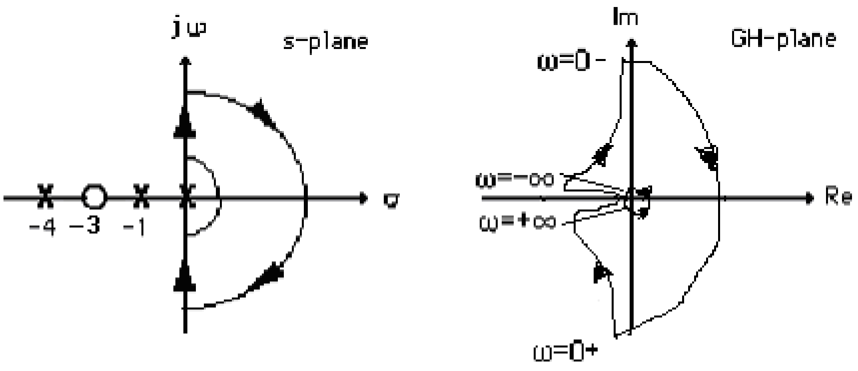
HW6

1. Chap 10 Prob. 1 (c)

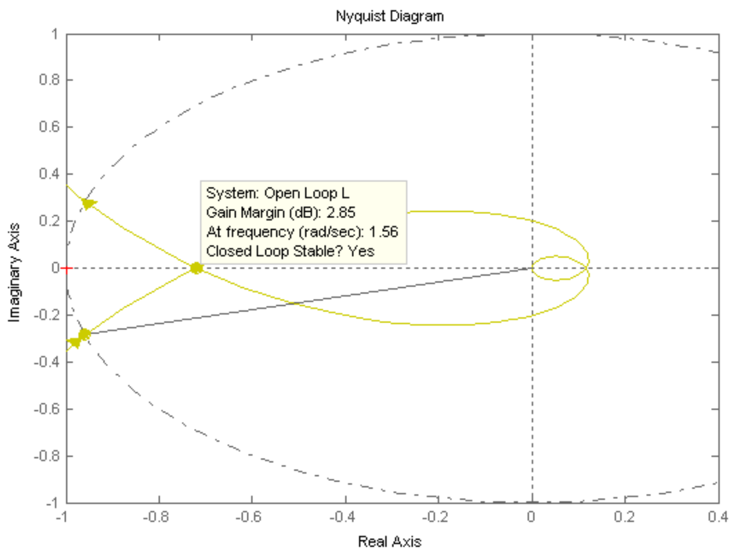
$$|G(j\omega)| = \frac{\sqrt{4+\omega^2}\sqrt{16+\omega^2}}{\omega\sqrt{1+\omega^2}\sqrt{9+\omega^2}};\ \angle G(j\omega) = tan^{-1}\frac{\omega}{2} + tan^{-1}\frac{\omega}{4} - 90^{\circ} - tan^{-1}\omega - tan^{-1}\frac{\omega}{3}$$

2. Chap 10 Prob. 4System 3



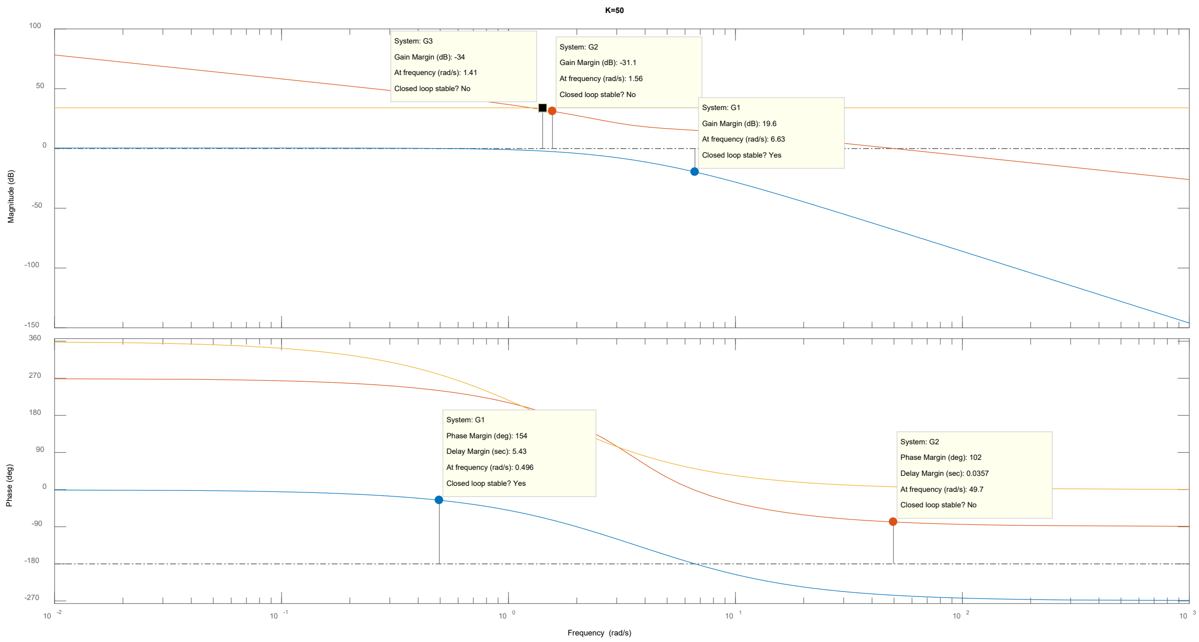
3. Chap 10 Prob. 8System2and Prob. 9(b) for Prob. 8System 2

8.System 2: For K = 1,



The Nyquist diagram intersects the real axis at -0.720. Thus K can be increased to 1.39 before there are encirclements of -1. There are no poles encircles by the contour. Thus P = 0. Hence, Z = P - N, Z = 0 + 0 if K <1.39; Z = 0 – (-2) if K > 1.39. Therefore stability if 0 < K < 1.39.

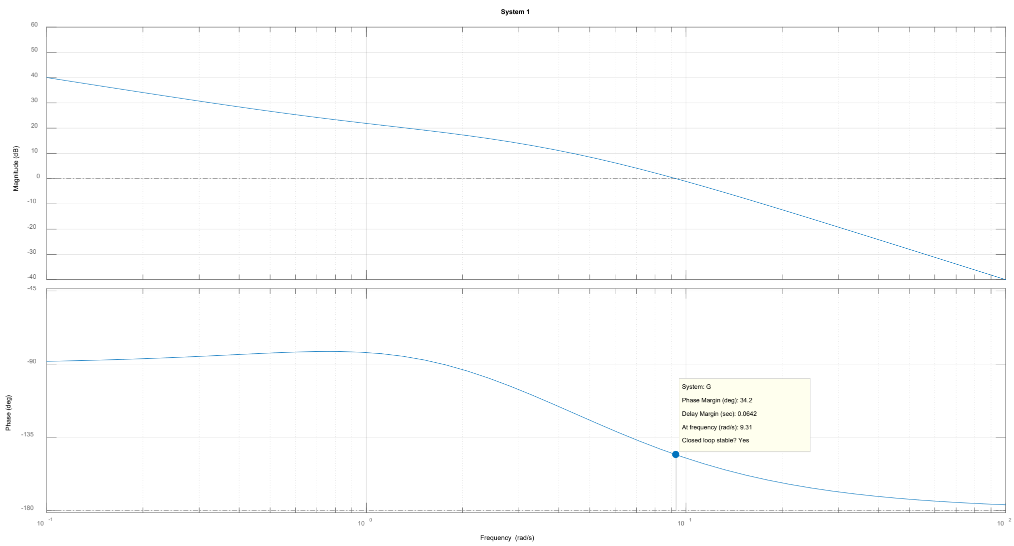
9b.



When $K = 50$ only the System 1 is closed loop stable, for the other two systems the gain margin and phase margin do not exist.

4. Chap 10 Prob. 19System 1

The Bode plot is:



The phase margin is 34.2°. The open loop response is -7dB with -156° at approximately 14 rad/sec which is the Bandwidth of the closed loop system. Using Figure 10.48 $\zeta = 0.34$, so $\%OS = 100e^{-\frac{\zeta\pi}{\sqrt{1-\zeta^2}}} = 32.1\%$. Using Eq. (10.55) $T_s = 1.197$ sec and Eq. (10.56) yields $T_p = 0.34$ sec.

5. Chap 10 Prob. 22

a. From the Bode plots: Gain margin ≅ 20 dB; phase margin ≅ 55°; 0 dB frequency ≅ 1 rad/s; –180° frequency ≅ 4.5 rad/s; bandwidth (@-7 dB point) ≅ 2 rad/s.

b. From Eq. (10.73) ζ = 0.55; from Eq. (4.38) %OS = 12.6; from Eq. (10.55) Ts = 4.41 s; from Eq. (10.56) Tp = 2.28 s.