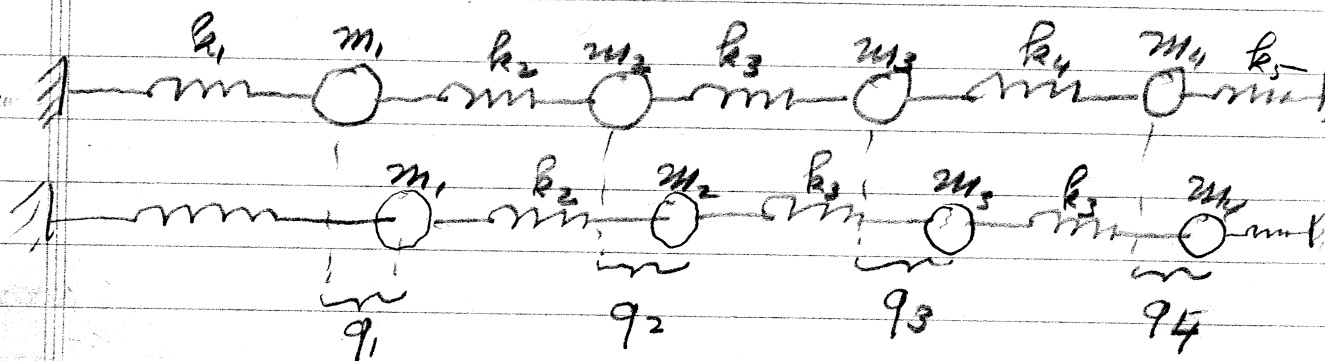


## System of Four coupled masses



$q_i$  = amplitude of  $m_i$  away from equil'm.

Newton's 2<sup>nd</sup> Law

$$m_1 \ddot{q}_1 = k_1(0 - q_1) + k_2(q_2 - q_1) = -(k_1 + k_2)q_1 + k_2 q_2$$

$$m_2 \ddot{q}_2 = k_2(q_1 - q_2) + k_3(q_3 - q_2) = k_2 q_1 - (k_2 + k_3)q_2 + k_3 q_3$$

$$m_3 \ddot{q}_3 = k_3(q_2 - q_3) + k_4(q_4 - q_3) = k_3 q_2 - (k_3 + k_4)q_3 + k_4 q_4$$

$$m_4 \ddot{q}_4 = k_4(q_3 - q_4) + k_5(0 - q_4) = k_4 q_3 - (k_4 + k_5)q_4$$

or

$$0 = \begin{bmatrix} m_1 & & & \\ & m_2 & & \\ & & m_3 & \\ & & & m_4 \end{bmatrix} \frac{d^2}{dt^2} \begin{bmatrix} q_1 \\ q_2 \\ q_3 \\ q_4 \end{bmatrix} + \begin{bmatrix} +(k_1 + k_2) & -k_2 & 0 & 0 \\ -k_2 & +(k_2 + k_3) & -k_3 & 0 \\ 0 & -k_3 & +(k_3 + k_4) & -k_4 \\ 0 & 0 & -k_4 & +(k_4 + k_5) \end{bmatrix} \begin{bmatrix} q_1 \\ q_2 \\ q_3 \\ q_4 \end{bmatrix}$$

$$\underline{B} \ddot{\underline{q}} + \underline{A} \underline{q} = 0$$

where positive definite symmetric