potential energy of the system.

3- For $K_1=K_2=K$ and $m_1=m$, $m_2=2m$, and using Lagrange's formula establish the differential equations of motion, and write the two equations in the form of a matrix $M \begin{pmatrix} x_1 \\ x_2 \end{pmatrix} = \begin{pmatrix} 0 \\ 0 \end{pmatrix}$

4- Deduce the natural pulsations of the system.

Exercise 2

Consider the system in the figure opposite consisting of two identical simple pendulums of mass m and length L, fixed to a fixed horizontal frame. A spring of stiffness K ensures the coupling between the two pendulums. At equilibrium, the two pendulums are vertical.
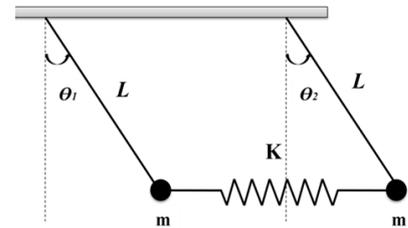
1- Describe the system and give the type of coupling?

2- Calculate the kinetic energy T and potential energy U of the system.

3- Find the differential equation of motion.

4- Determine the natural pulsations of the system and calculate the oscillation modes.

5- Calculate the ratios of the amplitudes in the modes.

6- Calculate θ_1 and θ_2 , for the following initial conditions:

$\theta_1 (t = 0) = \theta_0$, $\theta_2 (t = 0) = 0$ et $\dot{\theta}_1 (t = 0) = \dot{\theta}_2 (t = 0) = 0$