file: 610_F02_probs2 RWN 09/25/02

ENEE 610 Fall 2002
Problems to consider #2

1. For the Laplace transform function

$$F(s) = \frac{2}{s+1} + \frac{3}{s-3} - \frac{5}{s+5}$$

   a) Plot in the s plane the poles and zeros.
   b) Give all the possible regions of convergence.
   c) For each region give the time function f(t) for $F(s) = \int_{-\infty}^{+\infty} e^{-st} f(t)dt$.

2. a) Give the possible regions of convergence for the high pass function

$$F(s) = \frac{-3s^2}{s^2 + 2s + 7}$$

Repeat for G(s)=F(-s) and for H(s)=F(1/s). In all three cases plot the poles and zeros.

b) Assuming F(s) is a transfer function find all possible impulse responses for F(s), G(s), and H(s).

c) For y=F(s)u write this as a differential equation and set it up in PSpice and run it (discuss how you choose initial conditions).

3. For the following semistate equations find the (matrix) transfer function.

$$\begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 0 \end{bmatrix} \frac{dx}{dt} = \begin{bmatrix} 0 & 0 & 1 \\ -1 & 0 & 0 \\ 0 & 0 & -2 \end{bmatrix} x + \begin{bmatrix} 1 & 0 \\ 0 & 0 \\ 0 & 1 \end{bmatrix} u$$

$$y = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix} x$$

4. Repeat 3 for

$$\begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ 0 & 0 & 0 \end{bmatrix} \frac{dx}{dt} = \begin{bmatrix} -1 & 0 & 0 \\ 0 & -1 & 0 \\ 0 & 0 & -1 \end{bmatrix} x + \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix} u$$

$$y = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix} x$$

Discuss the meaning of degree of this system and that of 3. above.

5. The n-vector of voltages $v_{in}(s)$ is applied to the series connection of two n-ports of impedance matrices R and Z(s), respectively. Give an expression for the n-vector of current, i(s), which flows as well as the voltage $v_z(s)$ across the n-port of Z(s). Assuming the input $u=[v_z(s)+Ri(s)]$ and the output $y=[v_z(s)-Ri(s)]$ find the (nxn matrix) transfer function {this is one version of scattering matrix; $u=2v_{incident}$, $y=2v_{reflected}$}.