

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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1.1 Mason's Gain Formula

1.2 Matrix Formula

1.3 Example

2 BODE PLOT

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2.2 Example

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3.1 Damping

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5 STATE-SPACE MODEL

5.1 Controllability and Observability

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5.3 Example

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6 NYQUIST PLOT

6.1 Introduction

6.2 Example

7 COMPENSATORS

7.1 Phase Lead

7.2 Lag Lead

7.3 Example

▣ lead Compensator network includes a parallel combination of R and C in feed-forward path. If the transfer function of compensator is

$$G_c(s) = \frac{s+2}{s+4} \quad (7.0.1)$$

, the value of RC is ?

And also find the value of RC for a lead compensator used in previous example.

$$G_c(s) = \frac{3(s + \frac{1}{3})}{s + 1} \quad (7.0.2)$$

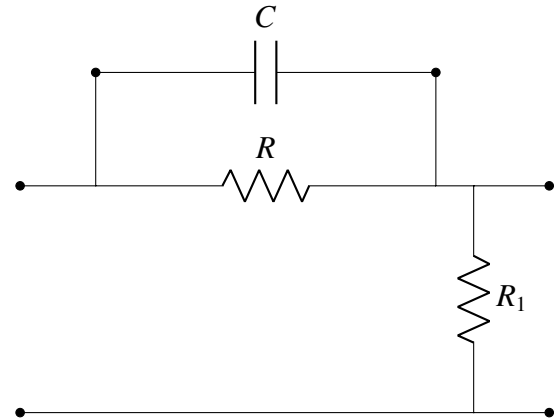


Fig. 7.0

Solution:

The transfer function for the following circuit is

$$T(s) = \frac{V_o}{V_i} \quad (7.0.3)$$

Let

$$\alpha = \frac{R_2}{R_1 + R_2} \quad (7.0.4)$$

and

$$\tau = R_1 C \quad (7.0.5)$$

Now our T(s) is

$$T(s) = \frac{R_2}{\frac{\frac{1}{sC}R_1}{\frac{1}{sC} + R_1} + R_2} \quad (7.0.6)$$

Simplifying T(s)

$$T(s) = \frac{s + \frac{1}{\tau}}{s + \frac{1}{\tau\alpha}} \quad (7.0.7)$$

Comparing with the given

$$G_c(s) = \frac{s+2}{s+4} \quad (7.0.8)$$

$$\tau = R_1 C = 0.5$$

for

$$T(s) = \frac{3(s + \frac{1}{3})}{s + 1} \quad (7.0.9)$$

here this is a lead compensator with a gain of 3. so we can simply write passive circuit part as.

$$T(s) = \frac{(s + \frac{1}{3})}{s + 1} \quad (7.0.10)$$

again by comparing with

$$T(s) = \frac{s + \frac{1}{\tau}}{s + \frac{1}{\tau\alpha}} \quad (7.0.11)$$

$$\tau = 3 \quad (7.0.12)$$

$$RC = 3 \quad (7.0.13)$$

8 GAIN MARGIN

8.1 Introduction

8.2 Example

8.3 Example

9 PHASE MARGIN

9.1 Introduction

9.2 Example

10 OSCILLATOR

10.1 Introduction

10.2 Example

11 ROOT LOCUS

11.1 Introduction