STRUCTURAL VIBRATION 1 SHEET 5

Q1 (iii) Equation of motion was derived in the lectures.

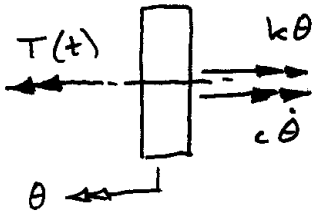
$$I\ddot{\theta} + k\theta = T$$

Put $T = T e^{i\omega t}$ and $\theta = \Theta^* e^{i\omega t}$

$$\therefore \Theta^* = \frac{T}{k - I\omega^2} = 0.0916 \text{ rad}$$

Note that Θ^* is real since there is no damping.

(v)

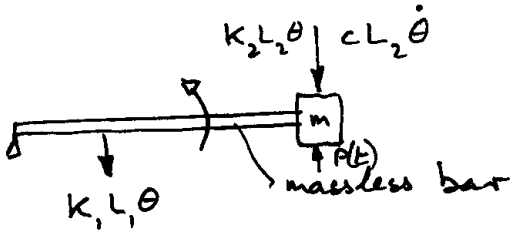


$\curvearrowleft \ddot{\theta}$: $T - k\theta - c\dot{\theta} = I\ddot{\theta}$

or $I\ddot{\theta} + c\dot{\theta} + k\theta = T(t)$

With the same substitutions, $\Theta^* = \dfrac{T}{(k - I\omega^2) + i\omega c}$

Q2



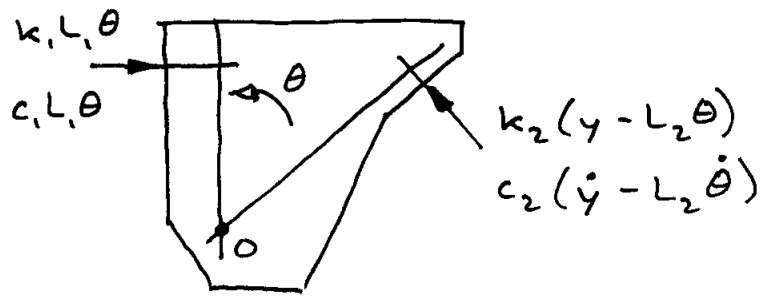
Equation of motion was derived in the lectures

$$mL_2^2\ddot{\theta} + cL_2^2\dot{\theta} + (K_1L_1^2 + K_2L_2^2)\theta = L_2 p(t)$$

Put $p(t) = P e^{i\omega t}$ and $\theta(t) = \Theta^* e^{i\omega t}$

Hence $H(\omega) = \dfrac{\Theta^*}{P} = \dfrac{L_2}{(K_1L_1^2 + K_2L_2^2 - mL_2^2\omega^2) + i\omega cL_2^2}$

Q3.



Equation of motion:

$\ddot{\theta}$ ↷ O

$$[k_2(y - L_2\theta) + c_2(\dot{y} - L_2\dot{\theta})] \cdot L_2 - [k_1 L_1 \theta + c_1 L_1 \dot{\theta}] L_1 = I_o \ddot{\theta}$$

or

$$I_o\ddot{\theta} + (c_1 L_1^2 + c_2 L_2^2)\dot{\theta} + (k_1 L_1^2 + k_2 L_2^2)\theta = k_2 L_2 y(t) + c_2 L_2 \dot{y}(t)$$

Put $y(t) = Y e^{i\omega t}$ and $\theta(t) = \Theta^* e^{i\omega t}$