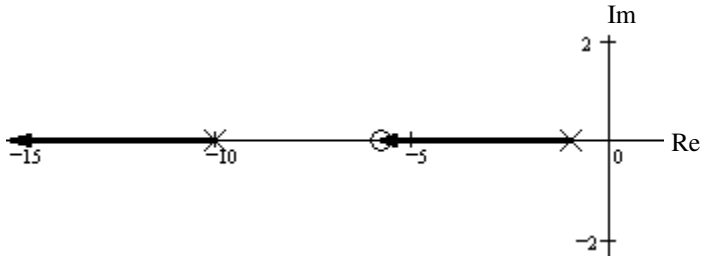
ECE 3510 Basic Root Locus Examples

Sketch (by hand) the root-locus plots for the following open-loop transfer functions:
For these hand sketches, just use the rules on the first page of the notes
Mention the rules used and show work.

1. $\mathbf{G}(s) = \dfrac{s+6}{(s+1)\cdot(s+10)}$

By real-axis rule alone:

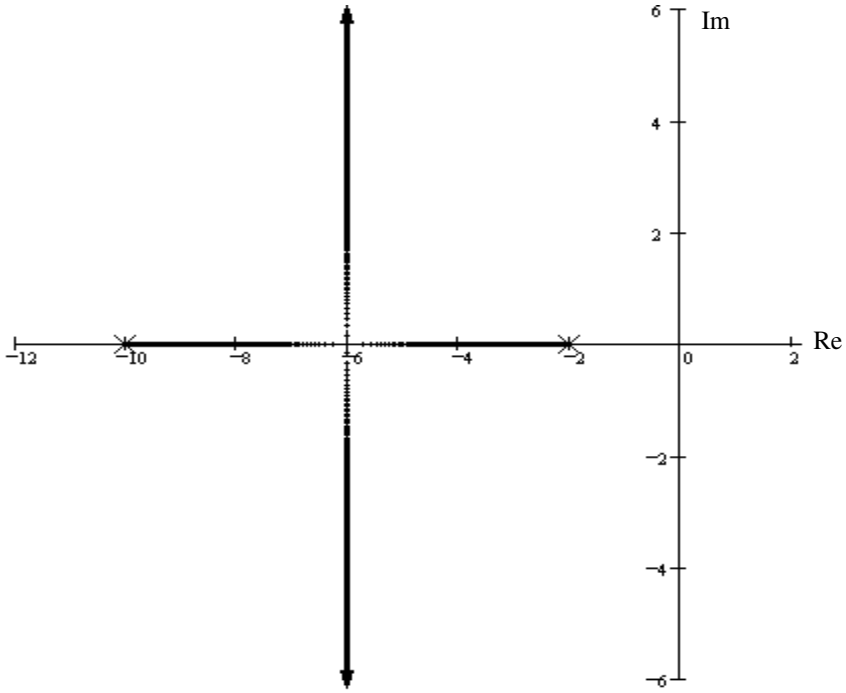


2. $\mathbf{G}(s) = \dfrac{20}{(s+2)\cdot(s+10)}$ $m := 0$ $n := 2$

$n - m = 2$

asymptotes:

centroid: $\sigma_C = \dfrac{-2 + -10}{2} = -6$



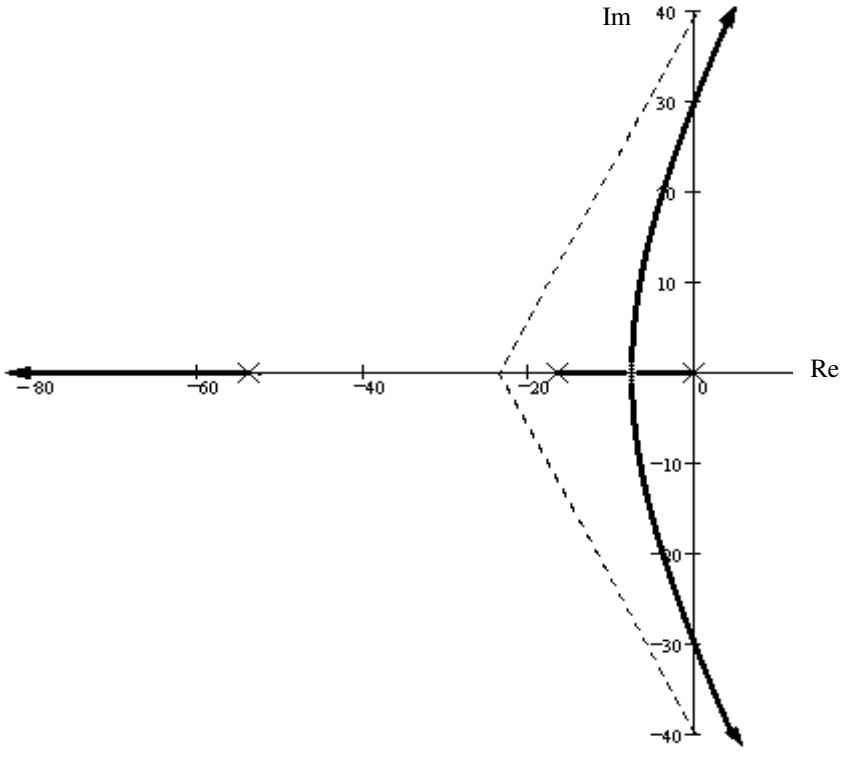
3. $\mathbf{G}(s) = \dfrac{1}{s\cdot(s+16.64)\cdot(s+53.78)}$ $m := 0$ $n := 3$

$n - m = 3$

asymptotes:

centroid:

$\sigma_C = \dfrac{0 + -16.64 + -53.78}{3} = -23.473$



Basic Root Locus Examples p2

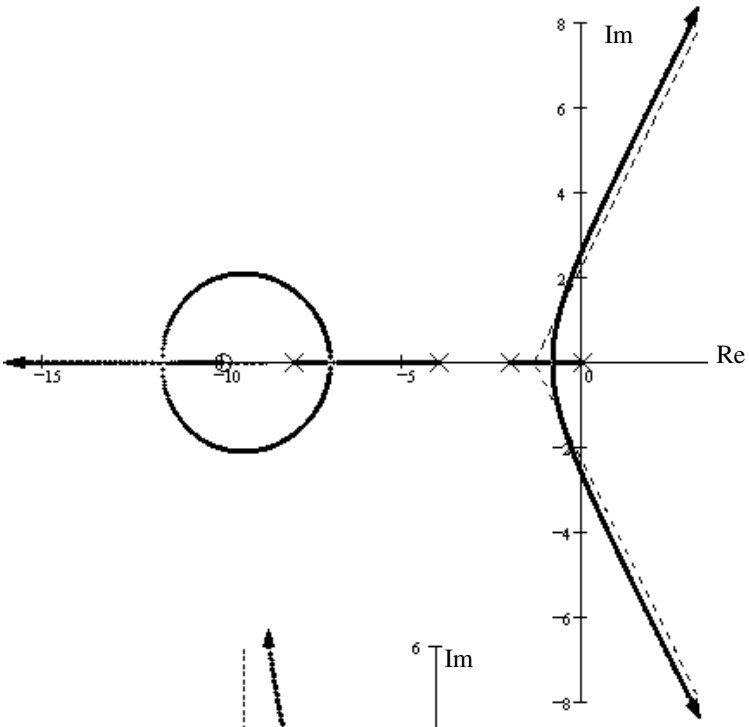
4. $\mathbf{G}(s) = \dfrac{4\cdot s + 40}{s\cdot(s+2)\cdot(s+8)\cdot(s+4)}$

$= \dfrac{4\cdot(s+10)}{s\cdot(s+2)\cdot(s+8)\cdot(s+4)}$ $\quad m := 1$ $\quad n := 4$ $\quad n - m = 3$

asymptotes: 

centroid:

$\sigma_C = \dfrac{0 + -2 + -8 + -4 - -10}{3} = -1.333$



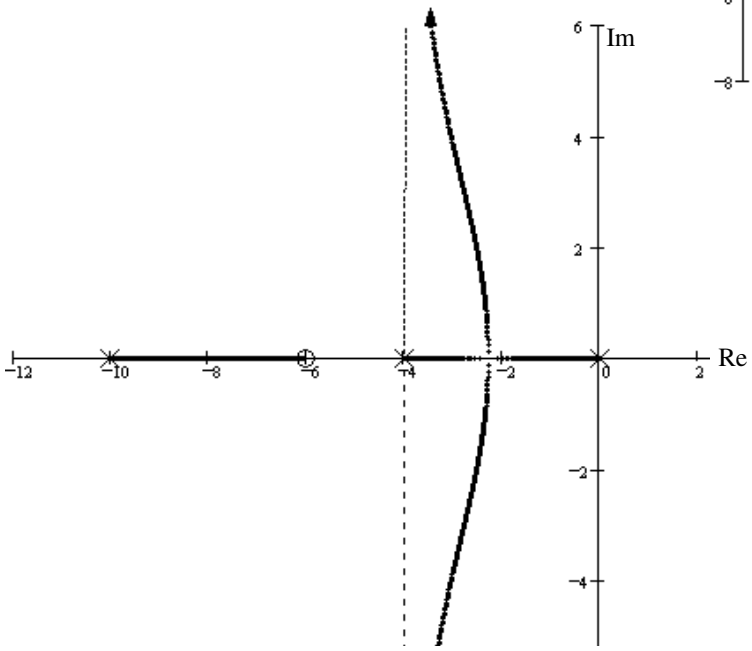
5. $\mathbf{G}(s) = \dfrac{3\cdot s + 18}{s\cdot(s+4)\cdot(s+10)}$

$= \dfrac{3\cdot(s+6)}{s\cdot(s+4)\cdot(s+10)}$ $\quad m := 1$ $\quad n := 3$ $\quad n - m = 2$

asymptotes:

centroid:

$\sigma_C = \dfrac{0 + -4 + -10 - -6}{2} = -4$

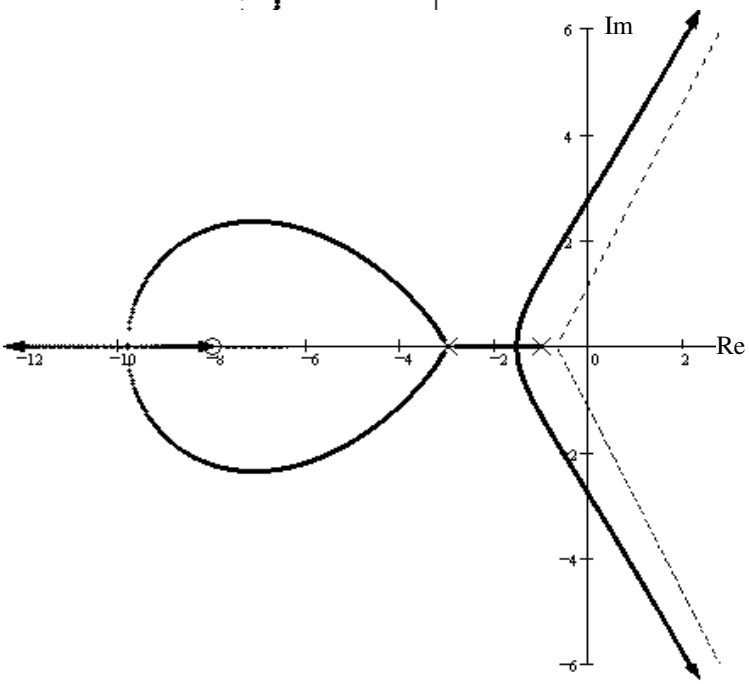


6 $\mathbf{G}(s) = \dfrac{s+8}{(s+1)\cdot(s+3)^3}$ $\quad m := 1$ $\quad n := 4$ $\quad n - m = 3$

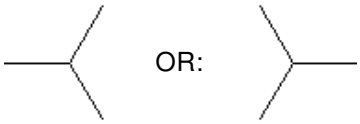
asymptotes: 

centroid:

$\sigma_C = \dfrac{-1 + -3 + -3 + -3 - -8}{3} = -0.667$



Angle of departure from triple poles:



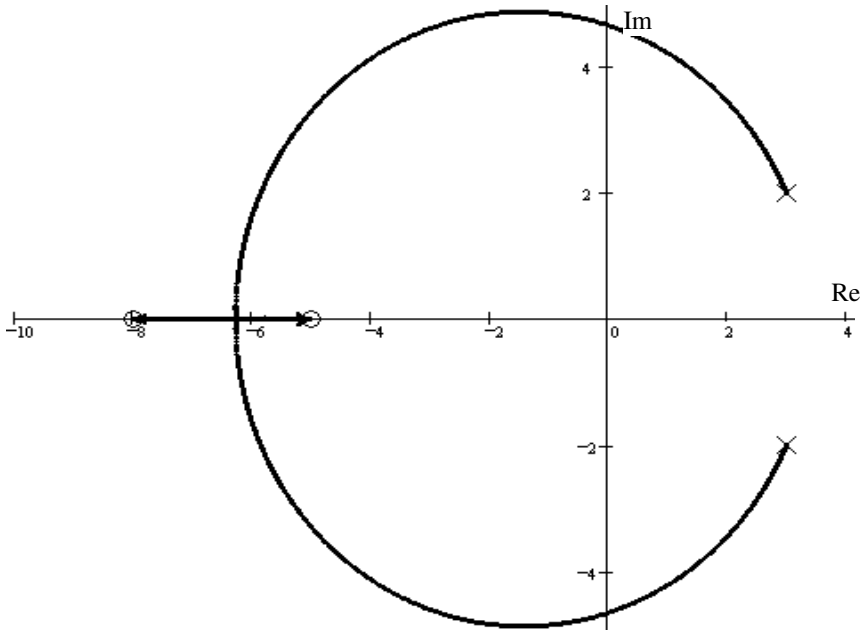
Basic Root Locus Examples p2

Basic Root Locus Examples p3

7. $\mathbf{G}(s) = \dfrac{(s+5)\cdot(s+8)}{s^2 - 6\cdot s + 13}$ $\quad m := 2$ $\quad n := 2$

$n - m = 0$

no asymptotes:



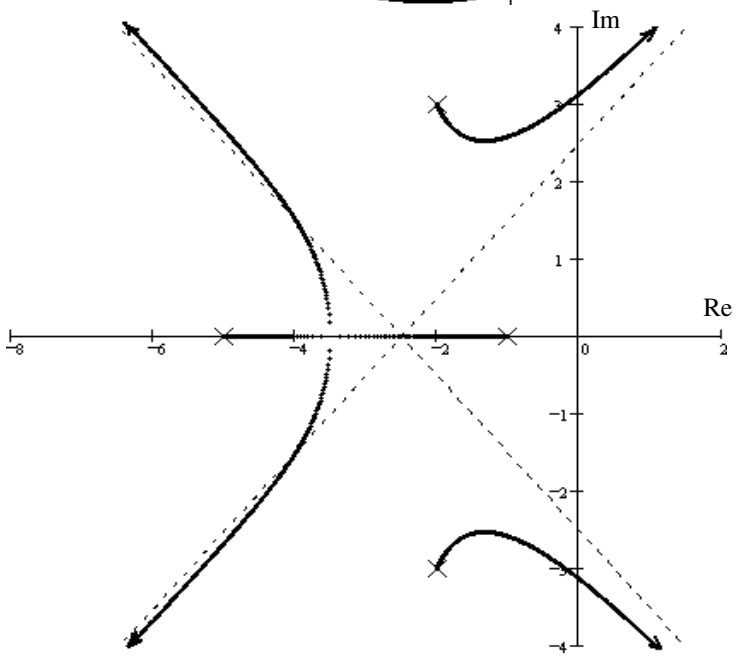
8. $\mathbf{G}(s) = \dfrac{1}{\left(s^2 + 4\cdot s + 13\right)\cdot(s+1)\cdot(s+5)}$ $\quad m := 0$ $\quad n := 4$

$n - m = 4$

asymptotes:

centroid:

$\sigma_C = \dfrac{-2 + -2 + -1 + -5}{4} = -2.5$



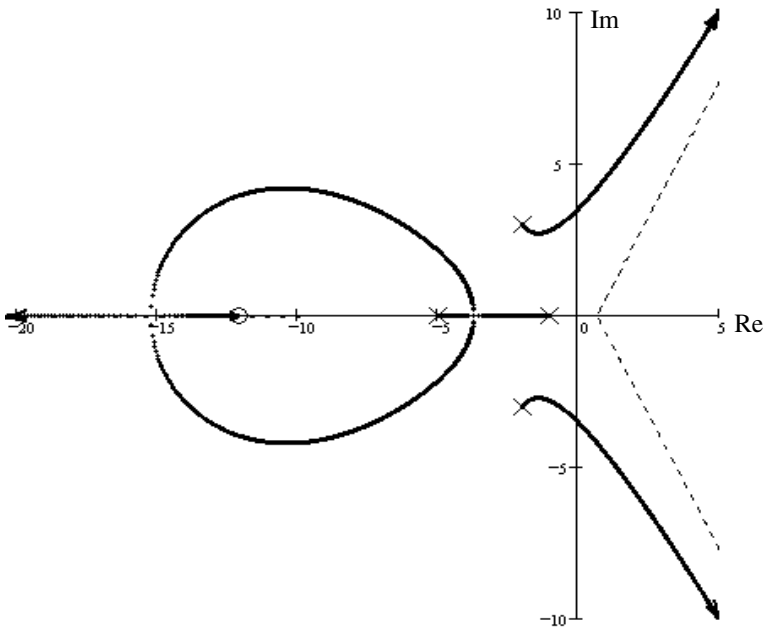
9 $\mathbf{G}(s) = \dfrac{s+12}{\left(s^2 + 4\cdot s + 13\right)\cdot(s+1)\cdot(s+5)}$ $\quad m := 1$ $\quad n := 4$

$n - m = 3$

asymptotes:

centroid:

$\sigma_C = \dfrac{-2 + -2 + -1 + -5 - -12}{3} = 0.667$



Basic Root Locus Examples p3

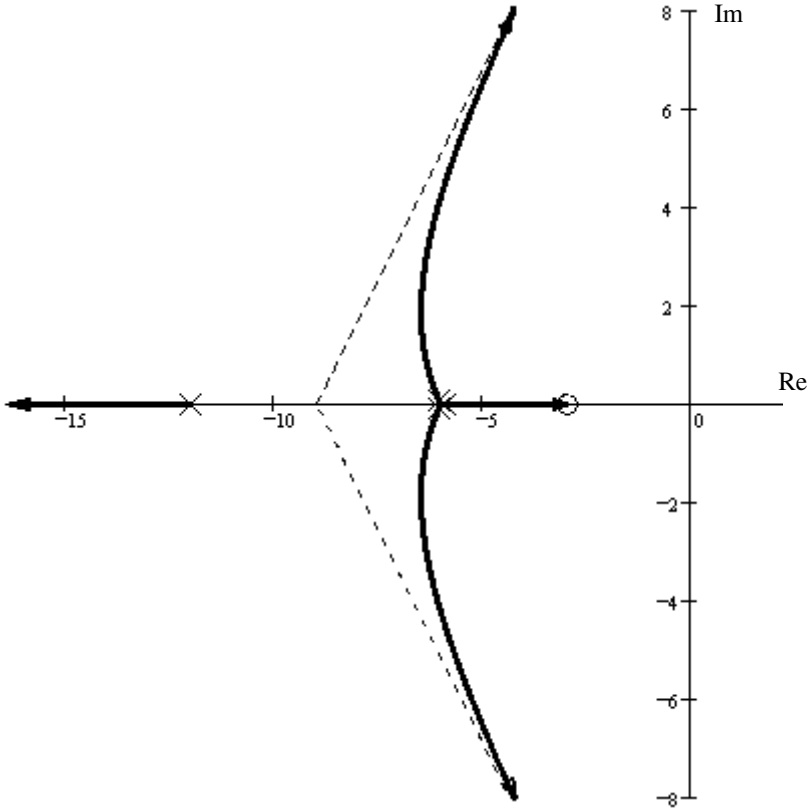
Basic Root Locus Examples p4

10 $\mathbf{G}(s) = \dfrac{s+3}{(s+6)^3 \cdot (s+12)}$ $m := 1$ $n := 4$ $n - m = 3$

asymptotes: 

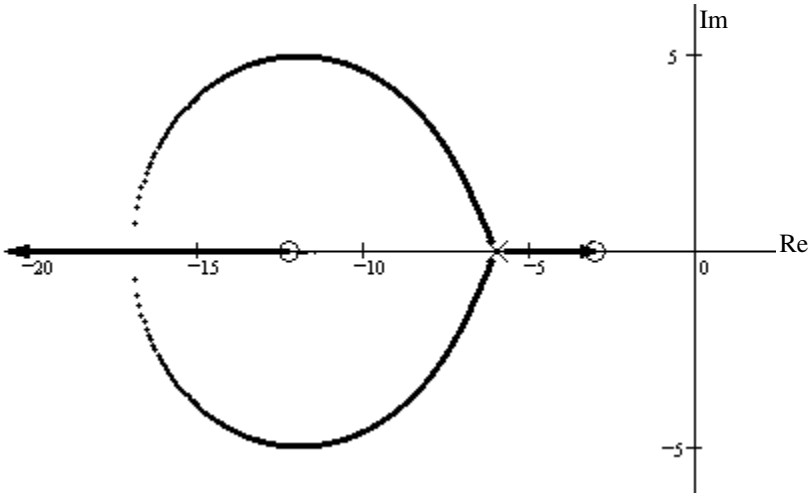
centroid:

$\sigma_C = \dfrac{(3 \cdot (-6) + -12) - -3}{3} = -9$



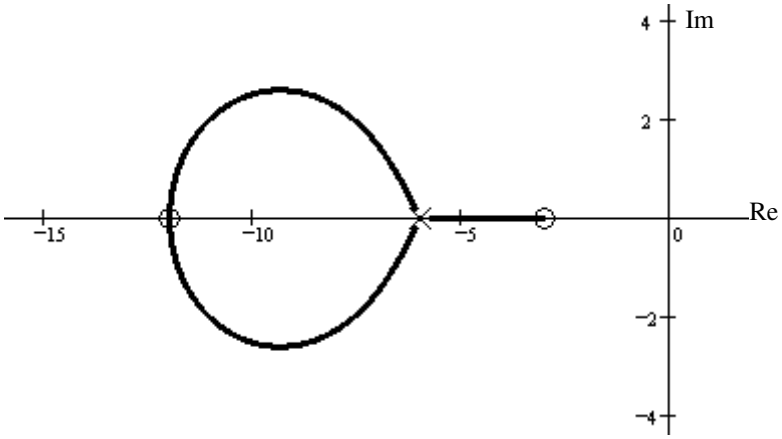
11 $\mathbf{G}(s) = \dfrac{(s+3)\cdot(s+12)}{(s+6)^3}$ $m := 2$ $n := 3$ $n - m = 1$

no asymptotes



12 $\mathbf{G}(s) = \dfrac{(s+3)\cdot(s+12)^2}{(s+6)^3}$ $m := 3$ $n := 3$ $n - m = 0$

no asymptotes



Basic Root Locus Examples p4