

**Report** **of Qualification Exam**

**Linear Control System**

Professor: Kyoung Kwan Ahn

Student ID: 20175312

Name: Pham Thanh Tuan

1. Answer the following questions:

(1) Plot the Bode Diagram of

(2) What is gain crossover frequency, phase crossover frequency and bandwidth of the above plant?

**Solution:**

* 1. Plot the Bode Diagram of
* Plot the Bode Diagram of (plot by Matlab)



**Bode Magnitude Plot**

* The magnitude frequency response is given by
* The asymptotes are given by

If , , and , .

* When
* The peak location is given by

**Bode Phase Plot**

* When .
* Plot of Bode phase follow as

(2) What is gain crossover frequency, phase crossover frequency and bandwidth of the above plant?

* Solve for gain crossover frequency:
* Solve for phase crossover frequency:

Im{ No phase crossover frequency .

* Solve for bandwidth frequency:

2. Answer the following questions

The system is given as follows:

(1) Calculate the system pole location and damping ratio.

(2) Calculate the maximum overshoot using the result of (1)

()

(3) Determine the gain of the state feedback controller to satisfy that the pole of system with state feedback controller becomes -5+5i and -5-5i. ()

(4) Calculate the maximum overshoot when you use state feedback controller.

(5) Determine the gain of the state observer to satisfy that the pole of state observerb becomes -20 and -30.

(6) Draw the block diagram including plant, state feedback controller and state observer.

**Solution:**

The system is given as follows:

We have:

2.1 Calculate the system pole location and damping ratio.

* Calculate the system pole location:

We have:

* Calculate the damping ratio: .

2.2 Calculate the maximum overshoot using the result of (1)

2.3 Determine the gain of the state feedback controller to satisfy that the pole of system with state feedback controller becomes -5+5i and -5-5i. ()

* The gain of the state feedback controller:

We have the state feedback controller as follow:

Using the pole of system:

2.4 Calculate the maximum overshoot when you use state feedback controller.

* The damping ratio: .
* Calculate the maximum overshoot using the result of (1)

2.5 Determine the gain of the state observer to satisfy that the pole of state observerb becomes -20 and -30.

* The gain of the state observer:

We have the plant system:

(1)

And the state observer is given as follow:

(2)

Let , Using (1) - (2), we obtain:

Using the pole of state observer: and

(6) Draw the block diagram including plant, state feedback controller and state observer.

* The block diagram

