$$\left(\frac{A_1}{A_2}\right)_1 = \frac{k}{2k - \frac{k}{m} \cdot m} = 1 \qquad \omega = \sqrt{\frac{k}{m}}$$

$$\left(\frac{A_1}{A_2}\right)_2 = \frac{2k - m \cdot \frac{3k}{m}}{k} = -1 \qquad \omega = \sqrt{\frac{3k}{m}}$$

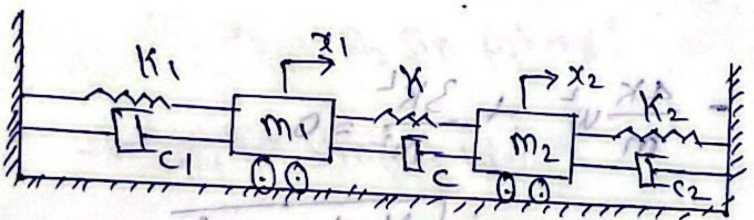
$$\therefore \omega_1 = 2\pi f_1 \qquad \omega_2 = 2\pi f_2$$

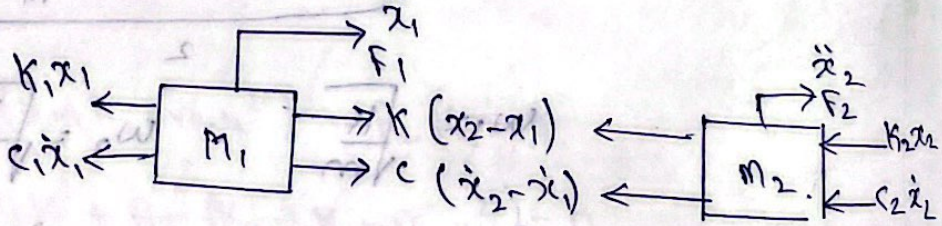
$$f_1 = \frac{\omega_1}{2\pi} \qquad f_2 = \frac{\omega_2}{2\pi}$$

$$f_1 = \frac{1}{2\pi}\sqrt{\frac{k}{m}}\ \text{Hz} \qquad f_2 = \frac{1}{2\pi}\sqrt{\frac{3k}{m}}\ \text{Hz}$$

(matrix) FORCED VIBRATIONS:-

A viscouly damped two degrees of freedom system. The system having two masses m_1 and m_2 is put to excitation force F_1 and F_2.





$$m_1\ddot{x}_1 + k_1 x_1 + k(x_1 - x_2) + c_1\dot{x}_1 + c(\dot{x}_1 - \dot{x}_2) = F_1(t)$$

$$m_2\ddot{x}_2 + k_2 x_2 + k(x_2 - x_1) + c_2\dot{x}_2 + c(\dot{x}_2 - \dot{x}_1) = F_2(t)$$

$$m_1\ddot{x}_1 + (c_1 + c)\dot{x}_1 + (k_1 + k)x_1 - c\dot{x}_2 - kx_2 = F_1(t)$$

$$m_2\ddot{x}_2 + (c_2 + c)\dot{x}_2 + (k_2 + k)x_2 - c\dot{x}_1 - kx_1 = F_2(t)$$

$$\begin{bmatrix} m_1 & 0 \\ 0 & m_2 \end{bmatrix}\begin{bmatrix} \ddot{x}_1 \\ \ddot{x}_2 \end{bmatrix} + \begin{bmatrix} c+c_1 & -c \\ -c & c+c_2 \end{bmatrix}\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} + \begin{bmatrix} K+K_1 & -K \\ -K & K+K_2 \end{bmatrix}\begin{bmatrix} x_1 \\ x_2 \end{bmatrix} = \begin{bmatrix} F_1(t) \\ F_2(t) \end{bmatrix}$$

$$[M]\ddot{x} + [C]\dot{x} + [K]x = F$$

for ~~un~~damped free vibration.

$$[m]\ddot{x} + [C]\dot{x} + [K]x = 0$$

for undamped free vibration characteristic equation,

$$[m]\ddot{x} + [K]x = 0$$

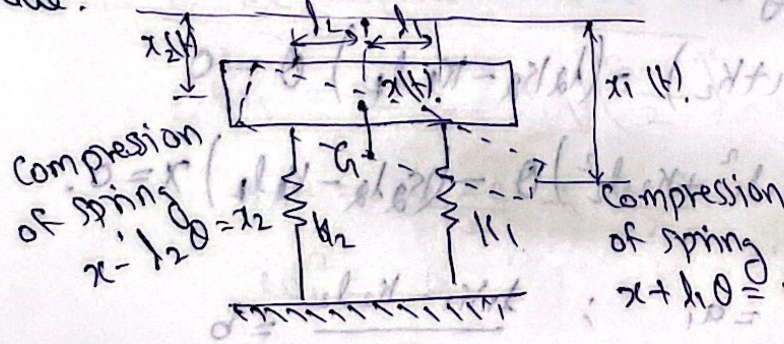
$$[-\omega^2 M + K]A = 0$$

where A is the displacement vector.

$$|K - \omega^2 M| = 0.$$

CO-ORDINATE COUPLING:-

When we suddenly apply brakes on a moving car or automobile, two motion of car body occur simultaneously, one the translatory (x) and the angular (θ). This type of unbalance in the system occurs because centre of gravity (G) of car and centre of rotation do not coincide.



forces.