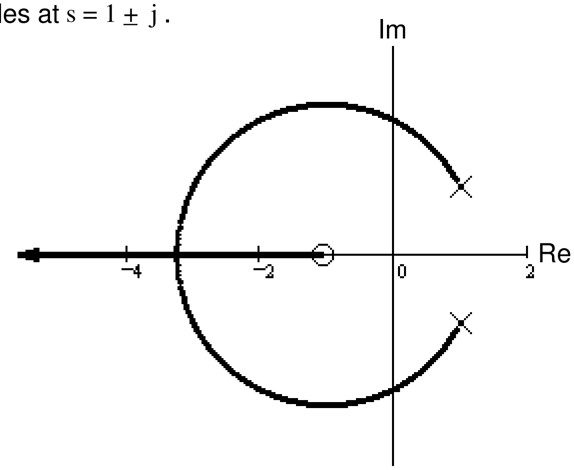
ECE 3510 homework RL4

A.Stolp a

1. A root - locus is sketched at right.
   The open - loop transfer function has one zero at s = -1 and two poles at $s = 1 \pm j$.

$$G(s) = \frac{s+1}{s^2 - 2\cdot s + 2} = \frac{s+1}{(s-1-j)\cdot(s-1+j)}$$



   a) Find the departure angle from the complex pole 1 + j .

   b) It looks like the root-locus crosses the jω axis at 2

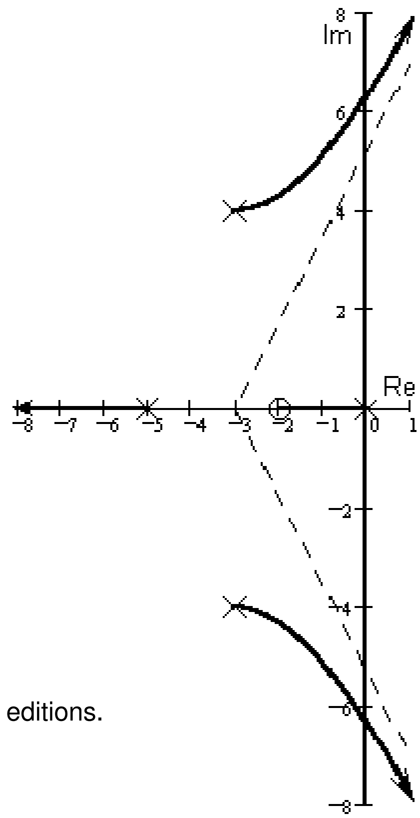
   Determine if this is true.
   Clearly show your work, guesses don't count.

   c Regardless of what you found in part b), continue to assume that the root-locus crosses the jω axis at 2. Give the range of gain k for which the system is closed-loop stable.

2. A root - locus is sketched at right.

$$G(s) = \frac{3\cdot(s+2)}{s\cdot(s+5)\cdot\left(s^2+6\cdot s+25\right)}$$

   Find the departure angle from the complex pole -3 + 4j .



3. Problem 4.13 in the Bodson text.

4. a) Nise, Ch.8, problem 4. Note: the answers are different for the 3rd & 4th editions.
   b) Also find the point where the root locus crosses the imaginary axis.
   c) Find the range of gain for which the system is "stable".
   d) Find the arrival angle at the top zero (departure of top pole in 4th Ed.).

Answers

1. a) $117\cdot\text{deg}$
   b) YES
   c) $k > 2$

2. $3.73\cdot\text{deg}$

3. $206.6\cdot\text{deg}$
   $45\cdot\text{deg}$

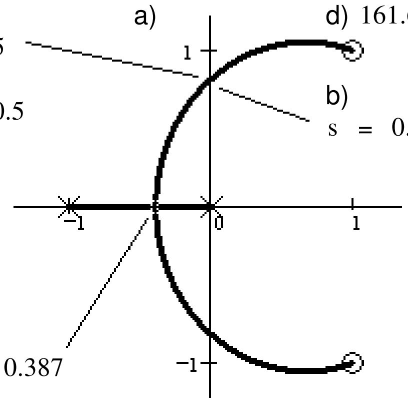
4. 3rd Ed.

   a) $k := 0.5$

   d) $161.6\cdot\text{deg}$

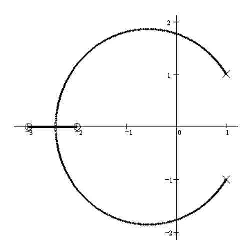
   b) $s = 0.817\cdot j$

   c) $k < 0.5$



   a) -0.387

4. 4th Ed.
   breakaway: -2.434
   crossing: $s := 1.773\cdot j$ $k = 0.4$
   $k > 0.4$



   d) $122.5\cdot\text{deg}$