

2006

Problem 1.1

- (a) 4.19 rad/s
- (b) Even, there should be no sin terms
- (c) 0.67 cm

Problem 1.2: $2ma^2$

Problem 1.3: piecewise($t < 1, 4*t, t < 2, 4, t < 4, 10, t < 8, 0$)

Problem 1.5: In Matlab use: "TF = tfestimate (...)" and then "abs(TF)" give magnitude and "angle(TF)" gives phase.

Problem 2

(a) $(-1.04\omega^2 + 10)(-1.4\omega^2 + 25.36) - 3.2^2 = 0$

(b) $\begin{Bmatrix} 1 \\ 5 \end{Bmatrix}$

(c) $\begin{Bmatrix} 1 \\ -0.2 \end{Bmatrix}$

(d) $x_1(t) = \frac{25}{26} \cos 3t + \frac{1}{26} \cos 5t$

$x_2(t) = \frac{25}{26} (-0.2) \cos 3t + \frac{5}{26} \cos 5t$

Problem 3

(a)
$$\begin{bmatrix} m_1 & 0 \\ 0 & m_2 \end{bmatrix} \begin{Bmatrix} \ddot{x}_1 \\ \ddot{x}_2 \end{Bmatrix} + \begin{bmatrix} 0 & 0 \\ 0 & c_1 \end{bmatrix} \begin{Bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{Bmatrix} + \begin{bmatrix} k_1 + k_3 & -k_1 - k_3 \\ -k_1 - k_3 & k_1 + k_2 + k_3 \end{bmatrix} \begin{Bmatrix} x_1 \\ x_2 \end{Bmatrix} = \begin{Bmatrix} 0 \\ F \cos \omega t \cos \theta \end{Bmatrix}$$

(b) $x_1 = 4 \left(\frac{5 + k_3}{\det} \right), \quad x_2 = 4 \left(\frac{-\omega^2 m_1 + 5 + k_3}{\det} \right)$ (you should be able to determine the determinant)

(c) $k_3 = 75, m_1 = 80/\omega^2$