

Assignment for Chapter 5: Root Locus

5-1 Given the open-loop transfer function $G(s) = \frac{K_r(s+1)}{s^2(s+a)}$ for a unity feedback system, please sketch the root locus for $K_r = 0 \rightarrow +\infty$ with different $a = 5, a = 9, a = 10$.

Please determine the breakaway (or break-in) points on the real axis, the angles of asymptotes, and the real-axis intercept of the asymptotes.

5-2 Sketch the root locus of the closed-loop system with the following open-loop transfer function.

$$(1) \quad G(s) = \frac{K_r}{s(s+2)(s^2+2s+2)}$$

$$(2) \quad G(s) = \frac{K_r}{(s+1)(s+2)(s+3)}$$

$$(4) \quad G(s) = \frac{K_r(s+3)(s+4)}{s(s+1)(s+2)(s+5)(s+6)}$$

$$(5) \quad G(s) = \frac{K(0.5s+1)}{s^2(0.25s+1)(0.1s+1)}$$

5-3 Sketch the root-locus of the closed-loop system with the following open-loop transfer function

$$G(s)H(s) = \frac{K_r(s+1)(s+3)}{s^3}$$

What is the range of K_r to ensure the stability of the closed-loop system? Calculate the steady-state error e_{ss} of the system with unit ramp input.