

## Question 1

Consider the above closed loop system in Figure 1.

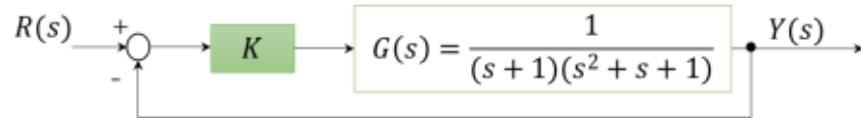
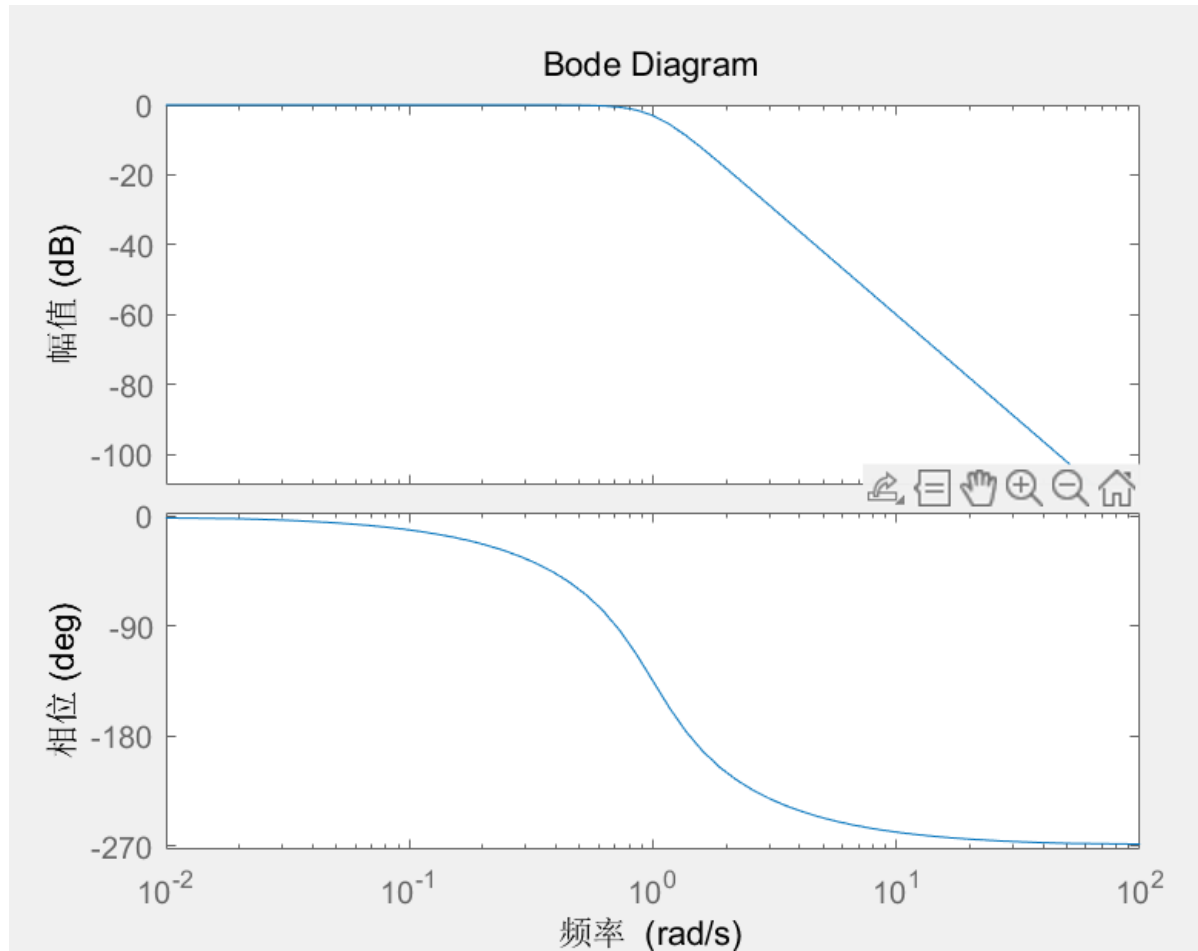


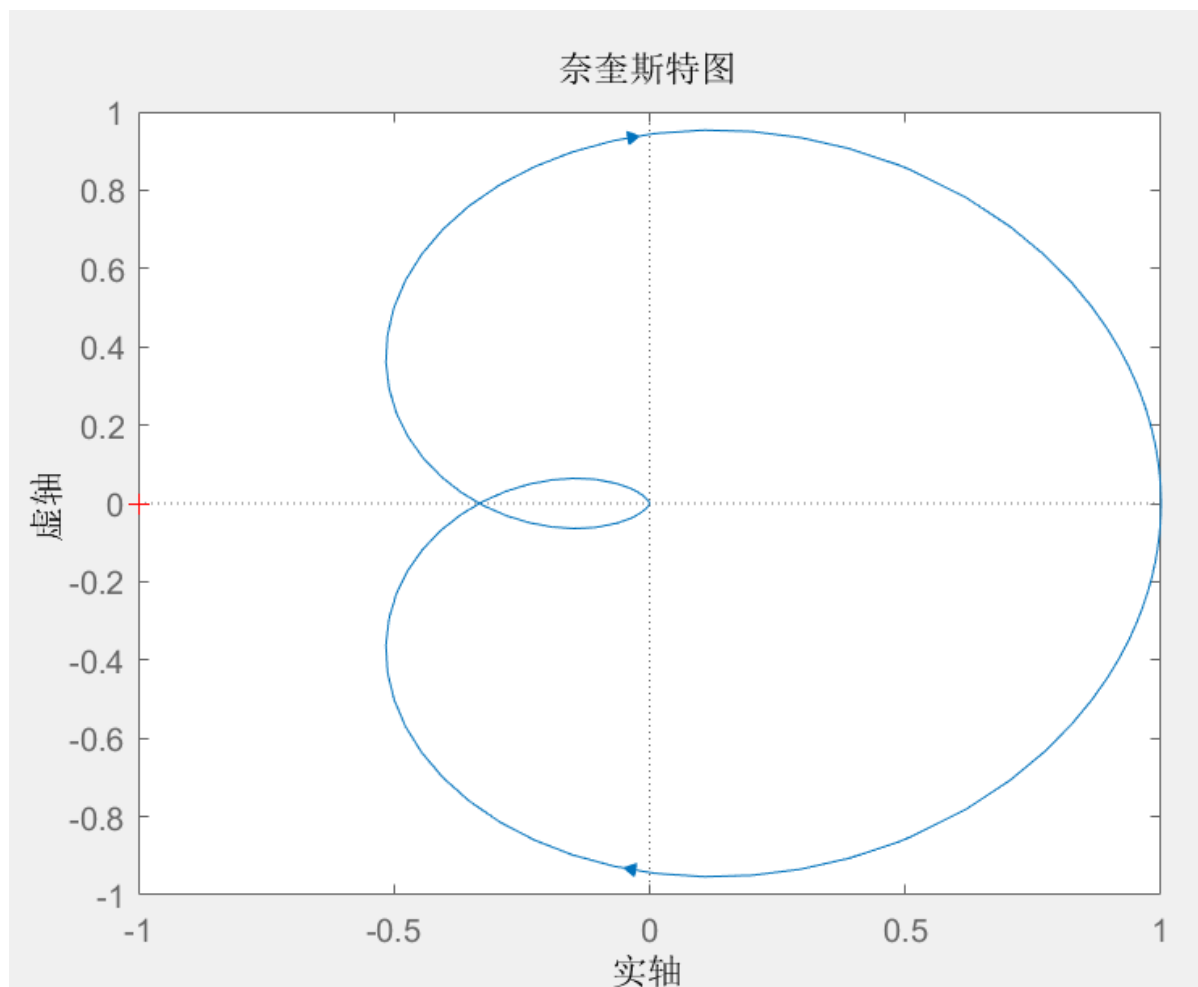
Figure 1

- a) Sketch the Bode plot of the transfer function  $G(s)$ . (4 Points)
- b) Sketch the Nyquist plot based on (a). (4 Points)
- c) Using Nyquist stability criterion to determine all values of the feedback gain  $K$  that stabilizes the closed-loop system. (6 Points)

(a)



(b)



(c)

$$-1 < K < 3$$

### Question 2

Consider the closed loop system in Figure 2.

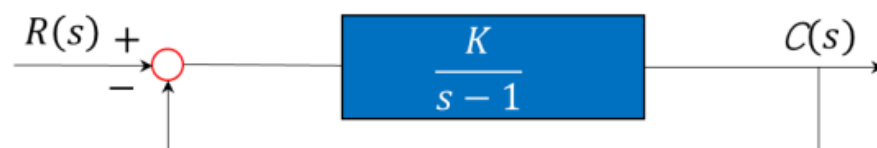


Figure 2.

Determine the critical value of  $K$  for stability using the Nyquist stability criterion.

(6 Points)

$$\frac{K}{s-1} = \frac{\frac{K}{s-1}}{1 + \frac{K}{s-1}} \Rightarrow \frac{K}{K + (s-1)} \Rightarrow \text{pole of CL} = \frac{1-K}{1}$$

$\Rightarrow -1 < K < 3$

open loop = num of pole = 1

$\Rightarrow$  num CL pole = 1  $\Rightarrow 1-K > 0 \Rightarrow K < 1$   $K_{\text{critical}} = 1$