

Control Systems

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9	Phase Margin	2	Solution: Computing the Routh array for the given characteristic equation, we get-		

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$$\begin{vmatrix} s^3 & 1 & K+2 & 0 \\ s^2 & K & 3 & 0 \\ s & \frac{K^2+2K-3}{K} & 0 & 0 \\ s^0 & 3 & 0 & 0 \end{vmatrix} \quad (4.3.2)$$

According to the Routh-Hurwitz stability criterion, for the system to be stable there should be no sign changes in the first column of the Routh array. That means-

$$K > 0 \text{ and } \frac{K^2 + 2K - 3}{K} > 0 \quad (4.3.3)$$

$$\Rightarrow K > 0 \text{ and } (K - 1)(K + 3) > 0 \quad (4.3.4)$$

which gives us

$$K > 0 \text{ and } (K > 1 \text{ or } K < -3). \quad (4.3.5)$$

Note that K cannot be negative.

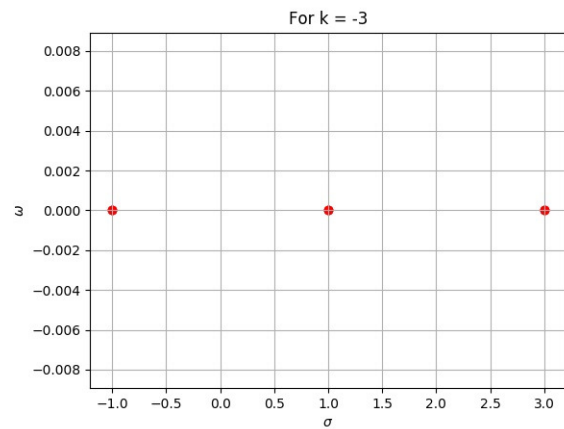
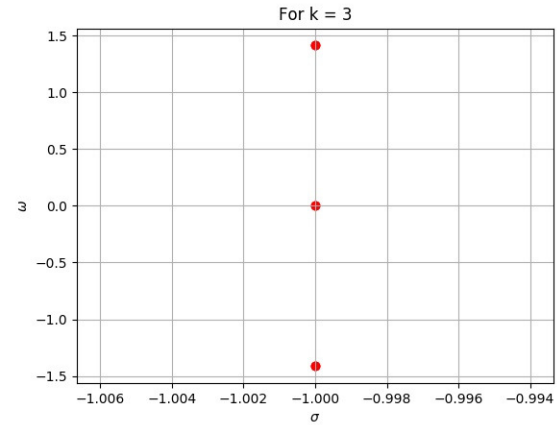
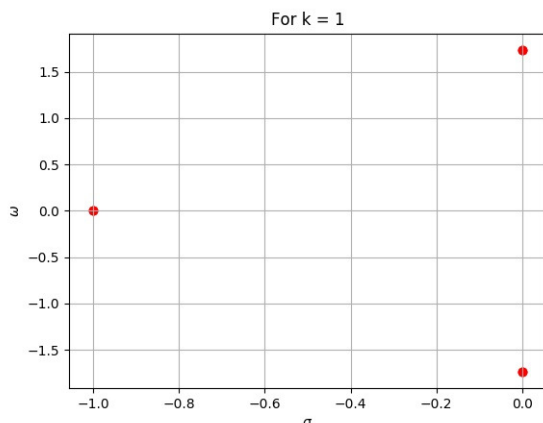
$$\Rightarrow K > 1 \quad (4.3.6)$$

The program to compute the routh-array and stability for different values of K.

codes/ee18btech11039/routh_array.py

The program for plotting the poles of the system for different values of K.

codes/ee18btech11039/pole_plot.py



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 Example

8 GAIN MARGIN

8.1 Introduction

8.2 Example

9 PHASE MARGIN

10 OSCILLATOR

10.1 Introduction

10.2 Example