ECE 3510 homework # 13

A.Stolp
2/28/06

1. Problem 4.5 (p.96) in the text. Note correction for part c

   a) Sketch (by hand) the root-locus plot for the following open-loop transfer function: $G(s) = \dfrac{s\cdot(s+1)}{(s+2)^2\cdot(s+3)}$

   Apply only the main rules (Section 4.4.2 in text or the first page of my notes)

   b) Repeat part a) for: $G(s) = \dfrac{(s+3)}{s\cdot(s+9)^3}$

   c) Repeat part a) for: $G(s) = \dfrac{(s+a)}{(s+b)\cdot\left(s^2-2\cdot s+2\right)}$ $\quad a>0 \quad b>0 \quad k>0$

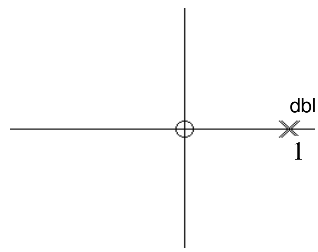
   Also give condition(s) that a and b must satisfy for the closed-loop system to be stable for sufficiently high gain (k) (note that you do not need to apply the Routh-Hurwitz criterion, nor provide the range of k for which the system is closed-loop stable).

2. Problem 4.11 (p.97) in the text. (Hint: do part c before b)

   a) Sketch the root-locus for the open-loop poles shown at right. There is one zero at $s = 0$ and two poles at $s = 1$.

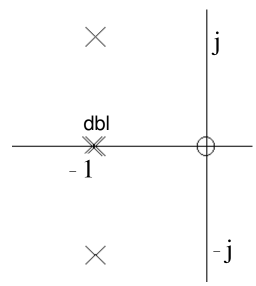
   c) Give the locations of the break-away points on the real axis.

   b) Give the range of gain k ($k > 0$) for which the system is closed-loop stable, and give the locations of the $j\omega$ axis crossings.



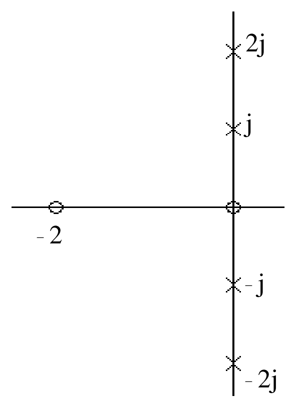
3. Problem 4.12 (p.97) in the text.
   Sketch the root-locus for the open-loop poles shown at right, using only the main rules. There is a zero at $s = 0$, two poles at $s = -1$ and two poles at $s = -1 \pm j$.

3.



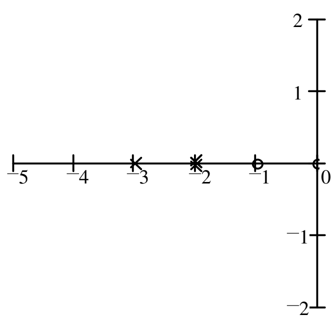
4. Problem 4.13 (p.98) in the text.

   Sketch the root-locus for the following problem. Do not calculate the range of gain for stability, the $j\omega$ axis crossings, or the break-away points from the real axis. However, give the angles of departure from the complex poles. There is a zero at $s = 0$ and a zero at $s = -2$. There are poles at $s = \pm j$ and $s = \pm 2j$.

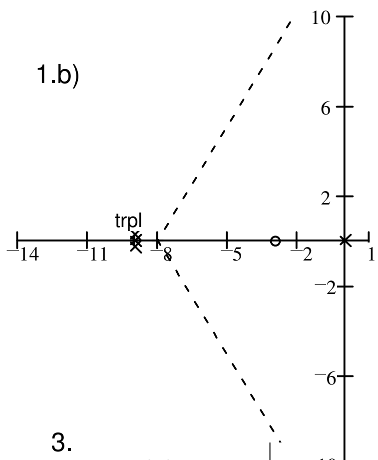


Answers

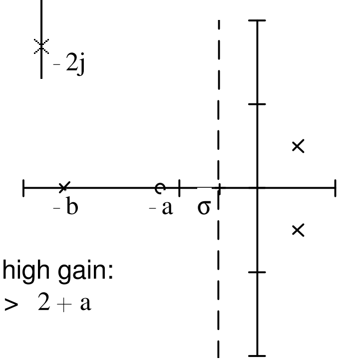
1.a)



1.b)

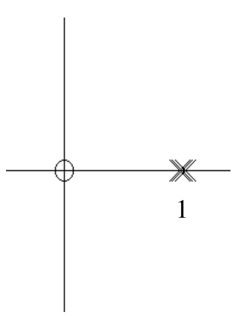


1.c)

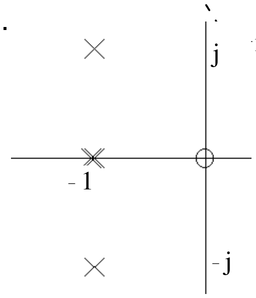


Stability at high gain:
$a>0 \qquad b > 2+a$

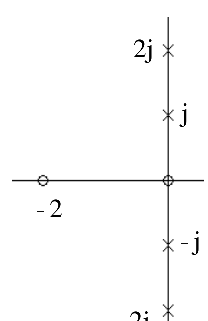
2.



3.



4.



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