CPE 391, spring 2012

**Homework #1 Solution**

1. Calculate the dynamic system response () of following system. is the unit step function.

Initial condition is

**Solution:**

,

As , u is the unit step input, that means

Then we have

1. Calculate the eigenvalues and eigenvectors of the following system.

**Solution:**

The characteristic equation of matrix ***A*** is

That means:

Solve it (you can also solve this equation with MATLAB), we have , , .

()

When , solve the equation

🡺

Let , then

Eigenvector

When , solve the equation

🡺 ,

Let , ,

Eigenvector

When , solve the equation

🡺 ,

Let , ,

Eigenvector

(1) Determine the value of for which the system is stable;

**Solution:**

Calculate the eigenvalues of the system matrix via characteristic equation:

Check the roots of this equation.

As

This equation always have two real roots: ,

In order to make the system stable, all eigenvalues of the system matrix should be have negative real part. That means .

As a result, , 🡺

🡺

So when , the system is stable.

(2) Check the observability and controllability of following system.

 ,,

**Solution:**

This system is controllable;

So this system is observable.

1. Find the minimal state vector representation of the following system. The transfer function is:

Solution:

Expand by partial fraction expansion:

Matching coefficients,

Then we have

Make , we have

Make , we have ,

Make , we have

Therefore,

Assume **,**

Check the controllability and observability of this system:

* This system is observable and controllable.