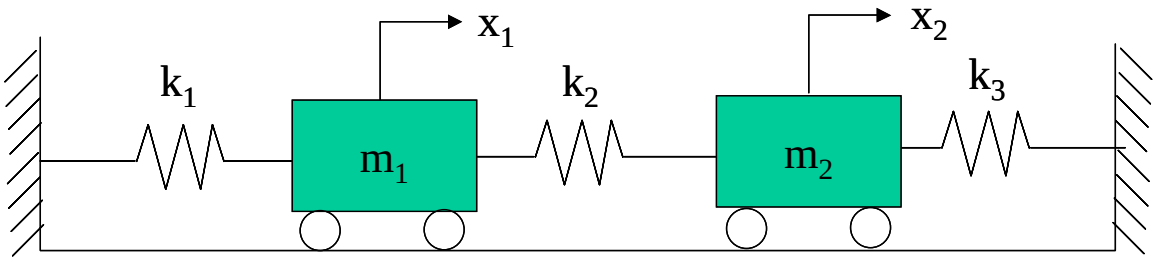
ME 534 COMPUTER-BASED MODELING AND SIMULATION
Instructor: Prof. Cagatay Basdogan



Consider the horizontal motion of the mass-spring system shown in the figure above. The horizontal deflections x_1 and x_2 are measured relative to the position of static equilibrium.

(a) Find the equations of motion for this system.
(b) If the deflection vector is $x = [x_1, x_2]^t$, rewrite the equations of the motion in the form of $\ddot{x} = Ax$.
(c) Show that the substitution $x = be^{jwt}$ leads to the eigenvalue problem

$$Ab = \lambda b,$$

where $\lambda = -\omega^2$. The possible values that ω may assume are the natural frequencies of the system.
(d) If $k_1 = k_2 = k_3 = 1$ N/m, and $m_1 = m_2 = 1$ kg, find the eigenvalues and eigenvectors of A matrix using numerical methods.
(e) If the initial conditions at $t = 0$ are $x_1 = 1, x_2 = \dot{x}_1 = \dot{x}_2 = 0$, show that

$$x = \begin{bmatrix} \frac{1}{2} \\ \\ \frac{1}{2} \end{bmatrix} \cos t + \begin{bmatrix} \frac{1}{2} \\ \\ -\frac{1}{2} \end{bmatrix} \cos \sqrt{3}t$$