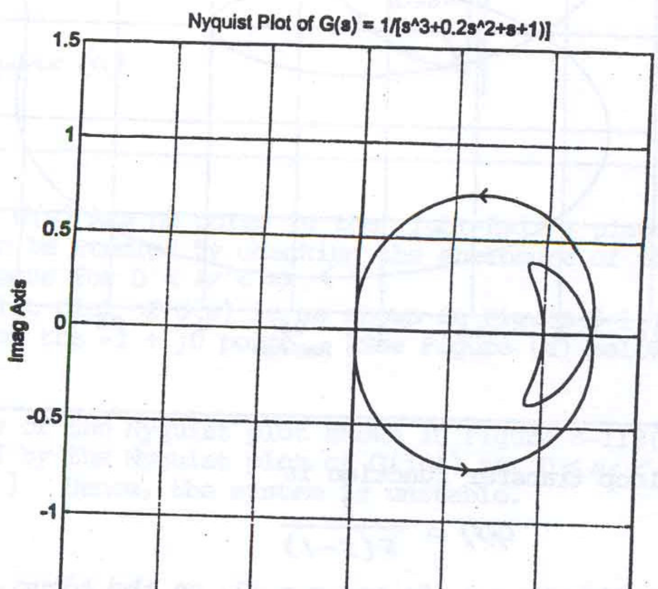
B-8-15. Note that G(s) has two open-loop poles in the right-hals s plane, as seen from the following MATLAB output.

```
p = [1  0.2  1  1];
roots(p)

ans =

  0.2623 + 1.1451i
  0.2623 - 1.1451i
 -0.7246
```

The following MATLAB program produces the Nyquist plot shown below.

```
% ***** Nyquist plot *****

num = [0  0  0  1];
den = [1  0.2  1  1];
nyquist(num,den)
v = [-1.5  1.5  -1.5  1.5]; axis(v); axis('square')
grid
title('Nyquist Plot of G(s) = 1/[s^3+0.2s^2+s+1)]')
```

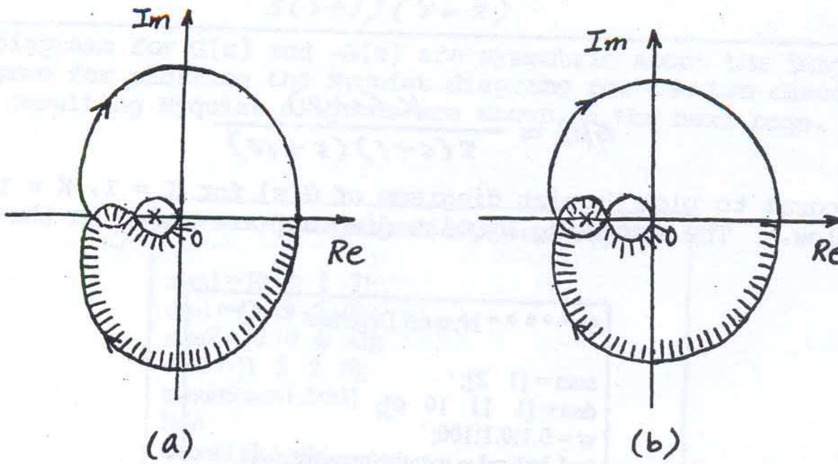


From the plot notice that the critical point (-1+j0) is not encircled. Because there are two open-loop poles in the right-half s plane and no encirclement of the critical point, the closed-loop system is unstable.

B-8-18. Since G(s) has no poles in the right-half s plane, the stability of the system can be studied by checking the enclosure of the $-1 + j0$ point by the Nyquist locus for $0 < \omega < \infty$.

If the Nyquist plot of G(s) is as shown in Figure 8-119(a), then there is no enclosure of the $-1 + j0$ point. [See Figure (a) below.] Hence, the system is stable.

For the case of the Nyquist plot shown in Figure 8-119(b), the $-1 + j0$ point is enclosed by the Nyquist plot of $G(j\omega)$ for $0 < \omega < \infty$. [See Figure (b) below.] Hence, the system is unstable.

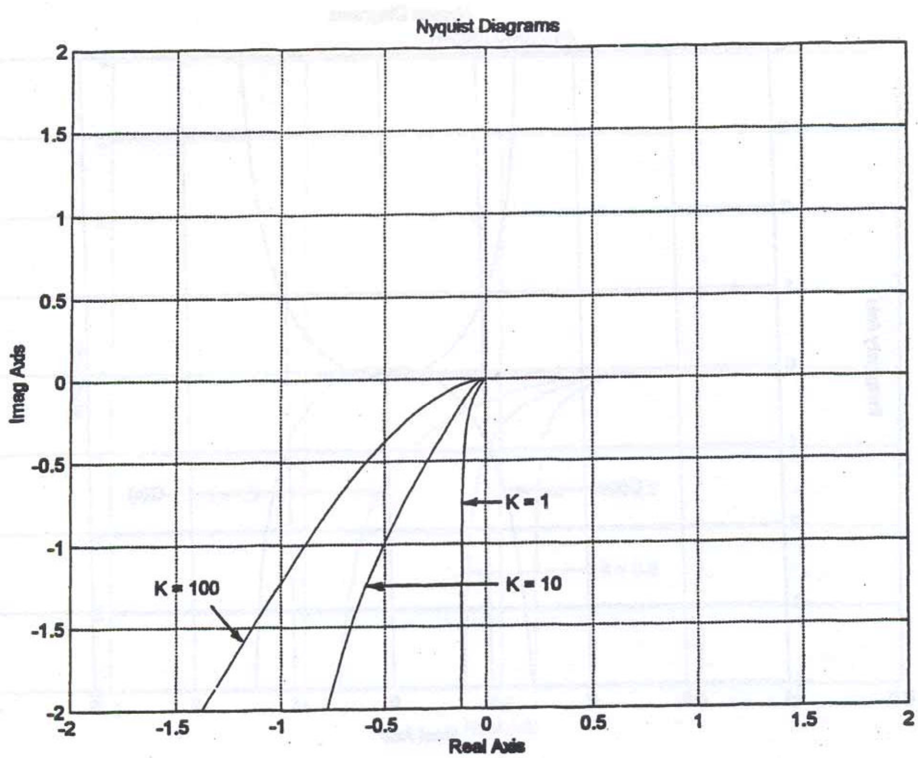


B-8-20.

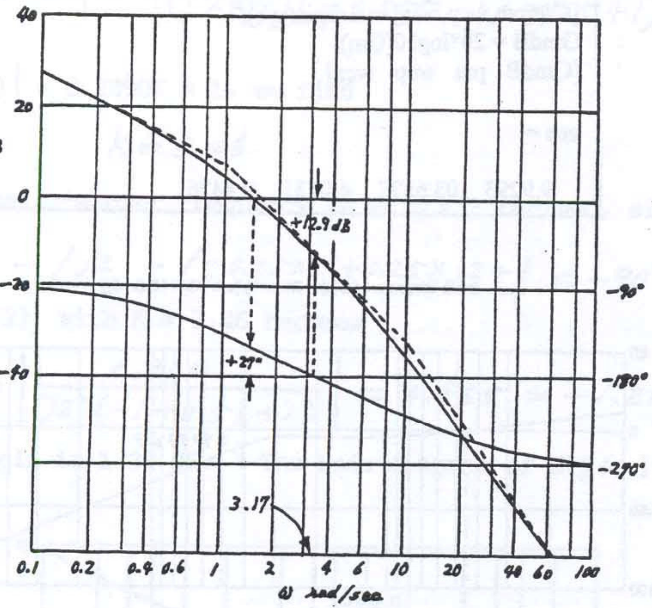
$$G(s) = \frac{K(s+2)}{s(s+1)(s+10)}$$

A MATLAB program to plot Nyquist diagrams of G(s) for K = 1, K = 10, and K = 100 is shown below. The resulting Nyquist diagrams are shown on the next page.

```
% * * * * * Nyquist Diagrams * * * * *

num = [1  2];
den = [1  11  10  0];
w = 0.1:0.1:100;
[re1,im1,w] = nyquist(num,den,w);
[re2,im2,w] = nyquist(10*num,den,w);
[re3,im3,w] = nyquist(100*num,den,w);
plot(re1,im1,re2,im2,re3,im3)
v = [-2  2  -2  2]; axis(v)
grid
title('Nyquist Diagrams')
xlabel('Real Axis')
ylabel('Imag Axis')
text(0.1,-0.75,'K = 1')
text(0.1,-1.25,'K = 10')
text(-1.6,-1.25,'K = 100')
```



B-8-27. A Bode diagram of the system is shown below.



From this Bode diagram, we find the phase margin and gain margin to be 27° and 13 dB, respectively.

The phase margin, gain margin, phase crossover frequency, and gain crossover frequency can be obtained easily with MATLAB. Use the command

```
[Gm, pm, wcp, wcg] = margin(sys)
```

See Problem B-8-28.
