ECE 3510 Homework #11 Root Locus Plots by Hand

c

Name _____

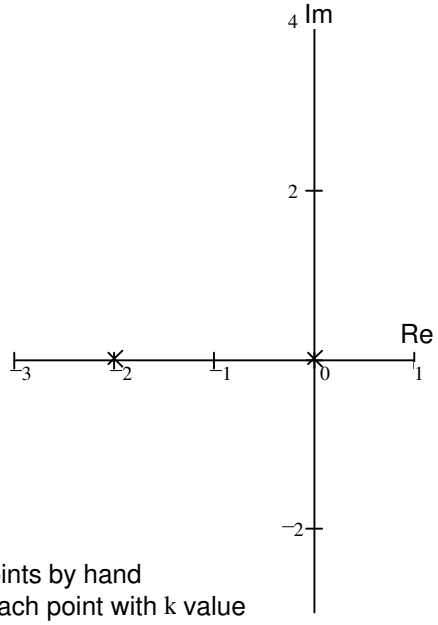
Example 1 from p. 70 of Bodson text

$$G(s) = \frac{1}{s\cdot(s+2)} \qquad p_1 := 0 \qquad p_2 := -2 \qquad H(s) = \frac{k\cdot\frac{1}{s\cdot(s+2)}}{1+k\cdot\frac{1}{s\cdot(s+2)}}\cdot\frac{s\cdot(s+2)}{s\cdot(s+2)}$$

denominator: $s\cdot(s+2)+k = s^2+2\cdot s+k = 0$

$$s_1(k) := \frac{-2-\sqrt{2^2-4\cdot k}}{2} \qquad s_2(k) := \frac{-2+\sqrt{2^2-4\cdot k}}{2}$$

$k := 0$	$s_1(k) =$ _____	$s_2(k) =$ _____
$k := 0.1$	$s_1(k) = -1.949$	$s_2(k) = -0.051$
$k := 0.2$	$s_1(k) =$ _____	$s_2(k) =$ _____
$k := 0.5$	$s_1(k) = -1.707$	$s_2(k) = -0.293$
$k := 0.8$	$s_1(k) = -1.447$	$s_2(k) = -0.553$
$k := 1$	$s_1(k) = -1$	$s_2(k) = -1$
$k := 2$	$s_1(k) = -1 - j$	$s_2(k) = -1 + j$
$k := 5$	$s_1(k) = -1 - 2j$	$s_2(k) = -1 + 2j$
$k := 10$	$s_1(k) =$ _____	$s_2(k) =$ _____
$k := 100$	$s_1(k) = -1 - 9.95j$	$s_2(k) = -1 + 9.95j$



Plot points by hand
label each point with k value

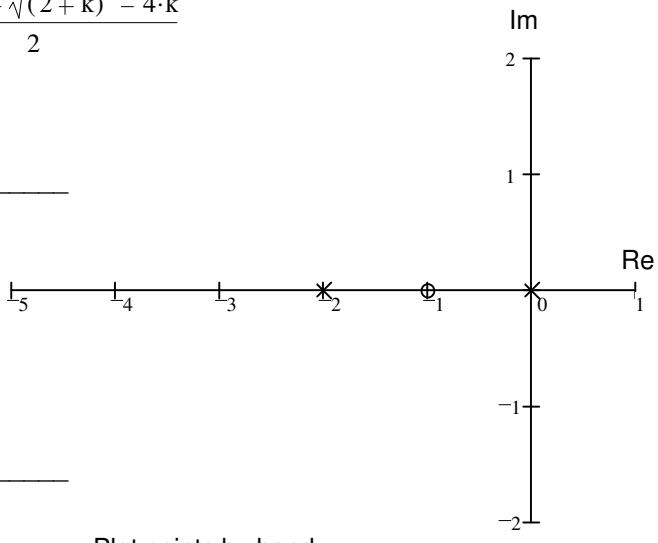
Example 2 from p. 70 of text

$$G(s) = \frac{s+1}{s\cdot(s+2)} \qquad z_1 := -1 \qquad p_1 := 0 \qquad p_2 := -2 \qquad H(s) = \frac{k\cdot\frac{s+1}{s\cdot(s+2)}}{1+k\cdot\frac{s+1}{s\cdot(s+2)}}\cdot\frac{s\cdot(s+2)}{s\cdot(s+2)}$$

denominator: = _____ = 0

$$s_1(k) := \frac{-(2+k)-\sqrt{(2+k)^2-4\cdot k}}{2} \qquad s_2(k) := \frac{-(2+k)+\sqrt{(2+k)^2-4\cdot k}}{2}$$

$k := 0$	$s_1(k) = -2$	$s_2(k) = 0$
$k := 0.1$	$s_1(k) = -2.051$	$s_2(k) = -0.049$
$k := 0.2$	$s_1(k) =$ _____	$s_2(k) =$ _____
$k := 0.5$	$s_1(k) = -2.281$	$s_2(k) = -0.219$
$k := 0.8$	$s_1(k) = -2.477$	$s_2(k) = -0.323$
$k := 1$	$s_1(k) = -2.618$	$s_2(k) = -0.382$
$k := 2$	$s_1(k) = -3.414$	$s_2(k) = -0.586$
$k := 5$	$s_1(k) = -6.193$	$s_2(k) = -0.807$
$k := 10$	$s_1(k) =$ _____	$s_2(k) =$ _____
$k := 100$	$s_1(k) = -101.01$	$s_2(k) = -0.99$



Plot points by hand

Example 3 from p71 of text

$$G(s) = \frac{s+2}{s\cdot(s+1)} \qquad z_1 := -2 \qquad p_1 := 0 \qquad p_2 := -1$$

$$H(s) = \frac{k\cdot(s+2)}{s\cdot(s+1)+k\cdot(s+2)}$$

denominator: $s\cdot(s+1)+k\cdot(s+2) = 0$

$s^2+s+k\cdot s+2\cdot k = 0$

$s^2+(1+k)\cdot s+2\cdot k = 0$

$s_1(k) =$ _____ $s_2(k) =$ _____

$k := 0$	$s_1(k) =$ _____	$s_2(k) =$ _____
$k := 0.1$	$s_1(k) = -0.87$	$s_2(k) = -0.23$
$k := 0.17157$	$s_1(k) = -0.588$	$s_2(k) = -0.584$
$k := 0.172$	$s_1(k) = -0.586 - 0.025j$	$s_2(k) = -0.586 + 0.025j$
$k := 0.2$	$s_1(k) = -0.6 - 0.2j$	$s_2(k) = -0.6 + 0.2j$
$k := 0.5$	$s_1(k) = -0.75 - 0.661j$	$s_2(k) = -0.75 + 0.661j$
$k := 0.8$	$s_1(k) = -0.9 - 0.889j$	$s_2(k) = -0.9 + 0.889j$
$k := 1$	$s_1(k) =$ _____	$s_2(k) =$ _____
$k := 3$	$s_1(k) = -2 - 1.414j$	$s_2(k) = -2 + 1.414j$
$k := 5$	$s_1(k) = -3 - j$	$s_2(k) = -3 + j$
$k := 5.827$	$s_1(k) = -3.414 - 0.045j$	$s_2(k) = -3.414 + 0.045j$
$k := 7$	$s_1(k) = -5.414$	$s_2(k) = -2.586$
$k := 10$	$s_1(k) = -8.702$	$s_2(k) = -2.298$
$k := 100$	$s_1(k) = -98.979$	$s_2(k) = -2.021$

Plot points by hand below