

# ECE311S: Dynamic Systems and Control

## Problem Set 4

### Problem 1

Compute  $e^{At}$  using the Laplace transform method and the eigenvalue/eigenvector method for the following matrix:

$$A = \begin{bmatrix} -2 & -2 & 0 \\ 0 & 0 & 1 \\ 0 & -3 & -4 \end{bmatrix}.$$

### Problem 2

Determine the best method to compute  $e^{At}$  for the following  $A$  matrix and then compute it:

$$A = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ 0 & 0 & 0 \end{bmatrix}.$$

### Problem 3

You are given the SISO system

$$\frac{Y(s)}{G(s)} = \frac{(s-1)}{(s^2+2s-3)}.$$

Show that it is possible for this system to generate an unbounded initial state response and a bounded input response.

### Problem 4

Consider the closed loop system in Figure 1, where  $K$  and  $z$  are real numbers which you'll have to pick in part 2 of this problem.

1. Using standard formulas for overshoot and settling time, sketch the region in the complex plane where the poles of the closed-loop system should lie in order for the following specifications to be met:

$$\text{Settling time } T_s \leq 0.8 \text{ sec}, \quad \text{Percent overshoot } \%OS \leq 1\% = 0.01.$$

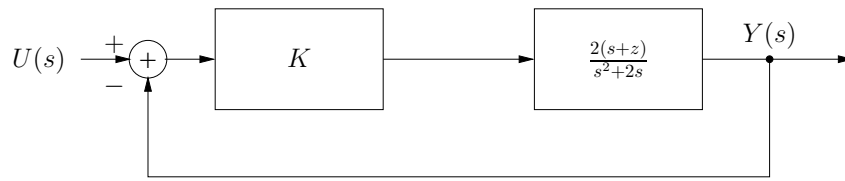


Figure 1: System block diagram

2. Choose  $K$  and  $z$  so that the poles of the closed-loop system lie in the region you found in part 1.