1. Given the state space system:

A = [2 0 0; 0 -1 0; 0 0 -1];

B = [1 0; 1 0; 0 1];

C = [1 0 2; 0 -1 0];

D = [1 0; 1 0];

1. What are the poles of the system? What is the multiplicity of each pole?
2. What are the invariant zeros of the system (finite and infinite)?
3. What are the transmission zeros of the system (finite and infinite)?
4. Given the state space system:

A = [-1 0 0; 0 -2 0; 0 0 -2];

B = [2 -2; -2 4; -4 2];

C = [1 1 0; 1 0 1];

D = [0 0; 0 0];

1. Use the transmission zero to find an input u(t) and initial conditions x(0) that will result in y(t)=0 for all time. Note: the Matlab commands null and tzero may be useful.
2. Verify your results using Matlab by calculating the output for your given input and initial conditions.

3. Consider a variation of the LQR problem:

for , for the LTI system:

1. Find an equivalent solution to the LQR problem as was derived in Lecture 20, including defining a new feedback invariant, gain matrix (K), and Algebraic Riccati Equation (ARE). Note: the following change of variables may be useful:
2. What is the minimum possible value for this new objective function?
3. How does adding the exponential effect the LQR result? Note you may deduce this several ways, such as from the change it has in the equations just derived or from comparing LQR output results with and without the exponential component.
4. Show that: .