

Control Systems

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$$\Rightarrow C(s) = \frac{100}{(s)(s^2 + 10s + 100)} \quad (3.3.1.5)$$

$C(s)$ can be expanded as:

$$C(s) = \frac{1}{s} - \frac{s+5}{(s+5)^2 + 75} - \frac{1}{\sqrt{3}} \cdot \frac{\sqrt{75}}{(s+5)^2 + 75} \quad (3.3.1.6)$$

In time domain,

$$c(t) = \mathcal{L}^{-1}C(s) \quad (3.3.1.7)$$

$$\Rightarrow c(t) = 1 - e^{-5t} \cos(\sqrt{75}t) - \frac{e^{-5t}}{\sqrt{3}} \sin(\sqrt{75}t) \quad (3.3.1.8)$$

From (3.3.1.8):

$$\lim_{t \rightarrow \infty} c(t) = 1 \quad (3.3.1.9)$$

At t_p , $c(t)$ is maximum:

$$\Rightarrow \frac{dc(t)}{dt} = 0 \quad (3.3.1.10)$$

Applying this condition on (3.3.1.8), we get:

$$t_p = \frac{\pi}{\sqrt{75}} \quad (3.3.1.11)$$

Substitute t_p in (3.3.1.8) to get $c(t_p)$:

$$c(t_p) = 1 + e^{-\frac{\pi}{\sqrt{3}}} \Rightarrow c(t_p) = 1.163 \quad (3.3.1.12)$$

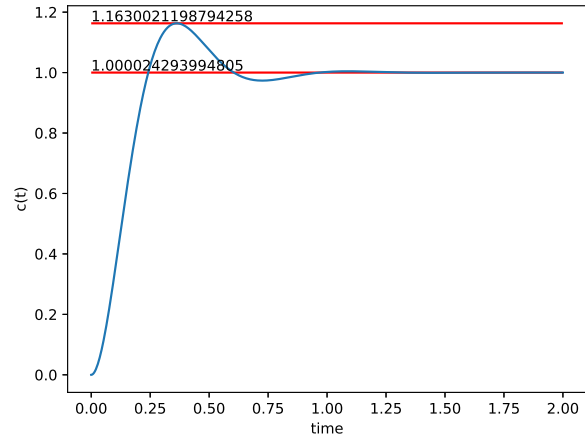
Substitute $c(t_p)$ and $c(\infty)$ in (3.3.1.2) to get peak overshoot:

$$M_p = 1.163 - 1 = 0.163 \quad (3.3.1.13)$$

3.3.2. Verify using a Python Plot

Solution:

codes/ee18btech11045.py



4 ROUTH HURWITZ CRITERION

4.1 Routh Array

4.2 Marginal Stability

4.3 Stability

4.4 Example

5 STATE-SPACE MODEL

5.1 Controllability and Observability

5.2 Second Order System

5.3 Example

5.4 Example

5.5 Example

6 NYQUIST PLOT

7 COMPENSATORS

7.1 Phase Lead

7.2 Example

8 GAIN MARGIN

8.1 Introduction

8.2 Example

9 PHASE MARGIN

10 OSCILLATOR

10.1 Introduction

10.2 Example