1.)
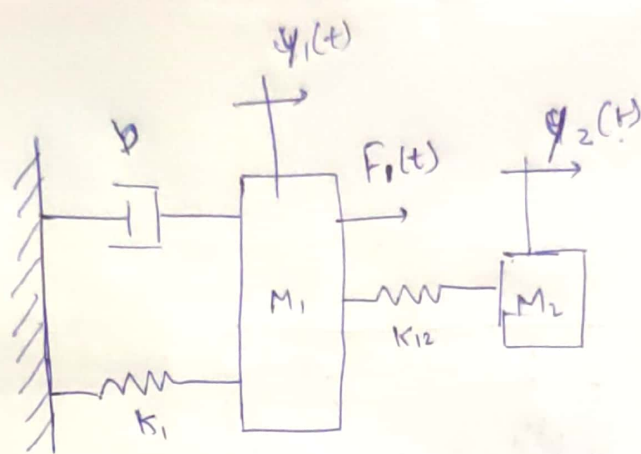

$y_1(t)$

$F_1(t)$

$y_2(t)$

M_1 —ww— M_2

K_{12}

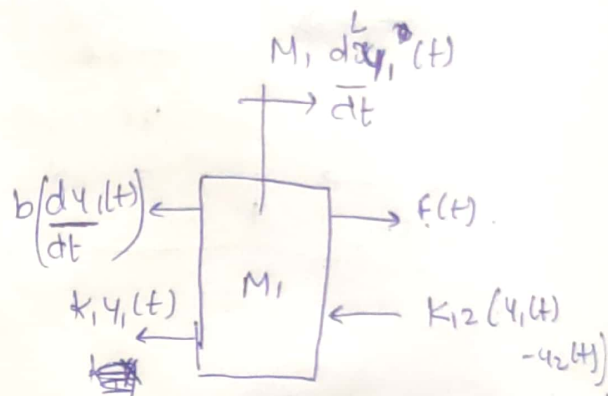b

K_1

$F(t) = 2\sin(10t)$

$M_1 = 100$

$K_1 = 50 \qquad b = 50.$

$M_2 = ? \quad K_{12} = ?$

---

for M_1

$$M_1 d^2 y_1(t) = F(t) - bd\, y_1(t)$$
$$\overline{dt} \qquad\qquad dt$$

$$- K_1 y_1(t).$$

$$- K_1(y_1 - y_2)$$

$M_1 \dfrac{d^L y_1(t)}{dt}$

$b\left(\dfrac{dy_1(t)}{dt}\right)$ ← M_1 → $F(t)$.

$K_1 y_1(t)$ ← ← $K_{12}(y_1(t) - y_2(t))$

for M_2

$$M_2 \frac{d^2 y_2(t)}{dt^2} = K_{12}(y_1 - y_2). \qquad K_{12}(y_1 - y_2) \rightarrow$$

$M_2 \dfrac{d^2 y_2(t)}{dt^2}$

M_2
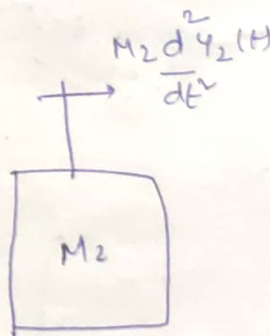
$$\Rightarrow M_2 \frac{d^2 y_2}{dt^2} + K_{12} y_2 = K_{12} y_1$$

From M_1

$$M_1 \frac{d^2 y_1}{dt^2} + \frac{bd y_1}{dt} + K_1 y_1 + K_{12}(y_1 - y_2) = F(t) \quad -①$$

From M_2

$$M_2 \frac{d^2 y_2}{dt^2} + K_{12} y_2 = K_{12} y_1 \quad -②$$

Applying Laplace Transform to –① and –②

$$\left[M_1 s^2 + bs + (k_1 + k_{12})\right] Y_1(s) = F(s) + k_{12} Y_2(s) \quad -③$$

$$(M_2 s^2 + k_{12}) Y_2(s) = k_{12} Y_1(s)$$

$$Y_2(s) = \frac{k_{12}}{M_2 s^2 + k_{12}} Y_1(s) \quad -④$$

Now, $F(t) = 2 \sin 10t$

$$F(s) = \frac{2 \times 10}{s^2 + 10^2}$$

$$\boxed{\begin{array}{c} f(t) = a \sin \omega_0 t \\ F(s) = \frac{a \omega_0}{s^2 + \omega_0^2} \end{array}}$$

for M_1 to not vibrate under steady state

$$y_1(t) = 0 \implies Y_1(s) = 0$$

from eq ④ ; $0 = Y_2(s) \cdot \dfrac{M_2 s^2 + k_{12}}{k_{12}}$

$$\implies M_2 s^2 + k_{12} = 0$$

$$\implies \boxed{k_{12} = -s^2 M_2} \implies k_{12} = -(j\omega_0)^2 M_2$$

$$\boxed{\omega_0 = 10}$$

$$= -(-\omega_0^2) M_2$$

$$= \omega_0^2 M_2$$

$$\therefore k_{12} = 100 M_2 \quad -⑤$$

Substitute eq ⑤ in –①.

$$M_1 \frac{d^2 y_1}{dt^2} + b \frac{d y_1}{dt} + k_1 y_1 + 100 M_2 (y_1 - y_2) = F(t)$$

$$\Rightarrow M_1 \frac{d^2 y_1}{dt^2} + 6 \frac{d y_1}{dt} + k_1 y_1 + M_L \omega_0^2 y_1 = F_{\text{s}} + k_5 \overline{z_0^2}$$
$$F(t) + 100 M_L y_2$$

$$\boxed{\quad} \rightarrow \textcircled{6}$$

Put eq ⑤ in eq ②.

$$M_2 \frac{d^2 y_2}{dt^2} + 100 M_2 y_2 = 100 M y_1 \qquad \boxed{\quad} \rightarrow \textcircled{7}$$

There for M_2 can act as a dynamic vibration absorber in the case when $k_{12} = 100 M_2$ and the equation one shown below.

$$M_1 \frac{d^2 y_1}{dt^2} + 6 \frac{d y_1}{dt} + k_1 y_1 + 100 M y_1 = \text{100 sin} \; 2 \sin 10t + 100 M_2 y_2$$

and.

$$M_2 \frac{d^2 y_2}{dt^2} + 100 M_2 y_2 = 100 M_2 y_1.$$