PROBLEM: Sketch the root locus and its asymptotes for a unity feedback system that has the forward transfer function

$$G(s) = \frac{K}{(s+2)(s+4)(s+6)}$$

Çözüm:

First, find the asymptotes.

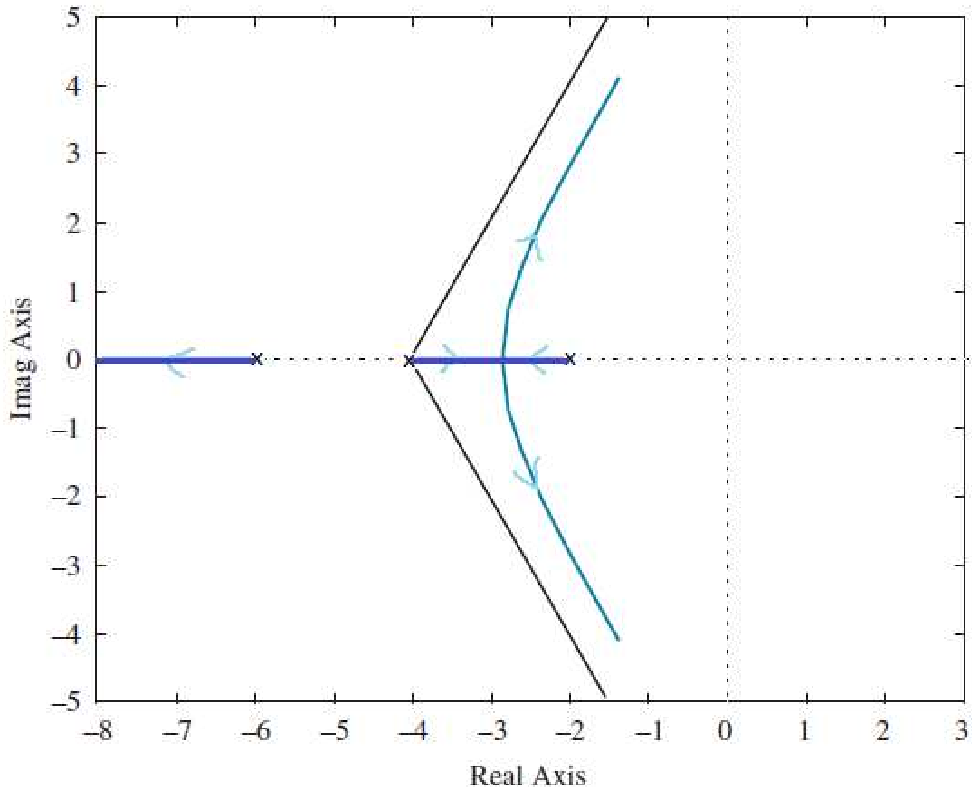
$$\sigma_a = \frac{\sum \text{poles} - \sum \text{zeros}}{\#\,\text{poles} - \#\,\text{zeros}} = \frac{(-2-4-6)-(0)}{3-0} = -4$$

$$\theta_a = \frac{(2k+1)\pi}{3} = \frac{\pi}{3},\ \pi,\ \frac{5\pi}{3}$$

Çizim alttaki gibidir. Burada hesaplanmayan bazı değerler vardır:

- ayrılma noktası hesaplanmalı,

-sanal eksen kesme noktaları çizim üzerinden gösterilebileceği gibi Rout tablosu yardımıyla tam değerleri hesaplanabilir.



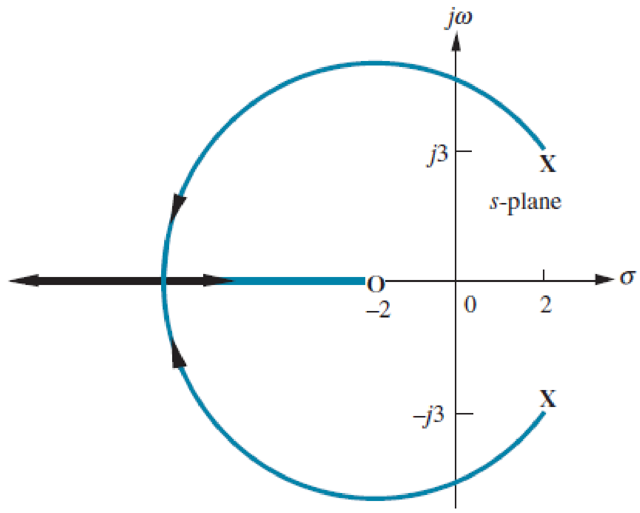
PROBLEM: Given a unity feedback system that has the forward transfer function

$$G(s) = \frac{K(s+2)}{(s^2 - 4s + 13)}$$

do the following:

a. Sketch the root locus.
b. Find the imaginary-axis crossing.
c. Find the gain, K, at the $j\omega$-axis crossing.
d. Find the break-in point.
e. Find the angle of departure from the complex poles.

a)



b)

Using the Routh-Hurwitz criteria, we first find the closed-loop transfer function.

$$T(s) = \frac{G(s)}{1+G(s)} = \frac{K(s+2)}{s^2 + (K-4)s + (2K+13)}$$

Using the denominator of $T(s)$, make a Routh table.

s^2	1	$2K+13$
s^1	$K-4$	0
s^0	$2K+13$	0

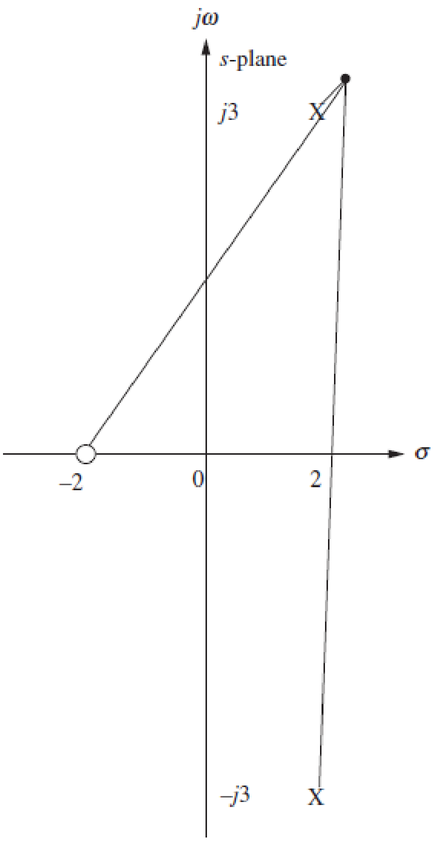
We get a row of zeros for $K = 4$. From the s^2 row with $K = 4$, $s^2 + 21 = 0$. From which we evaluate the imaginary axis crossing at $\sqrt{21}$.

c) From part (b), $K = 4$.

d) Birleşme noktası -7 olarak hesaplanmalıdır.

e) First, draw vectors to a point ε close to the complex pole.

At the point ε close to the complex pole, the angles must add up to zero. Hence,



$$\tan^{-1}\left(\frac{3}{4}\right) - 90^\circ - \theta = 180^\circ. \quad \Rightarrow \quad \theta = -233.1.$$