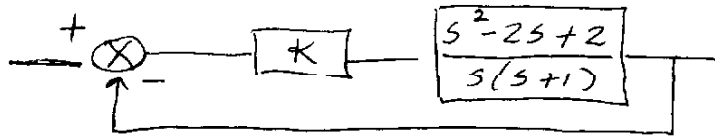
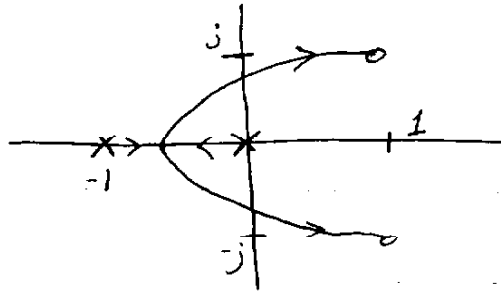


Given



you find the OL poles at $0, -1$ and
 OL zeros at $+1 \pm j$
 and develop the following sketch:



Find the breakaway points and $j\omega$ axis crossings.

Hint (1) - for breakaway points, start with $\frac{1}{\sigma+1} + \frac{1}{\sigma} = \frac{1}{\sigma-1-j} + \frac{1}{\sigma-1+j}$

and simplify to $\frac{2\sigma+1}{\sigma^2+\sigma} = \frac{2\sigma-2}{\sigma^2-2\sigma+2}$

Hint (2) - for $j\omega$ crossings, find the closed loop TF and use a Routh table.

BREAKAWAY POINTS

USE THE HINT!

$$\frac{2\sigma+1}{\sigma^2+\sigma} = \frac{2\sigma-2}{\sigma^2-2\sigma+2}$$

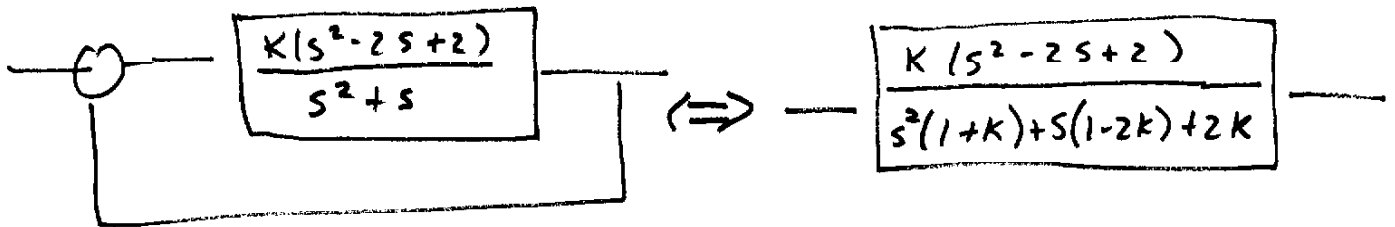
$$(2\sigma+1)(\sigma^2-2\sigma+2) = (\sigma^2+\sigma)(2\sigma-2)$$

$$-3\sigma^2 + 4\sigma + 2 = 0$$

$$\sigma = -0.3874 \leftarrow \text{Soln.}$$

or
1.7208

jw axis crossings



$$\begin{array}{l} s^2 \quad 1+K \quad 2K \\ s^1 \quad 1-2K \\ s^0 \quad 2K \end{array}$$

$$\Rightarrow K = \frac{1}{2} \quad \text{or} \quad K = 0$$

Using $K = \frac{1}{2}$, write

$$s^2 \left(\frac{3}{2} \right) + 1 = 0$$

$$s = \pm j \sqrt{\frac{2}{3}}$$