

In RW 5.16 part c,d

$$\begin{bmatrix} \dot{p}_c \\ \dot{q}_I \end{bmatrix} = \begin{bmatrix} 0 & -1/c \\ 1/I & -R/I \end{bmatrix} \begin{bmatrix} p_c \\ q_I \end{bmatrix} + \begin{bmatrix} 1/c \\ 0 \end{bmatrix} [q_s] \quad \begin{array}{l} I = 0.2 \\ C = 0.5 \\ R = 1.4 \end{array}$$

$$[q_I] = \begin{bmatrix} 0 & 1 \end{bmatrix} \begin{bmatrix} p_c \\ q_I \end{bmatrix} + [0][q_s]$$

$$A = \begin{bmatrix} 0 & -2 \\ 5 & -7 \end{bmatrix} \quad B = \begin{bmatrix} 2 \\ 0 \end{bmatrix}$$

$$H(s) = C(sI - A)^{-1}B + D$$

$$= [0 \ 1] \left( \begin{bmatrix} s & 0 \\ 0 & s \end{bmatrix} - \begin{bmatrix} 0 & -2 \\ 5 & -7 \end{bmatrix} \right)^{-1} \begin{bmatrix} 2 \\ 0 \end{bmatrix} + [0]$$

$$= [0 \ 1] \begin{bmatrix} s & 2 \\ -5 & s+7 \end{bmatrix}^{-1} \begin{bmatrix} 2 \\ 0 \end{bmatrix}$$

$$= \frac{1}{s^2 + 7s + 10} [0 \ 1] \begin{bmatrix} s+7 & -2 \\ 5 & s \end{bmatrix} \begin{bmatrix} 2 \\ 0 \end{bmatrix}$$

$$= \frac{1}{s^2 + 7s + 10} [0 \ 1] \begin{bmatrix} s+7 \\ 5 \end{bmatrix} = \frac{5}{s^2 + 7s + 10}$$

$$p_i = -2, -5$$

$$(s+2)(s+5) = 0$$

$$\ddot{q}_I + 7\dot{q}_I + 10q_I = 5q_s$$

$$\lambda^2 + 7\lambda + 10 = 0 \quad \lambda = -2, -5$$

eig(A)

$$\det(\lambda I - A) = 0$$

$$\det \left( \begin{bmatrix} \lambda & 0 \\ 0 & \lambda \end{bmatrix} - \begin{bmatrix} 0 & -2 \\ 5 & -7 \end{bmatrix} \right) = 0$$

$$\begin{vmatrix} \lambda & 2 \\ -5 & \lambda+7 \end{vmatrix} = 0$$

$$\lambda(\lambda+7) + 10 = 0$$

$$\lambda^2 + 7\lambda + 10 = 0$$

$$\lambda = -2, -5$$