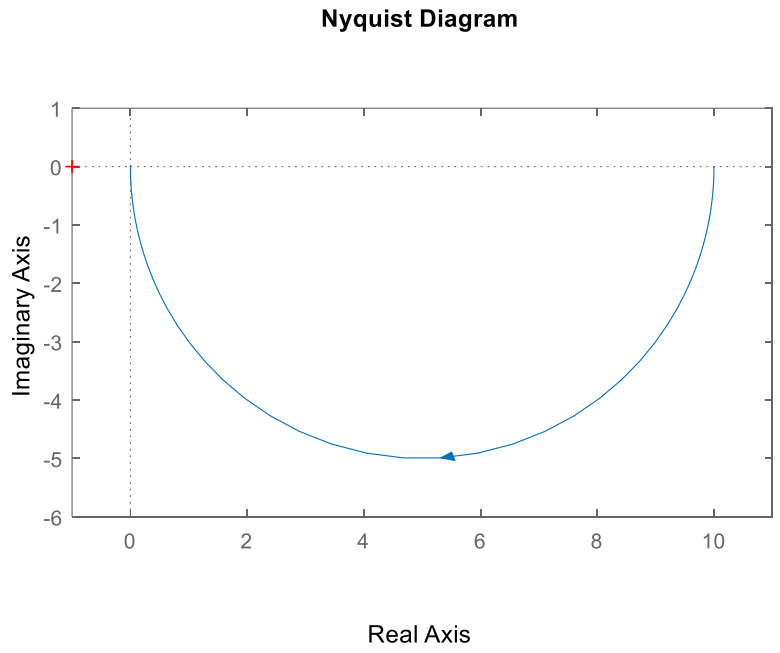
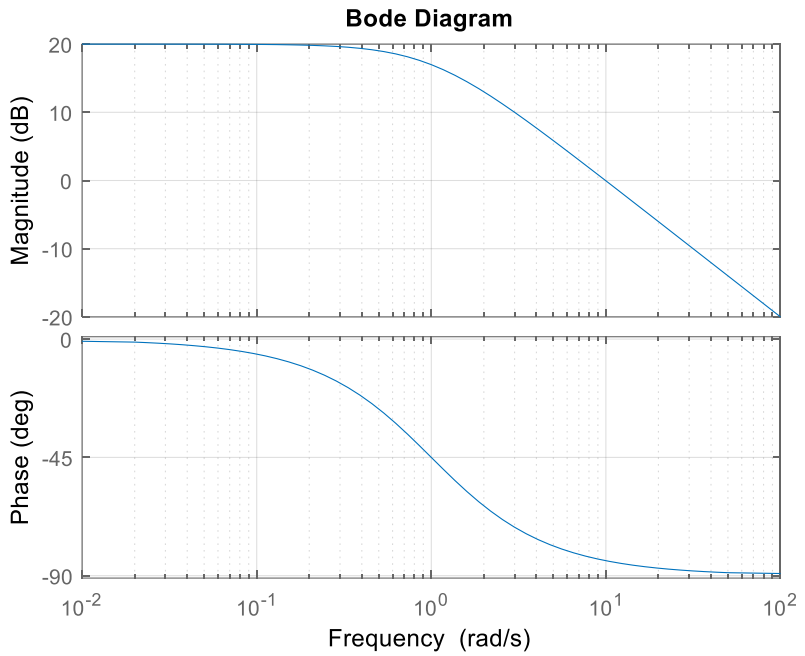
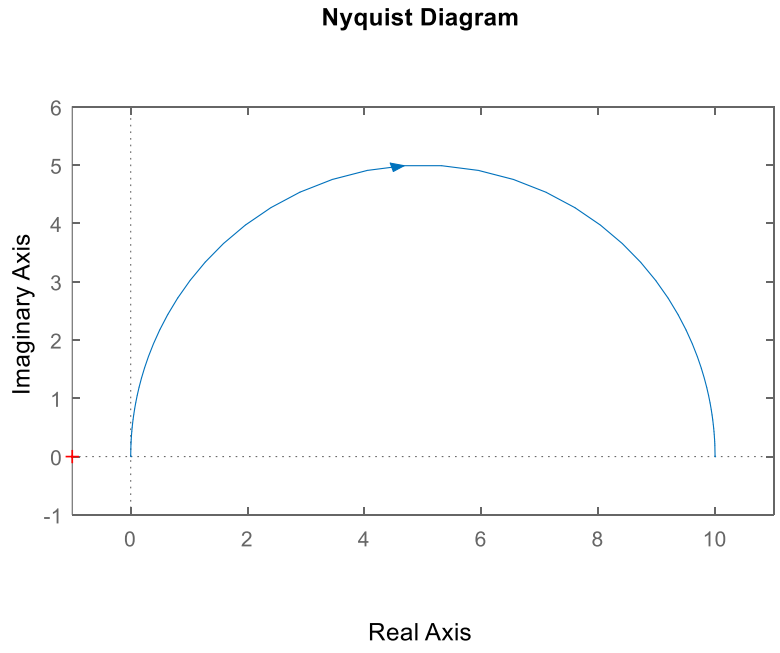
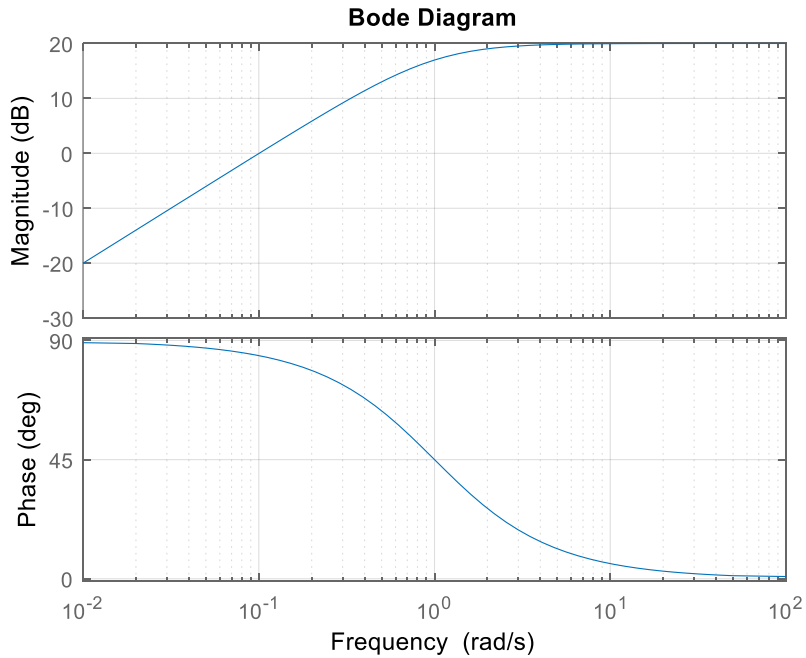
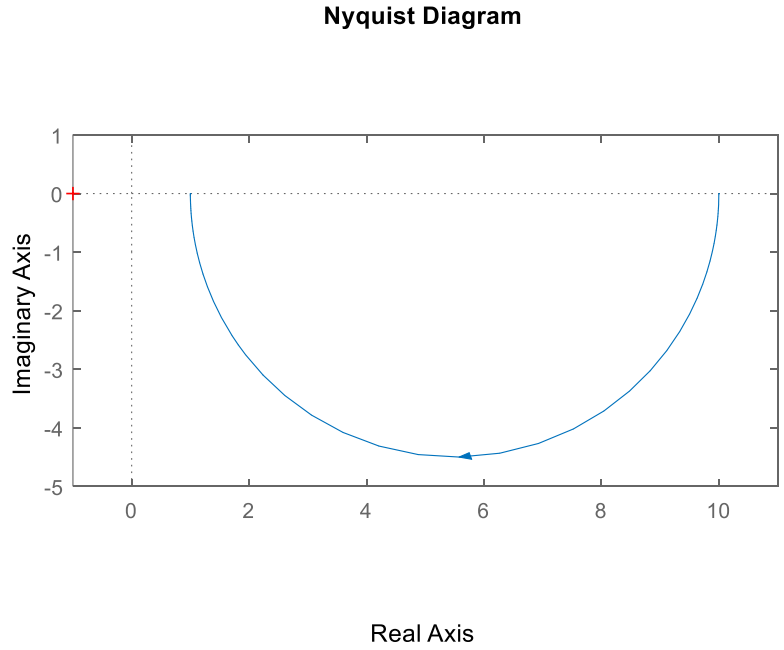
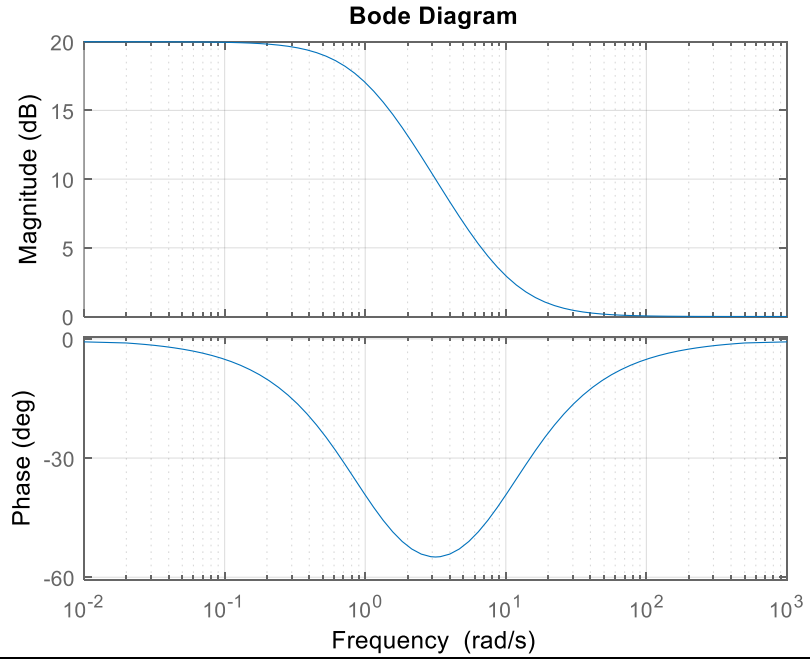
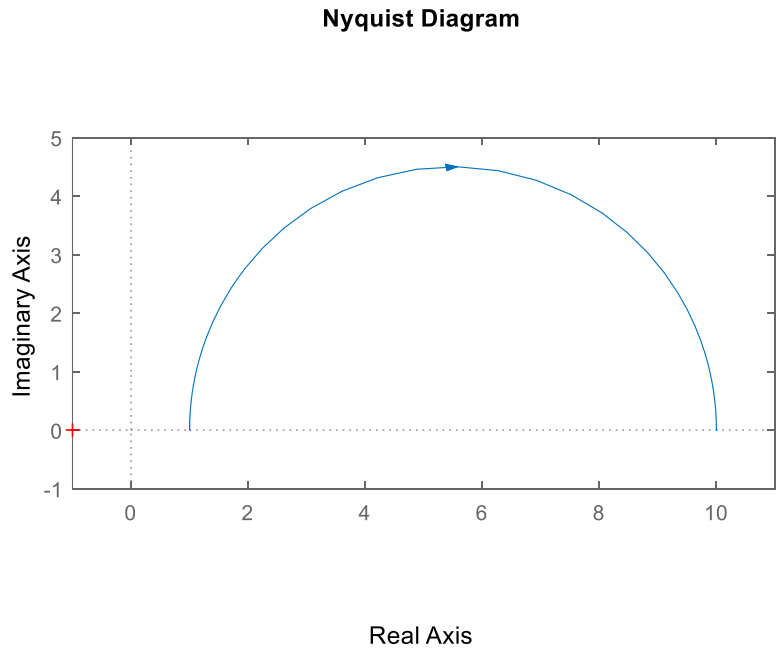
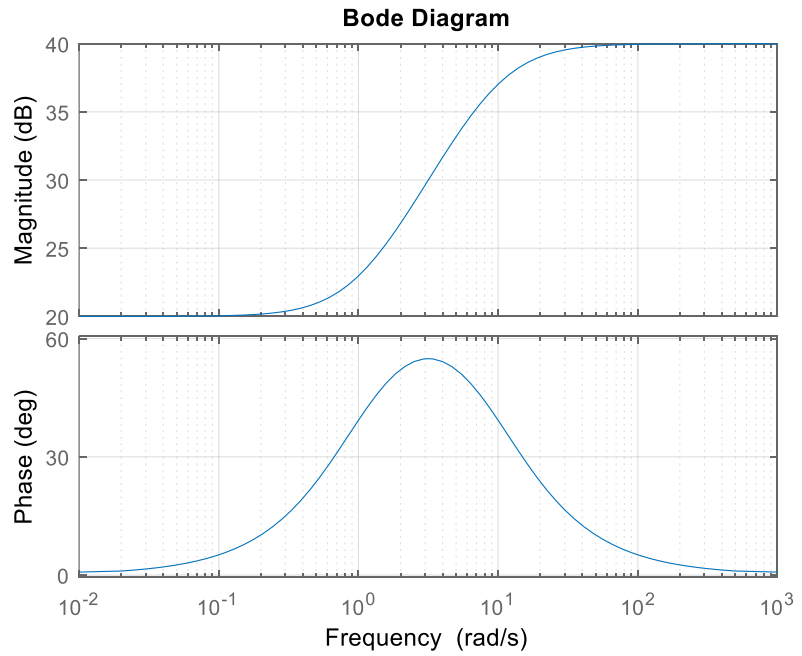
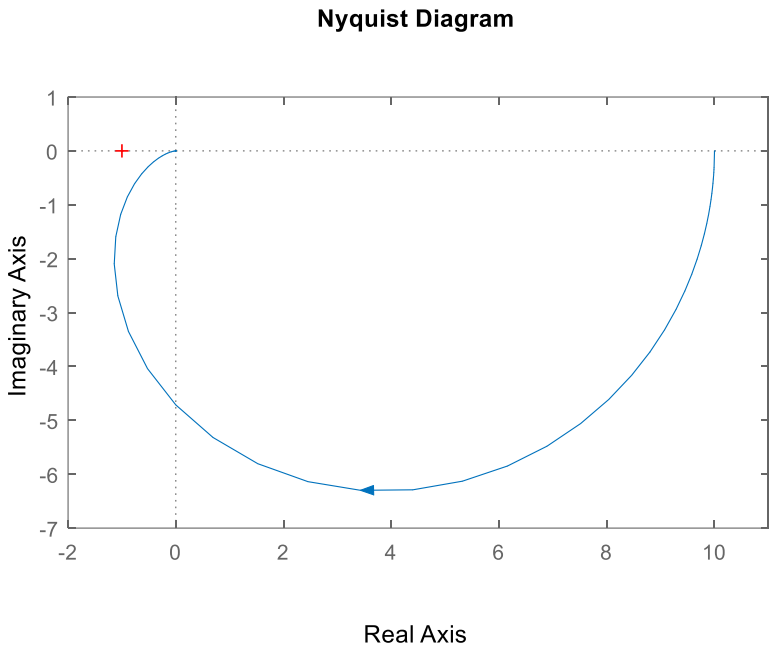
1. 10 ----- (1+s) P		
2. 10 s ----- (1+s) $\bar{Z}$ P		

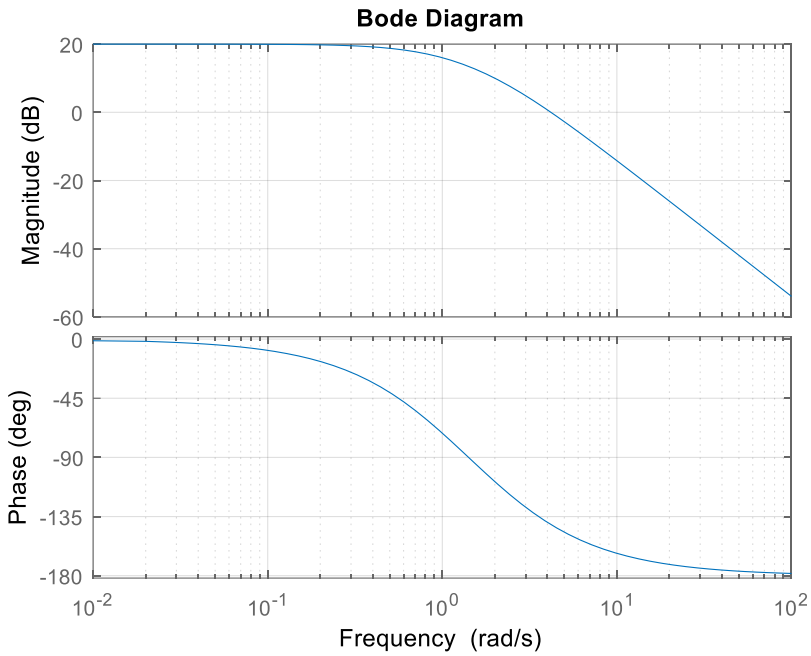
3. 10 (1+s/10) ---------- (1+s) P Z		
4. (1+s) -------- (1+s/10) Z P		

5.

$$\frac{10}{(1+s)\,(1+s/2)}$$

P P

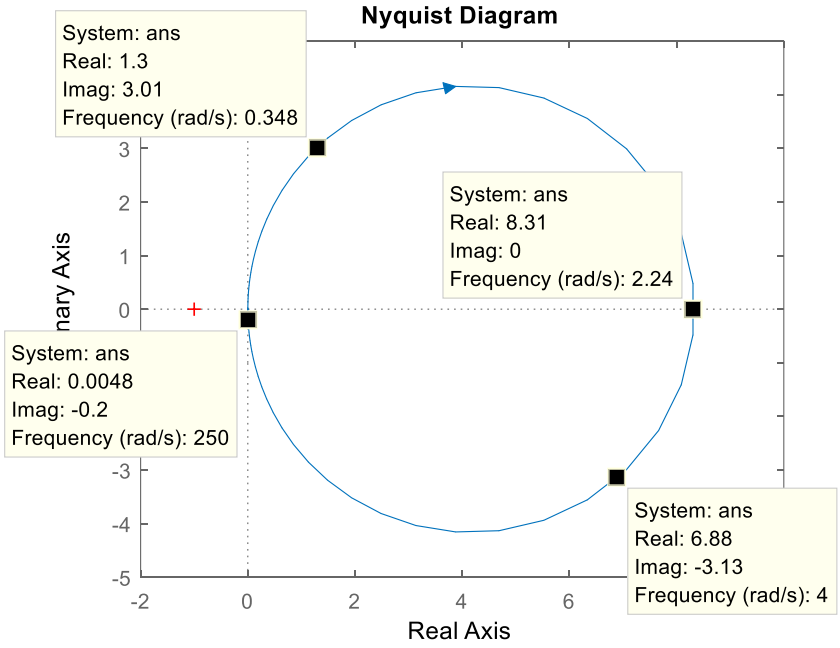


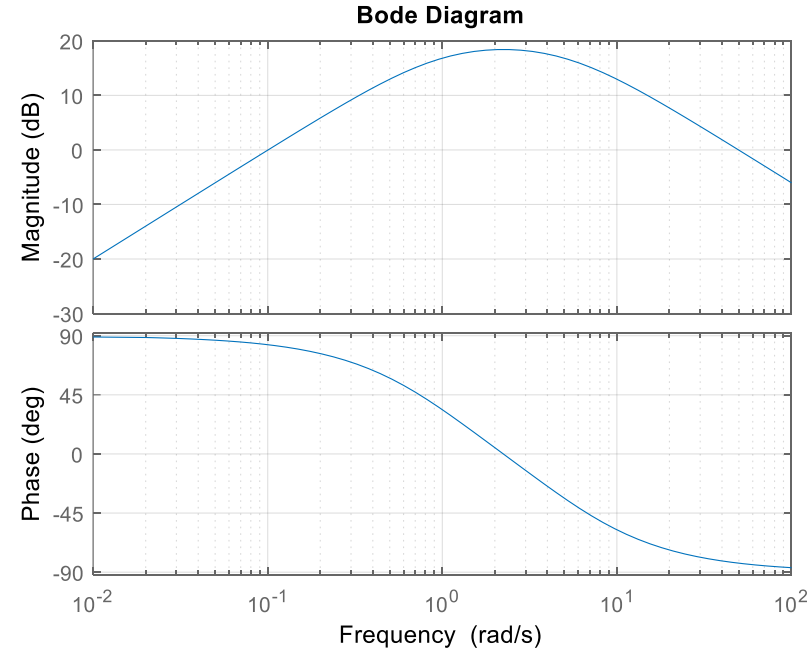


6.

$$\frac{10\,s}{(1+s)\,(1+s/5)}$$

$\bar{Z}$ P P

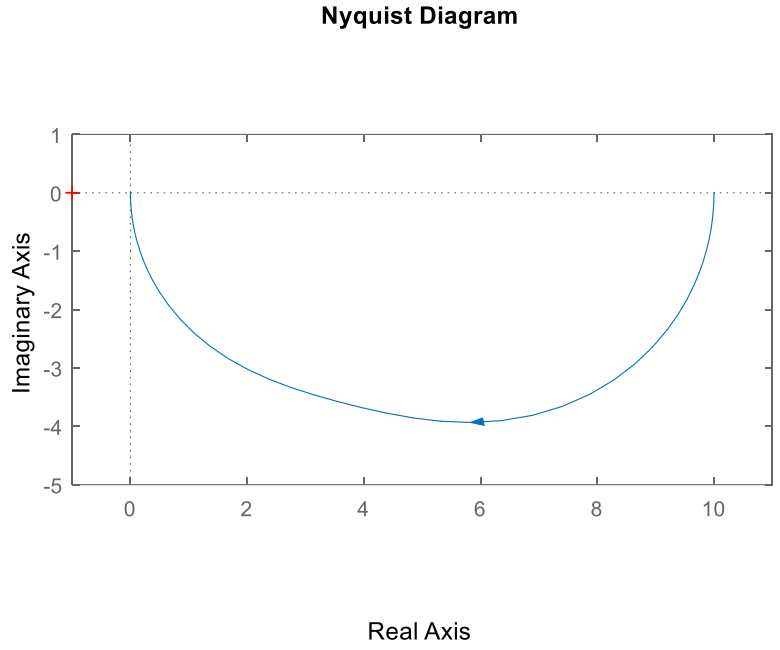


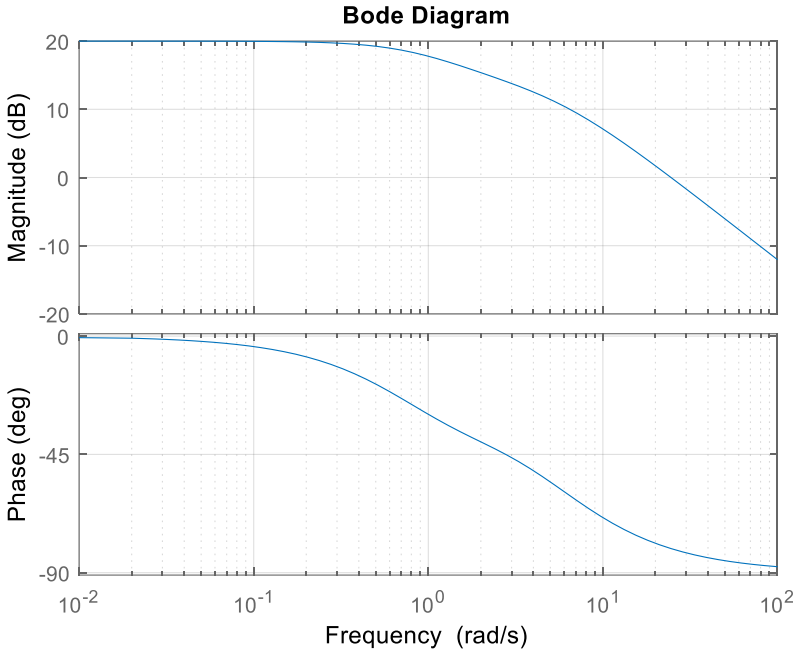


7.

$$\frac{10\,(1+s/2)}{(1+s)\,(1+s/5)}$$

P Z P

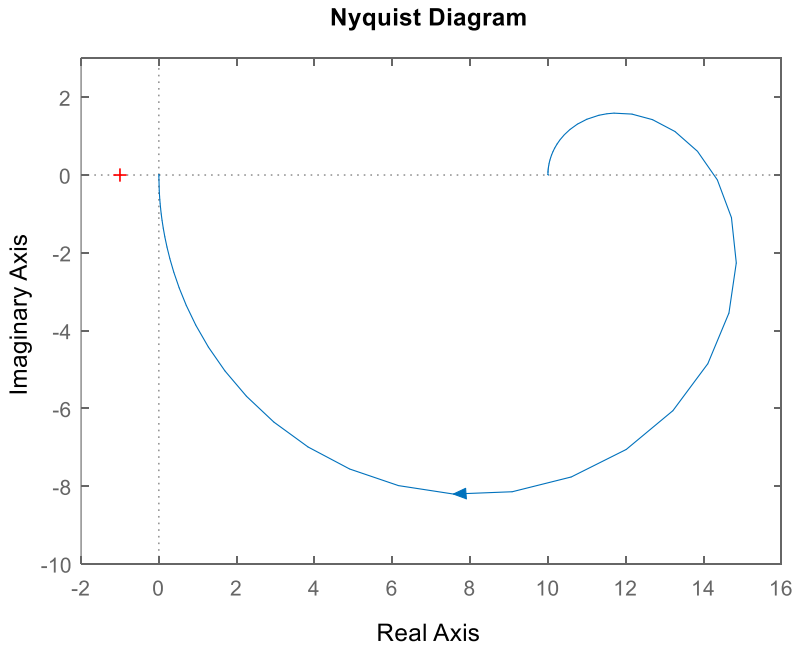


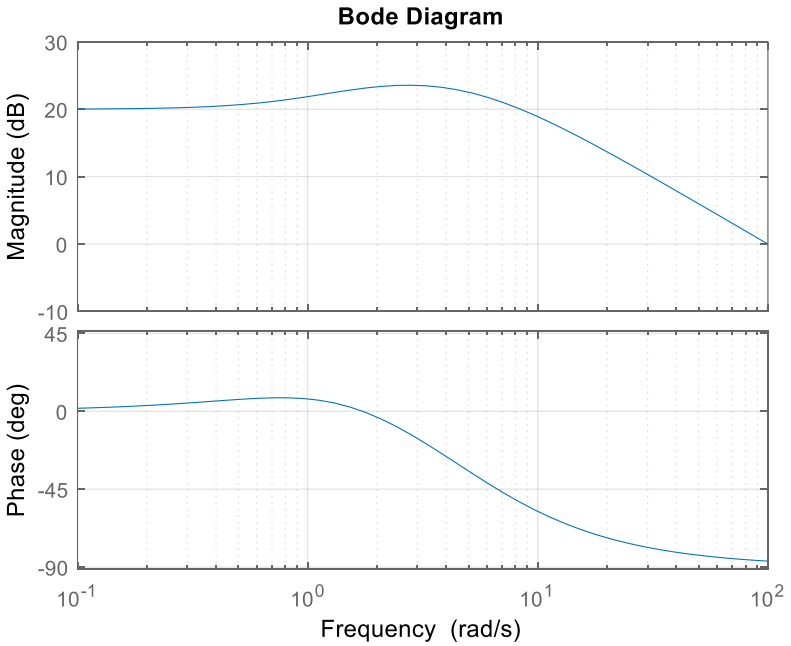


8.

$$\frac{10\,(1+s)}{(1+s/2)\,(1+s/5)}$$

Z P P

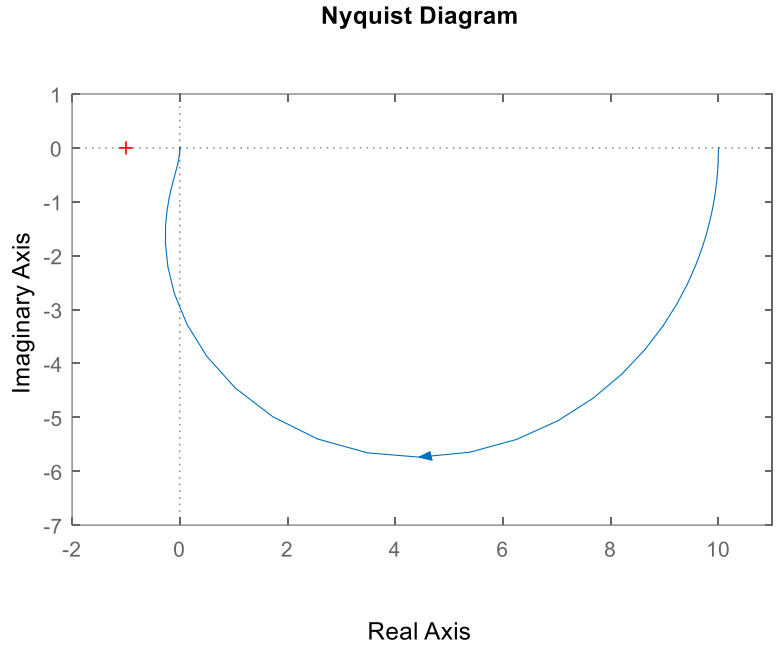


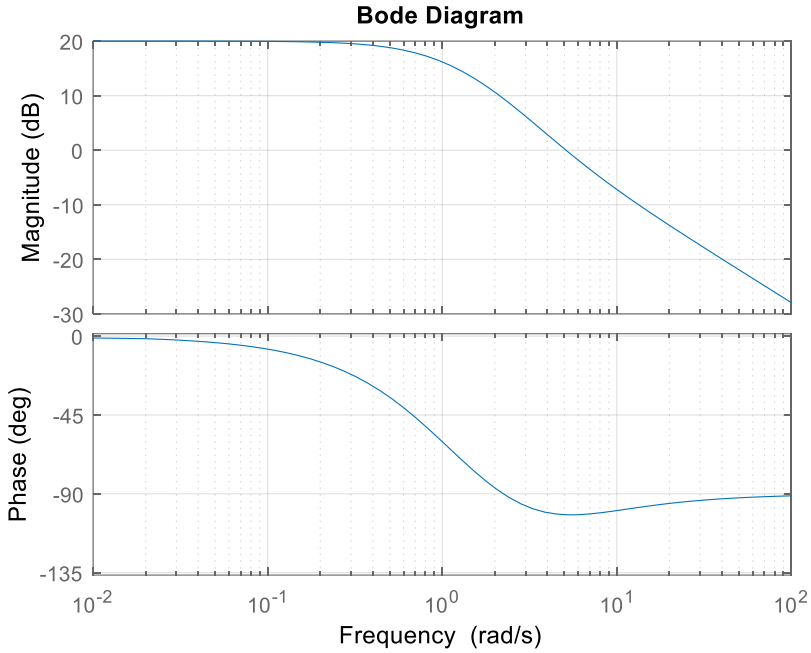


9.

$$\frac{10\,(1+s/5)}{(1+s)\,(1+s/2)}$$

P P Z

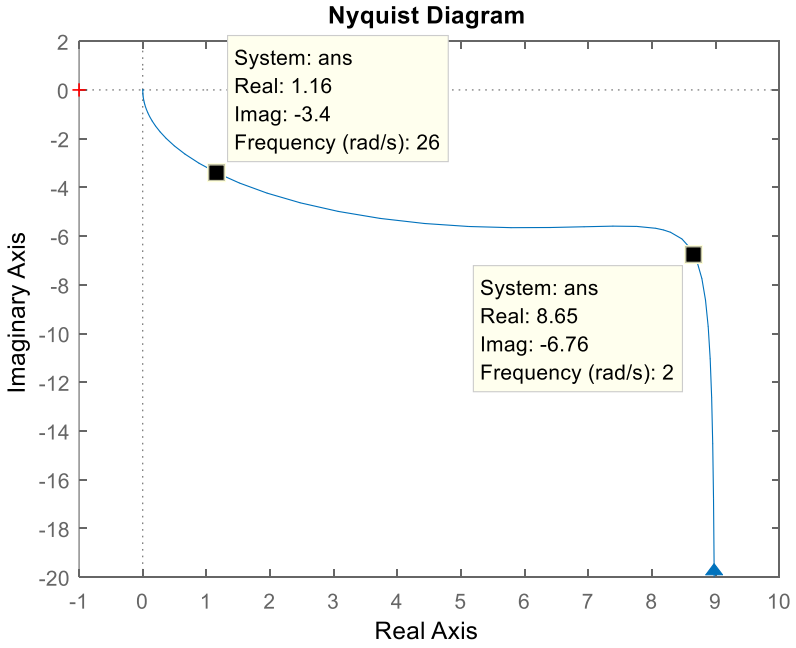


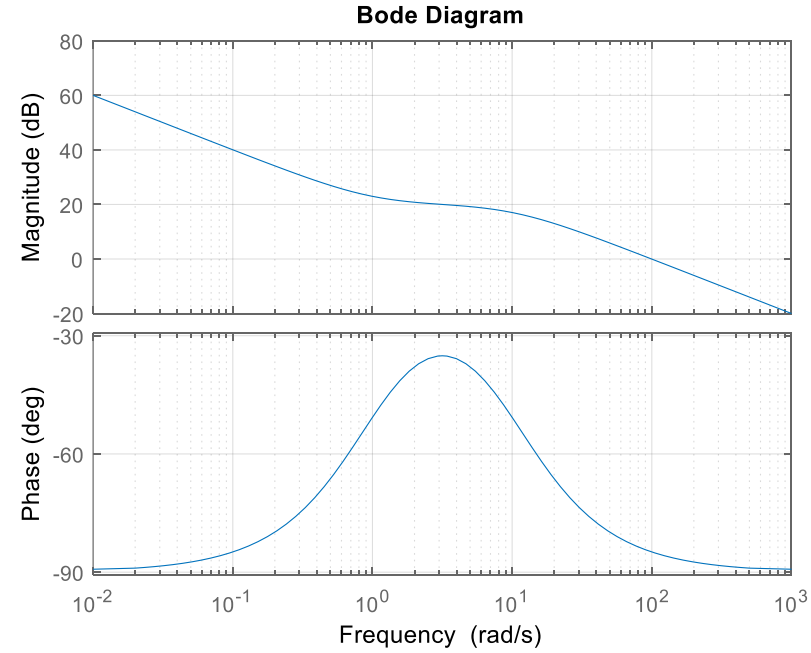


10.

$$\frac{10\,(1+s)}{s\,(1+s/10)}$$

$\bar{P}$ Z P

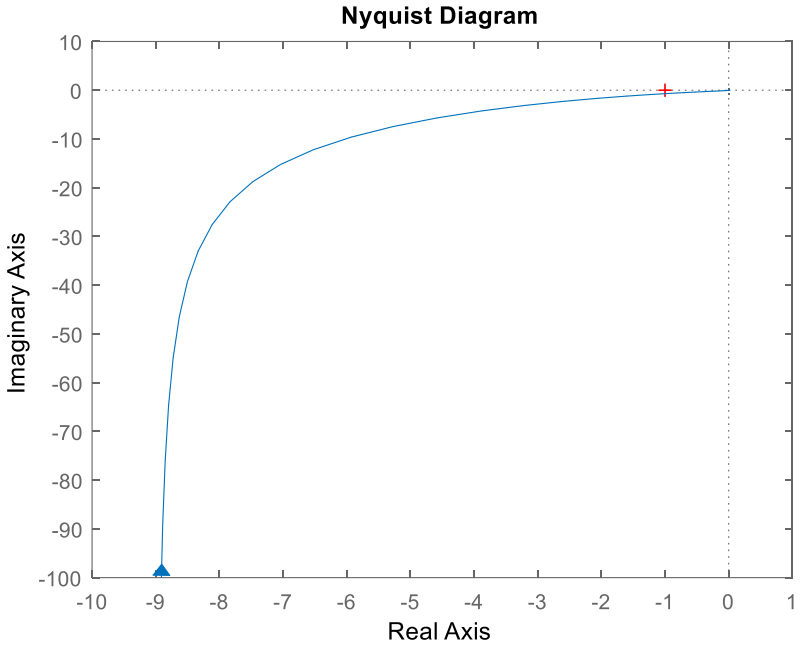


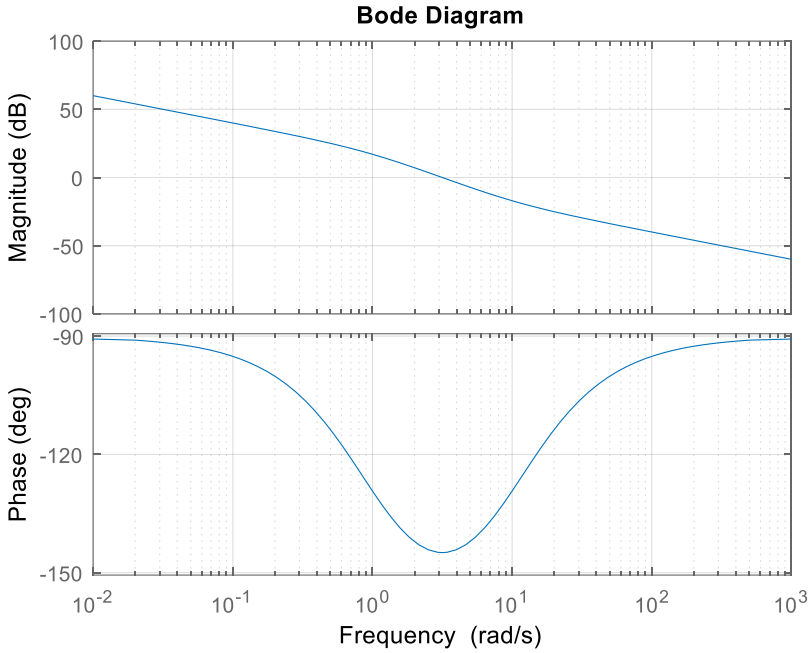


11.

$$\frac{10\,(1+s/10)}{s\,(1+s)}$$

$\bar{P}$ P Z

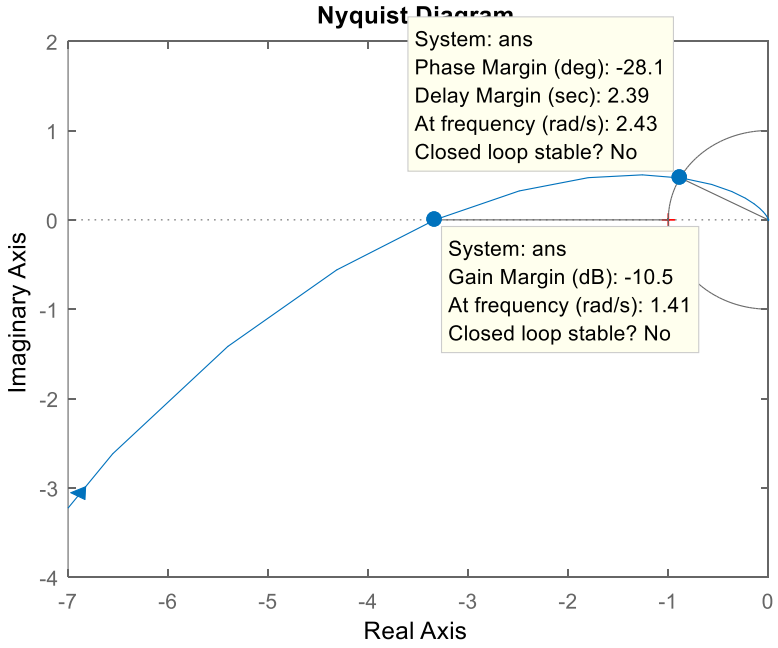


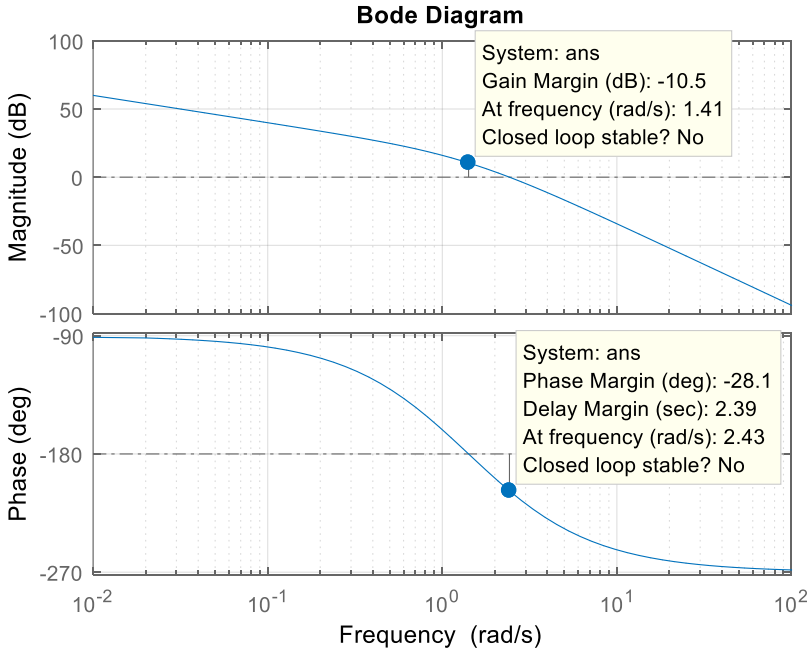


12.

$$\frac{10}{s\,(1+s)\,(1+s/2)}$$

$\bar{P}$ P P

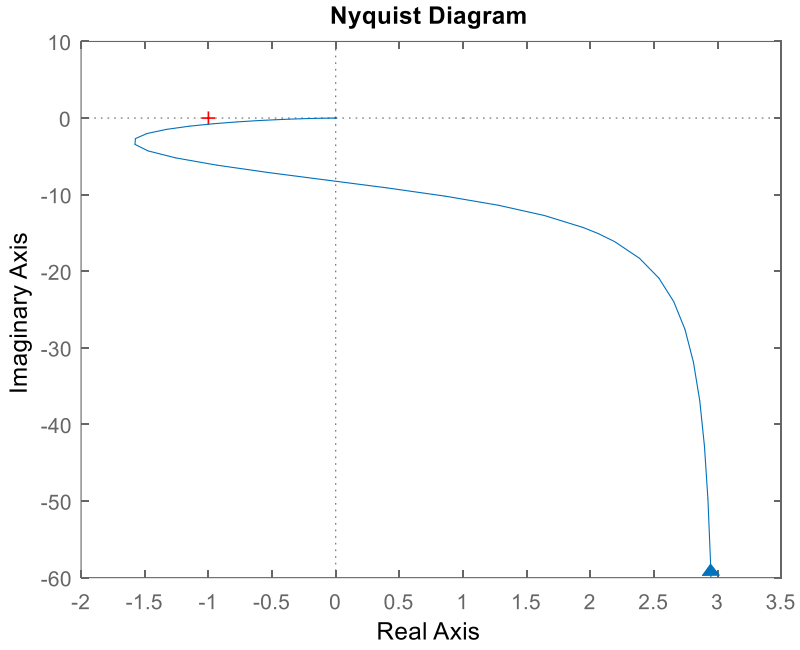


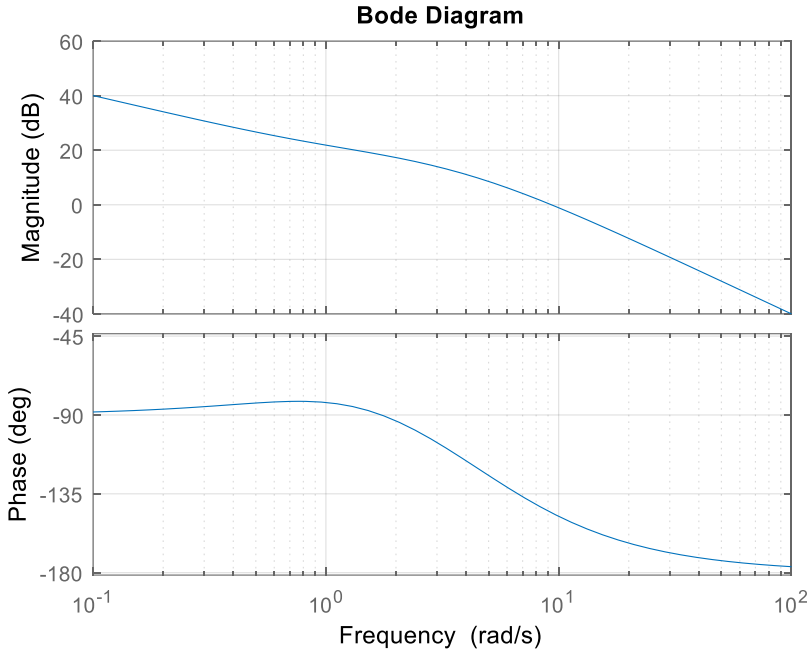


13.

$$\frac{10\,(1+s)}{s\,(1+s/2)\,(1+s/5)}$$

$\bar{P}$ Z P P

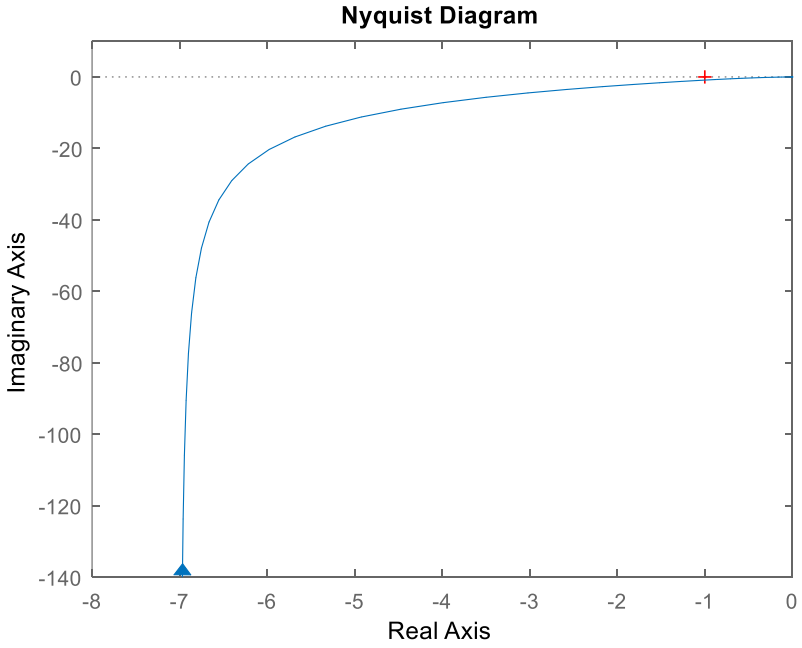


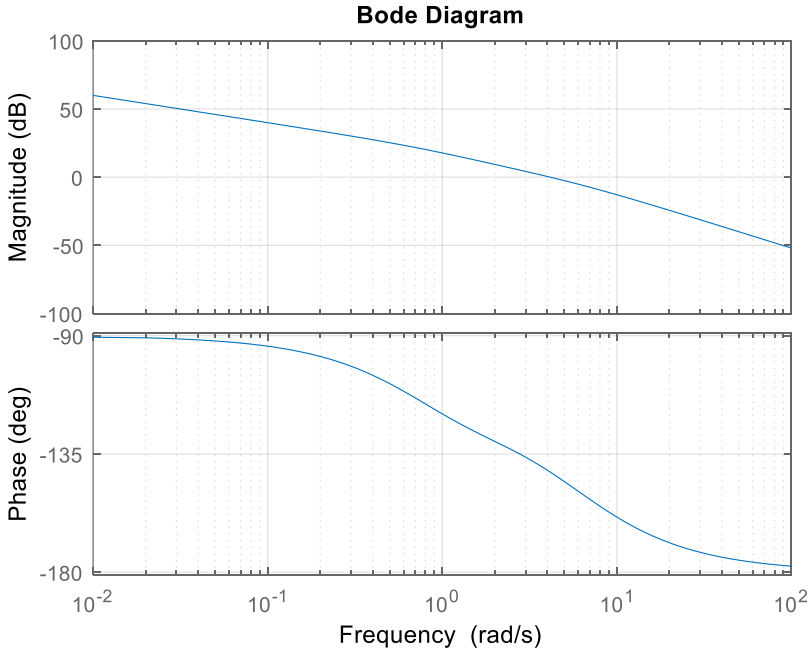


14.

$$\frac{10\,(1+s/2)}{s\,(1+s)\,(1+s/5)}$$

$\bar{P}$ P Z P

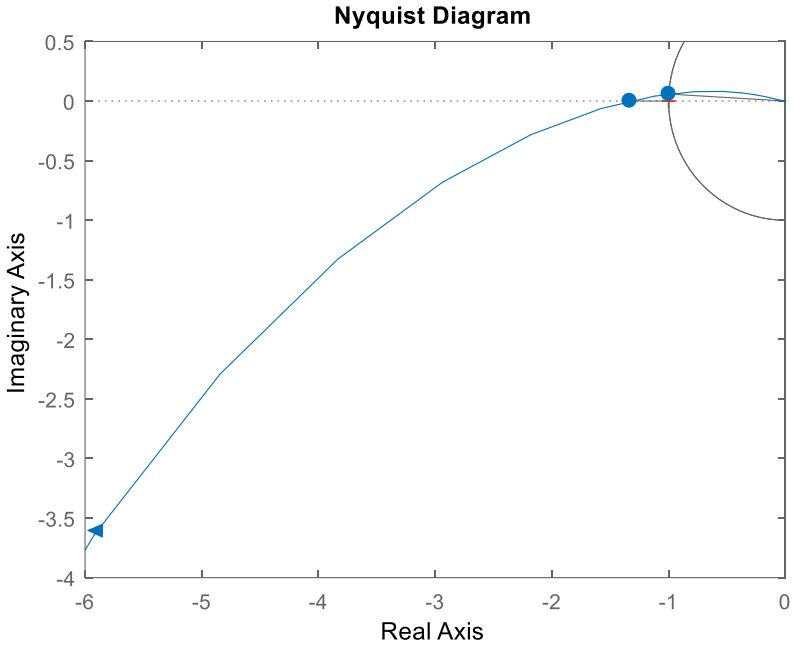


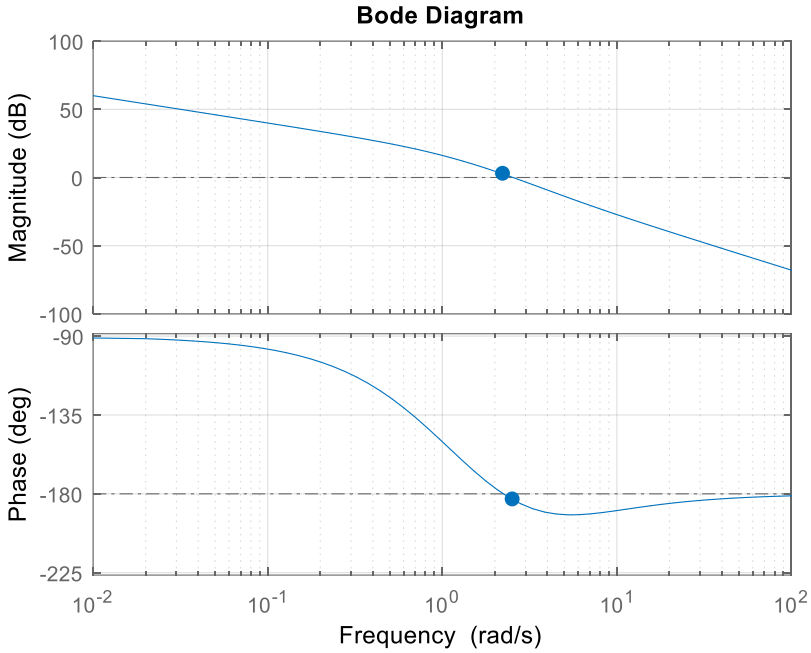


15.

$$\frac{10\,(1+s/5)}{s\,(1+s)\,(1+s/2)}$$

$\bar{P}$ P P Z

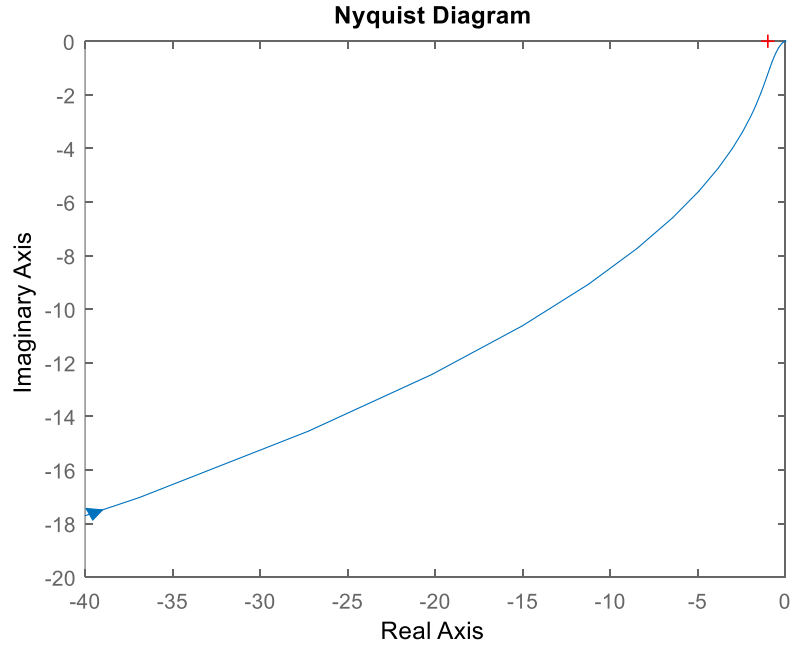


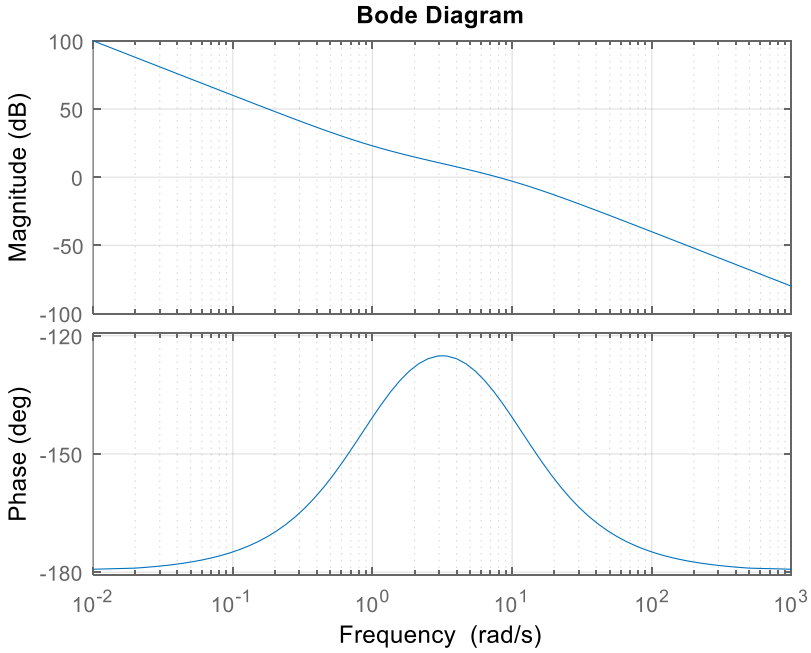


16.

$$\frac{10\,(1+s)}{s^2\,(1+s/10)}$$

$\bar{P}$ $\bar{P}$ Z P

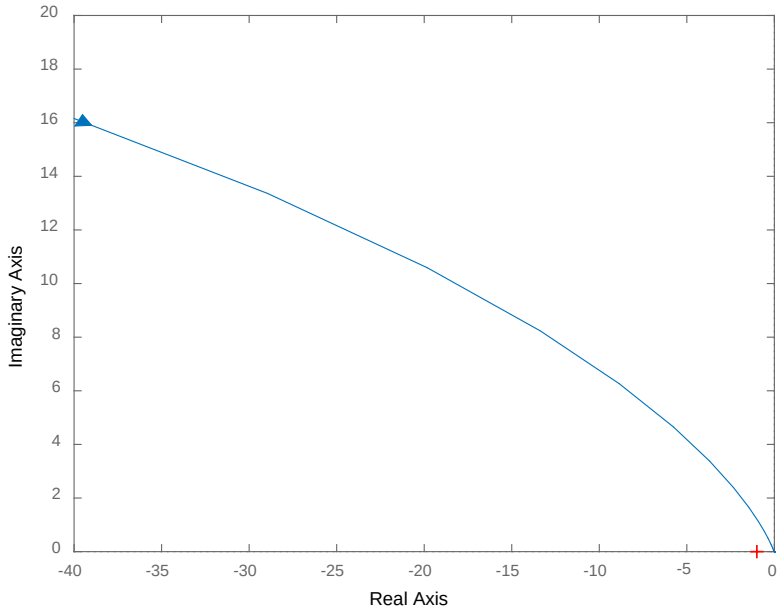


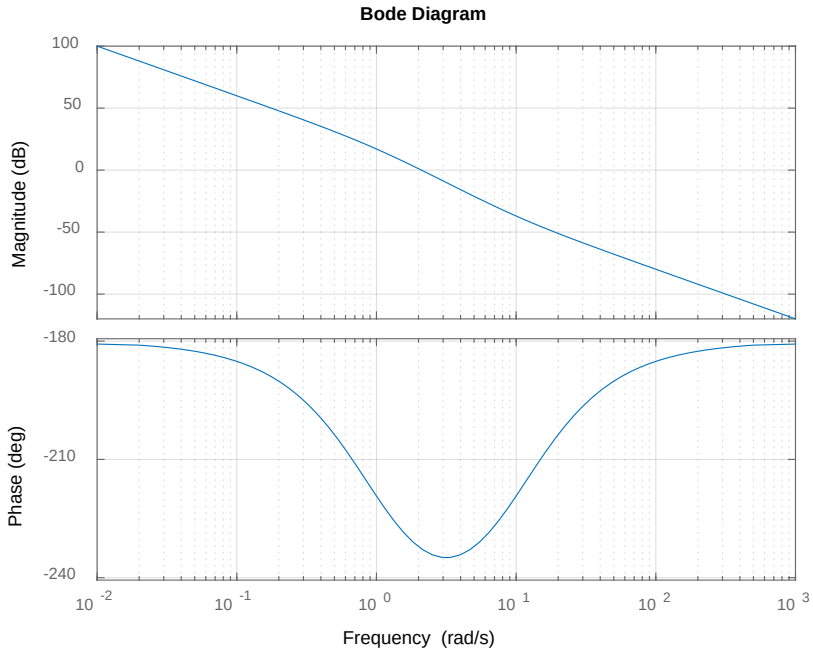


17.

$$\frac{10\,(1+s/10)}{s^2\,(1+s)}$$

$\bar{P}\ \bar{P}$ P Z

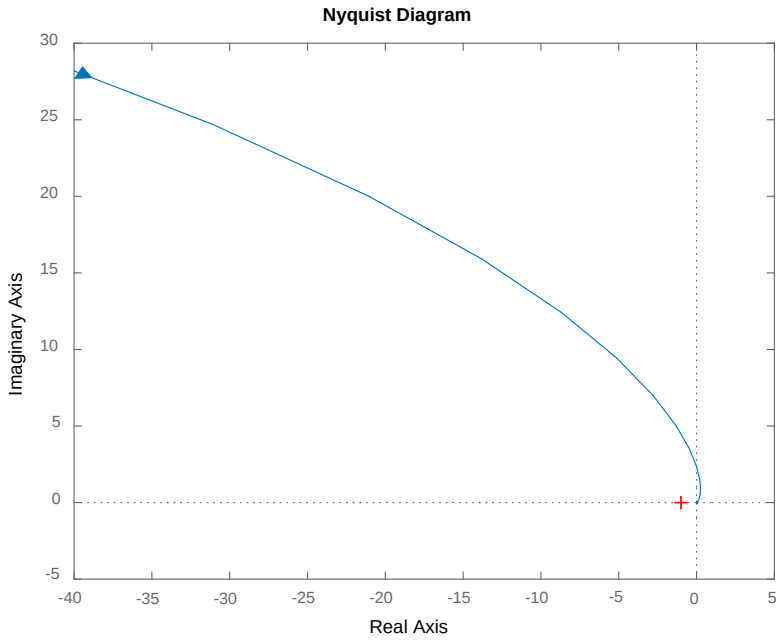


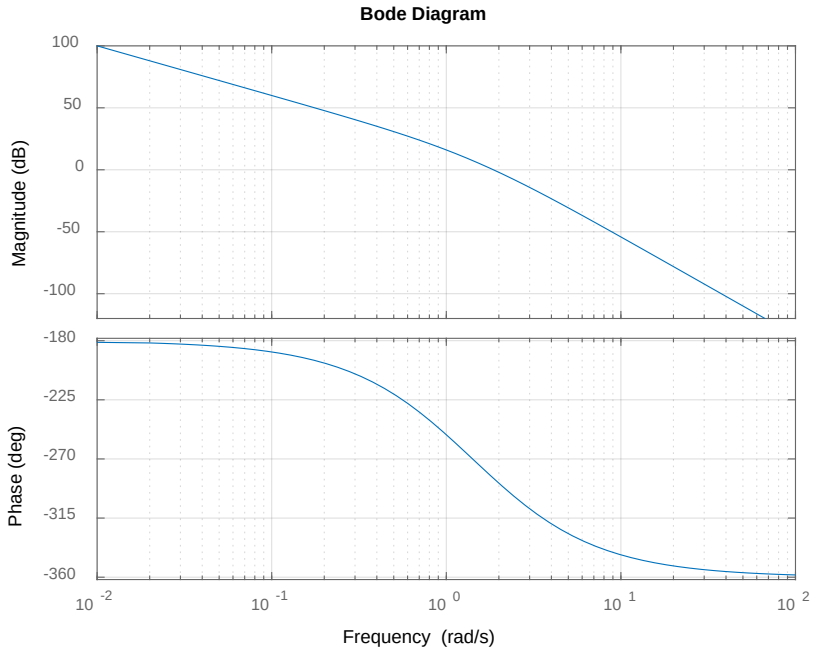


18.

$$\frac{10}{s^2\,(1+s)\,(1+s/2)}$$

$\bar{P}\ \bar{P}$ P P

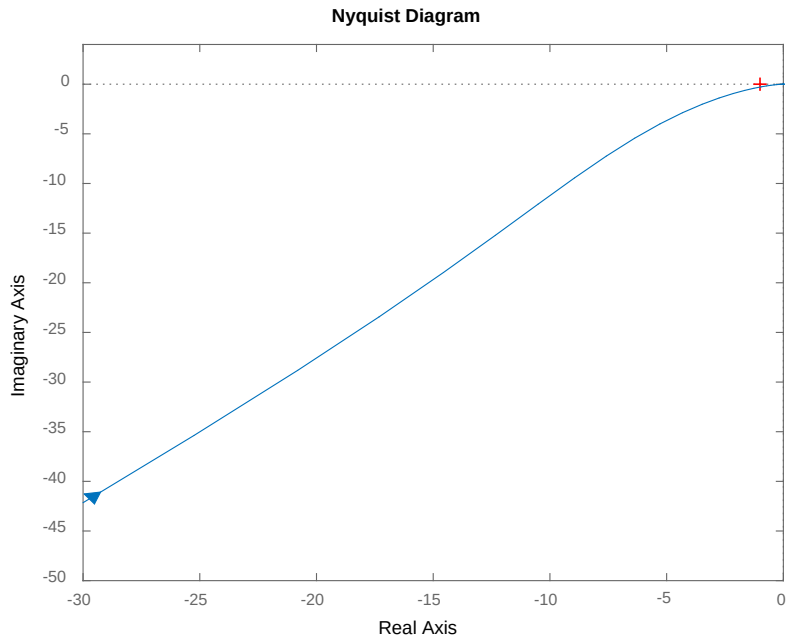


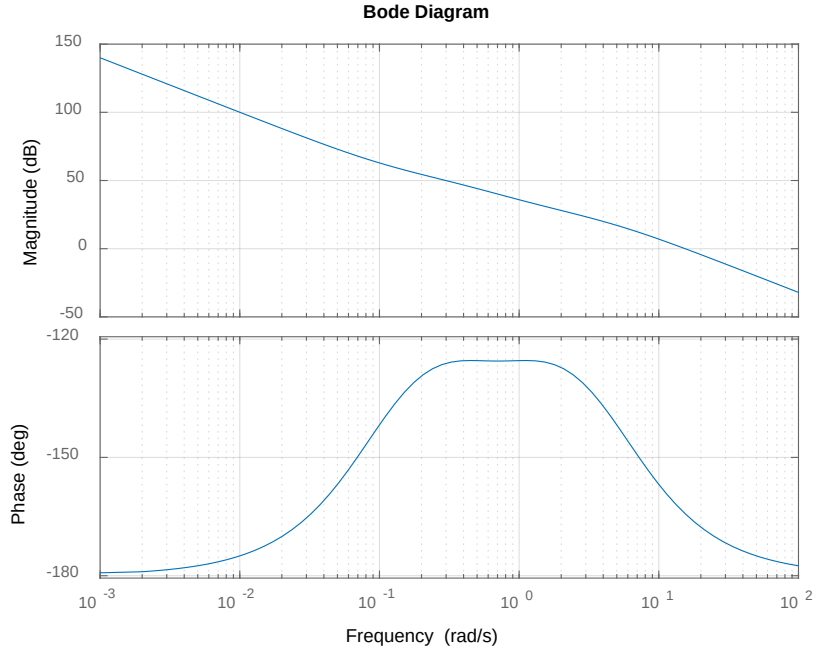


19.

$$\frac{10\,(1+s/0.1)\,(1+s)}{s^2\,(1+s/0.5)\,(1+s/5)}$$

$\bar{P}\ \bar{P}$ Z P Z P

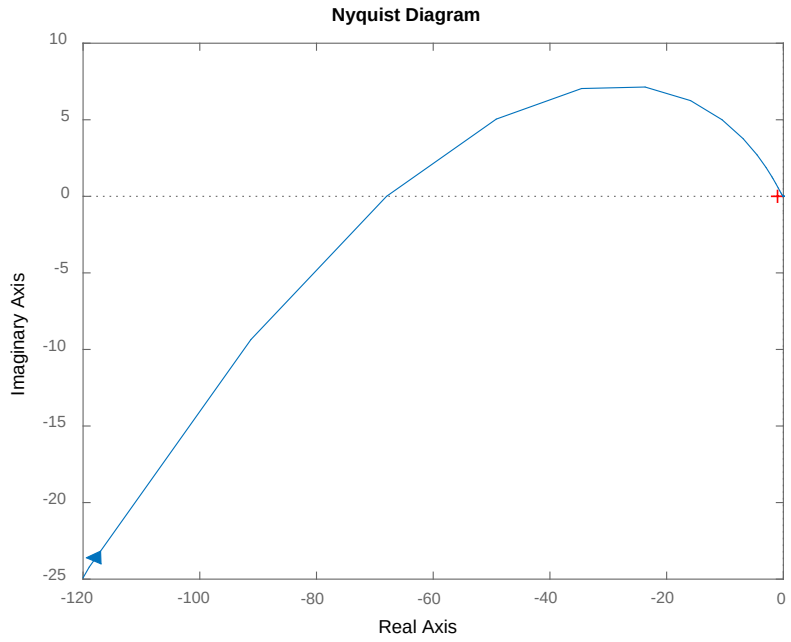


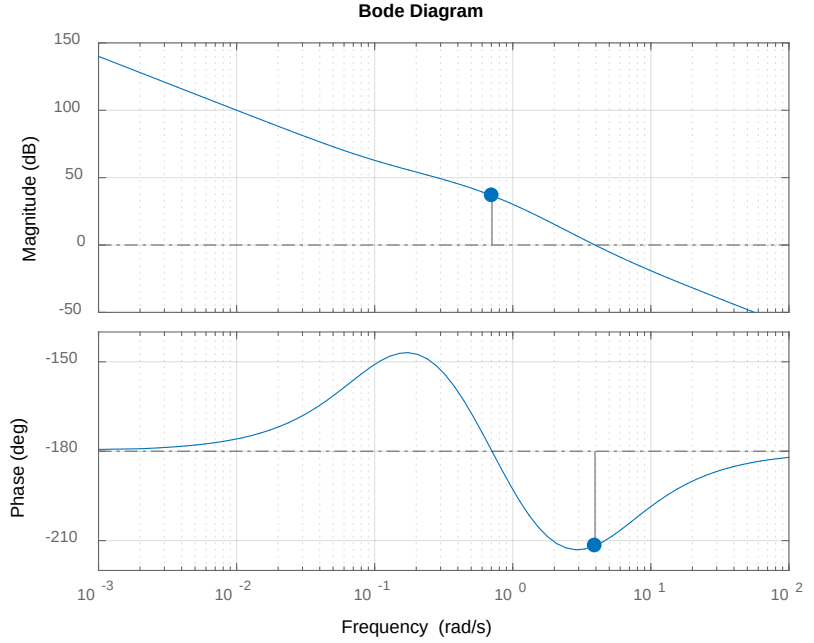


20.

$$\frac{10\,(1+s/0.1)\,(1+s/5)}{s^2\,(1+s/0.5)\,(1+s)}$$

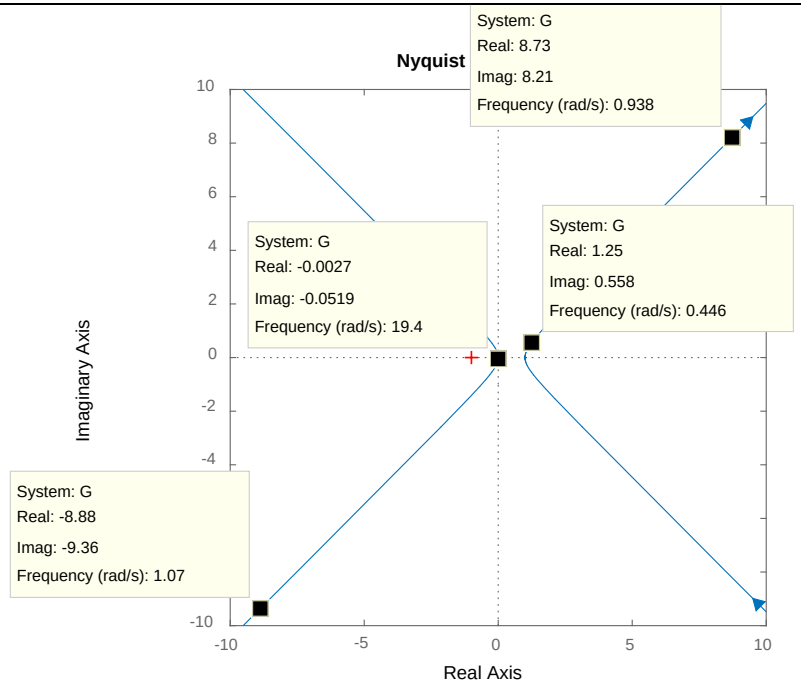
$\bar{P}\ \bar{P}$ Z P P Z

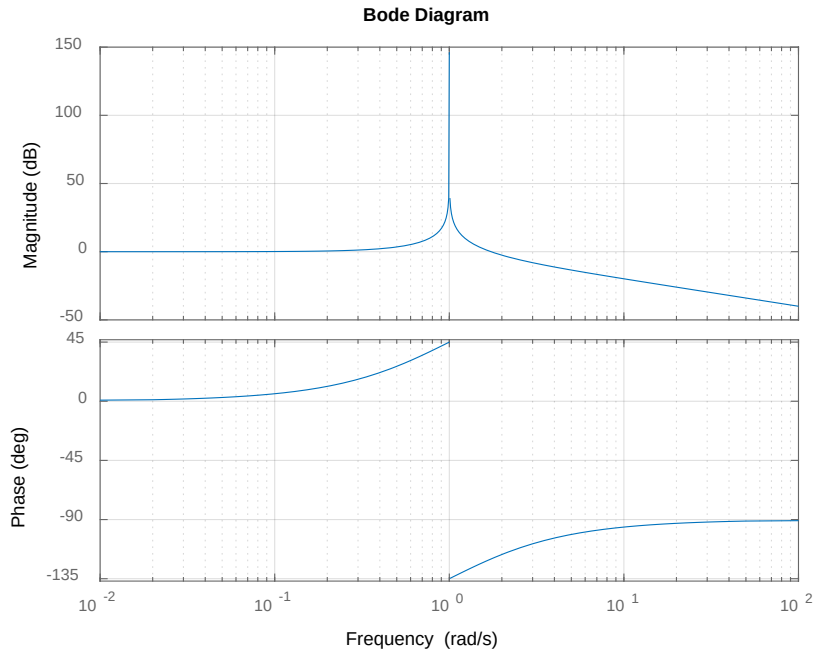




21.

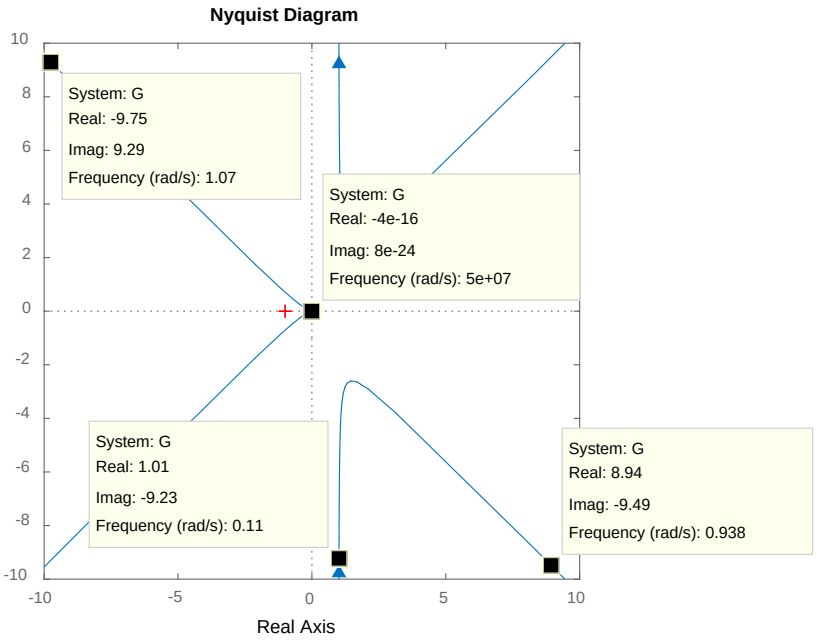
$$\frac{(1+s)}{(1+s^2)}$$

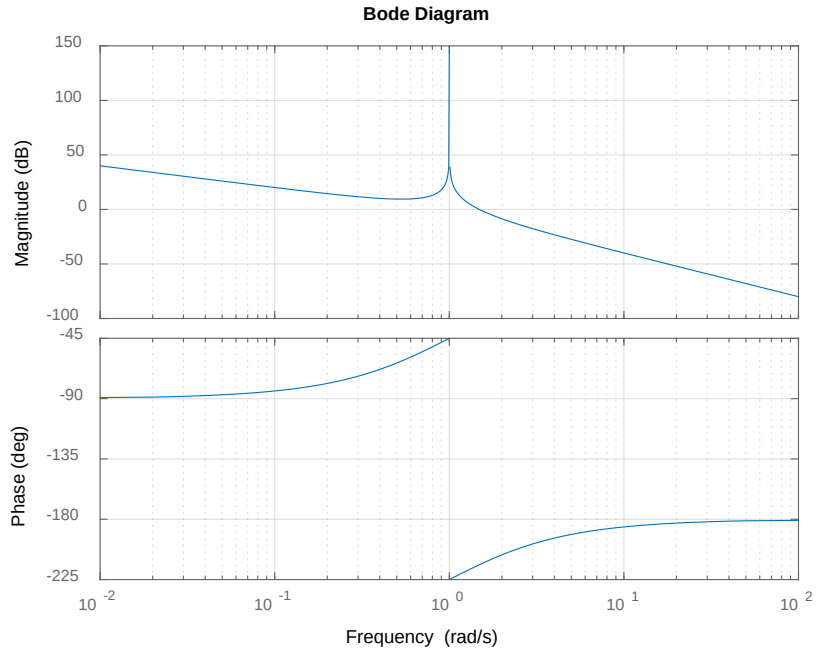




22.

$$\frac{(1+s)}{s(1+s^2)}$$





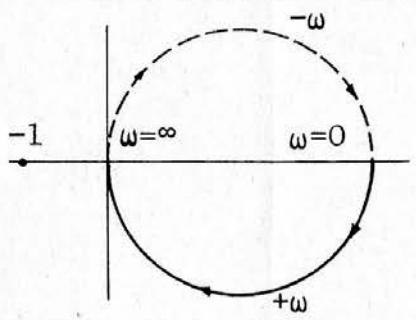
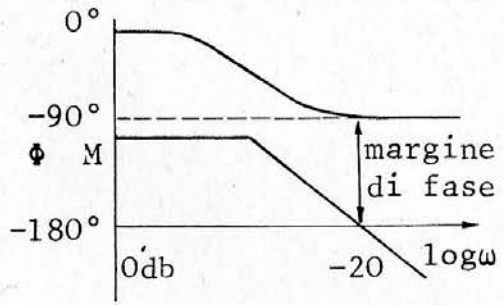
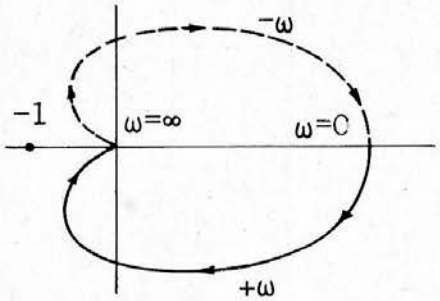
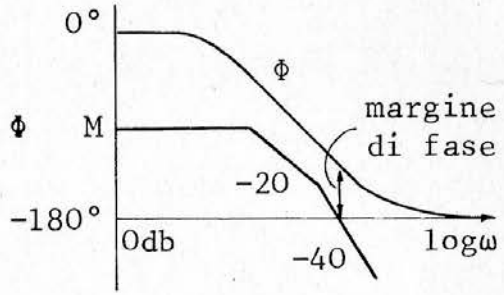
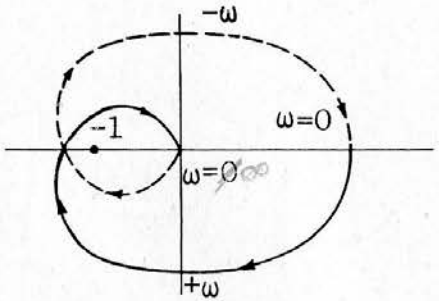
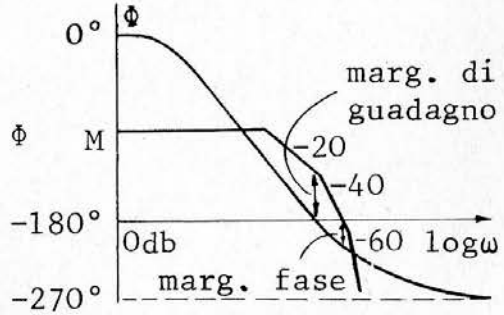
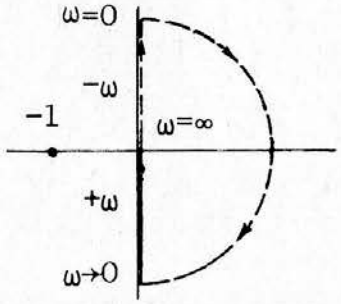
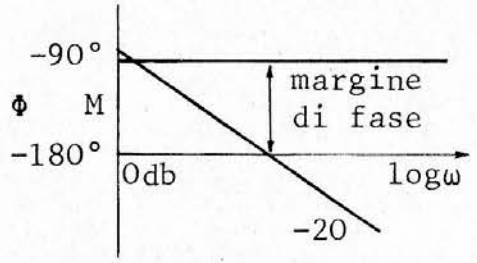
Comandi per diagrammi di Nyquist e Bode con Matlab delle funzioni tracciate

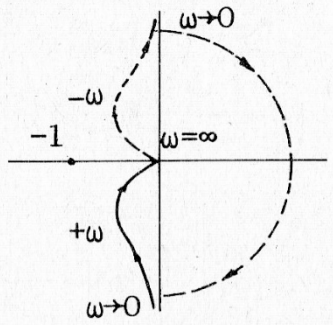
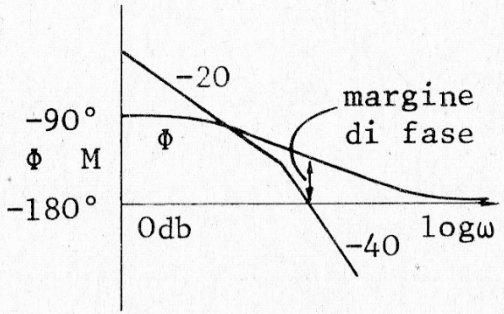
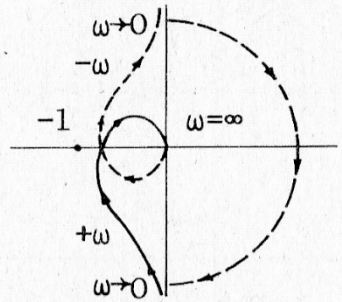
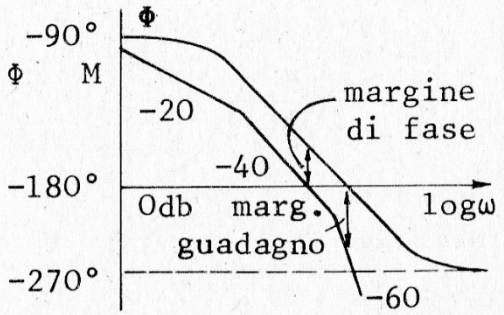
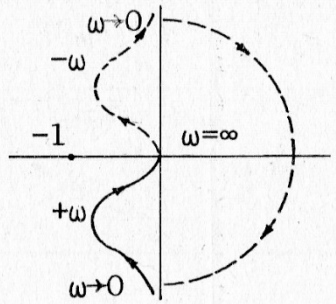
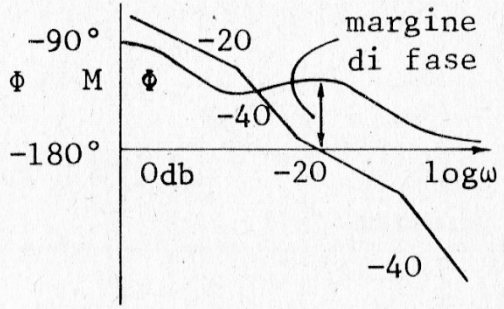
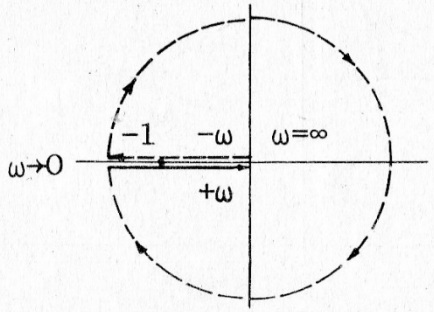
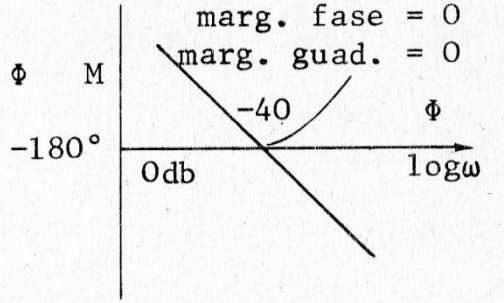
```
s=zpk('s');
G=10/(1+s)
[z,p,k] = zpkdata(G,'v')
G=zpk(z,p,k,'d','f')
nyquist(G)
daspect([1 1 1])
bode(G)
grid
```

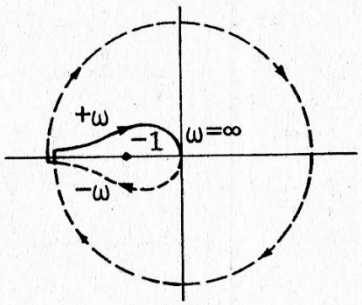
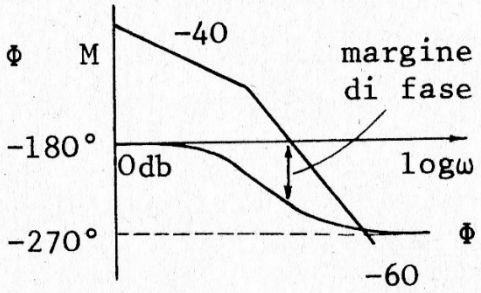
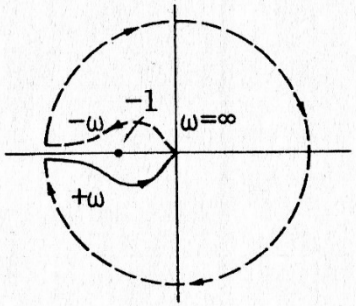
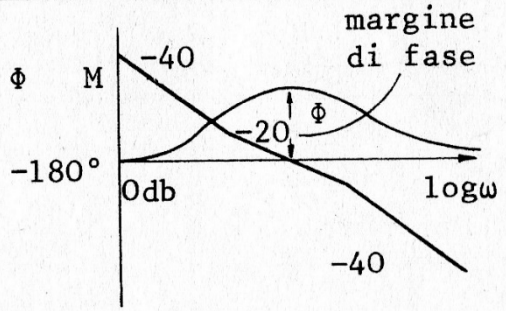
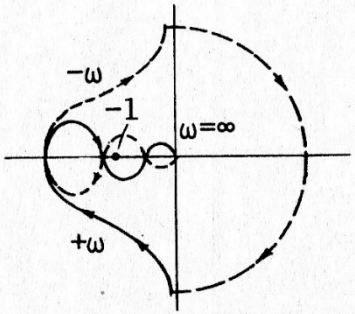
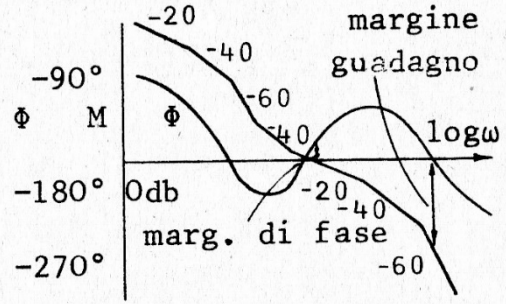
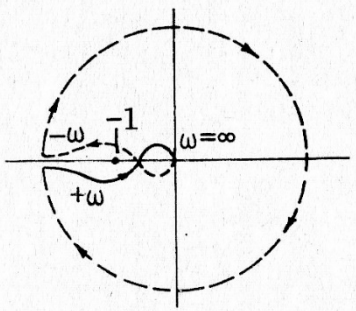
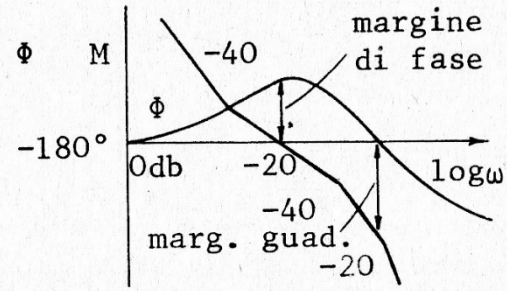
```
1. G=10/(1+s)    % P
2. G=10*s/(1+s)    % /Z P
3. G=10*(1+s/10)/(1+s)    % P Z
4. G=(1+s)/(1+s/10) % Z P
5. G=10/(1+s)/(1+s/2)    % P P
6. G=10*s/(1+s)/(1+s/5)    % /Z P P
7. G=10*(1+s/2)/(1+s)/(1+s/5)       % P Z P
8. G=10*(1+s)/(1+s/2)/(1+s/5)    % Z P P
9. G=10*(1+s/5)/(1+s)/(1+s/2)    % P P Z
10. G=10*(1+s)/(1+s/10)/s     % /P Z P
11. G=10*(1+s/10)/(1+s)/s     % /P P Z
12. G=10/(1+s)/(1+s/2)/s     % /P P P
13. G=10*(1+s)/(1+s/2)/(1+s/5)/s     % /P Z P P
14. G=10*(1+s/2)/(1+s)/(1+s/5)/s     % /P P Z P
15. G=10*(1+s/5)/(1+s)/(1+s/2)/s     % /P P P Z
16. G=10*(1+s)/(1+s/10)/s/s     % /P /P Z P
17. G=10*(1+s/10)/(1+s)/s/s     % /P /P P Z
18. G=10/(1+s)/(1+s/2)/s/s     % /P /P P Z
19. G=10*(1+s/0.1)*(1+s)/(1+s/0.5)/(1+s/5)/s/s    % /P /P Z P Z P
20. G=10*(1+s/0.1)*(1+s/5)/(1+s/0.5)/(1+s)/s/s    % /P /P Z P P Z
21. G=(1+s)/(1+s^2)
22. G=(1+s)/(1+s^2)/s
```

Le funzioni da 1 a 20 sono tracciate solo per frequenze positive (diagrammi polari)

Le ultime due funzioni sono rappresentate anche per frequenze negative (diagrammi di Nyquist)

G(s)·H	NYQUIST	BODE	NOTE
(1) $\frac{K}{sT_1 + 1}$			tipo 0 sempre stabile margine di guadagno = ∞
(2) $\frac{K}{(sT_1 + 1)(sT_2 + 1)}$			tipo 0 sempre stabile margine di guadagno = ∞
(3) $\frac{K}{(sT_1 + 1)(sT_2 + 1)(sT_3 + 1)}$			tipo 0 instabile può diventare stabile riducendo K
(4) $\frac{K}{s}$			tipo 1 stabile integratore ideale

(5) $\dfrac{K}{s(sT_1 + 1)}$			tipo 1 stabile margine di guadagno = ∞
(6) $\dfrac{K}{s(sT_1 + 1)(sT_2 + 1)}$			tipo 1 stabile può diventare instabile aumentando il guadagno
(7) $\dfrac{K(sT_a + 1)}{s(sT_1 + 1)(sT_2 + 1)}$			tipo 1 stabile
(8) $\dfrac{K}{s^2}$			tipo 2 instabile doppio integratore deve essere compensato

G(s) H	NYQUIST	BODE	NOTE
(9) $\dfrac{K}{s^2(sT_1+1)}$			tipo 2 instabile deve essere compensato
(10) $\dfrac{K(sT_a+1)}{s^2(sT_1+1)}$			tipo 2 stabile per qualsiasi guadagno
(11) $\dfrac{K(sT_a+1)(sT_b+1)}{s(sT_1+1)(sT_2+1)(sT_3+1)(sT_4+1)}$			tipo 1 stabile guadagno piccolo→stabile K aumenta →instab. aumenta ancora →stabile K molto elevato →instab.
(12) $\dfrac{K(sT_a+1)}{s(sT_1+1)(sT_2+1)}$			tipo 2 stabile diventa instabile se aumenta il guadagno