EECE 5610: Homework #3

Due on October 11, 2022 at 11:45 am
Homework should be submitted via Canvas before the beginning of the class. Late submission is not accepted.

Professor Milad Siami

Problem 1

Problem 2.7-1

(a) Find $e(0)$, $e(1)$, and $e(10)$ for

$$E(z) = \frac{0.1}{z(z-0.9)}$$

using the inversion formula.

(b) Check the value of $e(0)$ using the initial-value property.

(c) Check the values calculated in part (a) using partial fractions.

(d) Find $e(k)$ for $k = 0, 1, 2, 3, 4$ if $\mathcal{Z}[e(k)]$ is given by

$$E(z) = \frac{1.98z}{(z^2 - 0.9z + 0.9)(z - 0.8)(z^2 - 1.2z + 0.27)}$$

(e) A continuous time function $e(t)$, when sampled at a rate of 10 Hz ($T = 0.1s$), has the following z-transform $E(z) = \frac{2z}{z-0.8}$. Find function $e(t)$.

(f) Repeat part (e) for $E(z) = \frac{2z}{z+0.8}$.

(g) From parts (e) and (f), what is the effect on the inverse z-transform of changing the sign on a real pole?

Problem 2

Problem 2.10-2

Consider the system described by

$$x(k+1) = \begin{bmatrix} 0 & 1 \\ 0 & 3 \end{bmatrix} x(k) + \begin{bmatrix} 1 \\ 1 \end{bmatrix} u(k),$$

$$y(k) = \begin{bmatrix} -2 & 1 \end{bmatrix} x(k).$$

(a) Find the transfer function $Y(z)/U(z)$.
(b) Using any similarity transformation, find a different state model for this system.
(c) Find the transfer function of the system from the transformed state equations.

Problem 3

Problem 2.6-6

Given the MATLAB program

```
clear all;
s1 = 0;
e = 0;    %input signal e(0)
for k = 0:10
s2 = e - s1;
m = 0.5*s2 - s1;  % output signal m(k)
s1 = s2;
[k,m,s1]
e = e + 1;    %input signal e(k)
end
```

that solves the difference equation of a digital controller.

(a) Find the transfer function of the controller from input $e(.)$ to output $m(.)$.
(b) Find the z-transform of the controller input $\{e(k)\}_{k=0}^{\infty}$.
(c) Use the results of parts (a) and (b) to find the inverse z-transform of the controller output.
(d) Run the program to check the results of part (c). Please attach your MATLAB code/result (from the command window) to your report.

Problem 4

Problem 3.7-7 of the textbook (page 113).