

Control Systems

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Abstract—This manual is an introduction to control systems based on GATE problems. Links to sample Python codes are available in the text.

Download python codes using

svn co <https://github.com/gadepall/school/trunk/control/codes>

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1 SIGNAL FLOW GRAPH

1.1 Mason's Gain Formula

1.2 Matrix Formula

1.3 Example

2 BODE PLOT

2.1 Introduction

2.2 Example

2.3 Phase

3 SECOND ORDER SYSTEM

3.1 Damping

3.2 Peak Overshoot

3.3 Example

3.4 Settling Time

4 ROUTH HURWITZ CRITERION

4.1 Routh Array

4.2 Marginal Stability

4.3 Stability

4.4 Example

4.5 Example

5 STATE-SPACE MODEL

5.1 Controllability and Observability

5.2 Second Order System

5.3 Example

5.4 Example

5.5 Example

5.6 Example

5.7 Example

6 NYQUIST PLOT

6.1 Introduction

6.2 Example

6.3 Example

6.1. Using Nyquist Criterion, find out whether this system is stable or not.

$$G(s) = \frac{50}{s(s+3)(s+6)} \quad (6.1.1)$$

$$H(s) = 1. \quad (6.1.2)$$

6.2. **Solution:**

Nyquist Stability:

$$N = Z - P \quad (6.2.1)$$

Closed Loop Transfer Function:

$$T(s) = \frac{50}{s^3 + 9s^2 + 18s + 50} \quad (6.2.2)$$

$$Z = 0, P = 0 \quad (6.2.3)$$

$$N = 0 \quad (6.2.4)$$

Thus, system is stable, which can be verified from Nyquist Plot in Fig 6.2

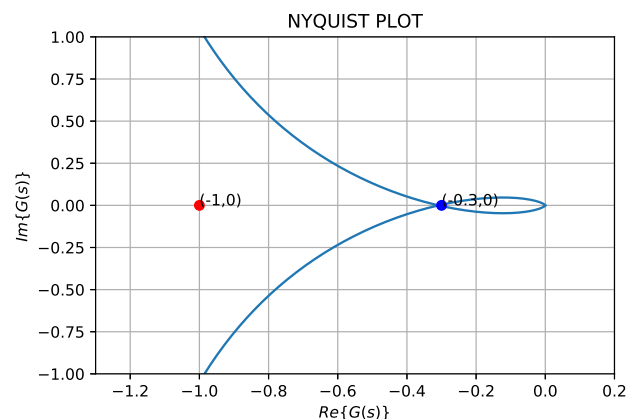


Fig. 6.2

The following code generates Fig 6.2

```
codes/ee18btech11050_1.py
```

7 COMPENSATORS

7.1 *Phase Lead*

7.2 *Lag Lead*

7.3 *Example*

8 GAIN MARGIN

8.1 *Introduction*

8.2 *Example*

8.3 *Example*

9 PHASE MARGIN

9.1 *Intoduction*

9.2 *Example*

10 OSCILLATOR

10.1 *Introduction*

10.2 *Example*

11 ROOT LOCUS

11.1 *Introduction*

11.2 *Example*

11.3 *Example*

12 POLAR PLOT

12.1 *Introduction*