ELEC 372

Supplementary Problem Set #4

Not to be handed in

These problems form the foundation of Quiz #4

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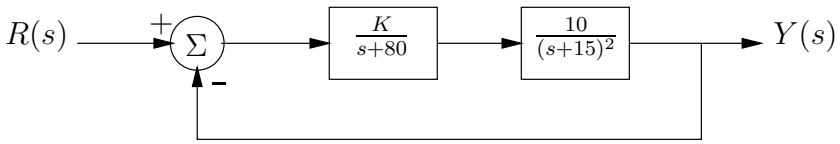
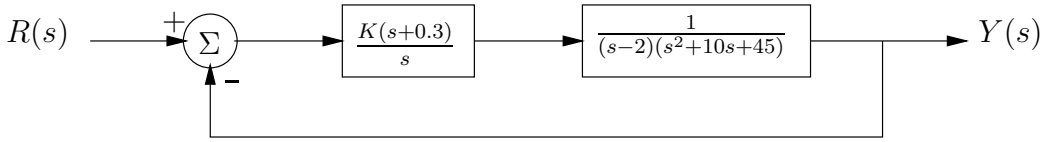
1. A system has the following block diagram representation



   where K is always positive. Find the limiting gain for a stable system.

2. Consider the lateral position control system for a landing on aircraft carrier.



   Find the range of K for stability of the closed-loop system.

3. A mechanical system has the open-loop transfer function given by:

$$G(s) = \frac{K}{s(s+30)}$$

   Using the root locus method, determine the value of gain K so that the closed-loop system has a damping ratio of $\zeta = \sqrt{2}/2$.

4. Consider a unity feedback control system with open-loop transfer function

$$G(s) = K\frac{s-1}{(s+1)(s^2+4s+5)}$$

   Find the following information about the system root locus ($K \geq 0$).

   (a) The angle of asymptotes.

(b) Asymptote centroid.

(c) The angle of departure from all poles.

5. Consider a unity feedback control system with open-loop transfer function

$$G(s) = K\frac{s-1}{(s+1)(s+2)(s+3)}$$

Find the following information about the system root locus ($K \geq 0$).

(a) The angle of asymptotes.

(b) Asymptote centroid.

(c) Breakaway points on the real axis, if any.

6. Consider a unity feedback control system with transfer function

$$G(s) = K\frac{s^2+2s+2}{s(s^2+4)}$$

Which one of the plots in the attached figure is the system root locus for $K \geq 0$?

7. Consider a unity feedback control system with open-loop transfer function

$$G(s) = K\frac{s+1}{s(s+2)(s^2+4s+5)}$$

Find the value of gain $K \geq 0$ for which the root locus crosses the imaginary axis.