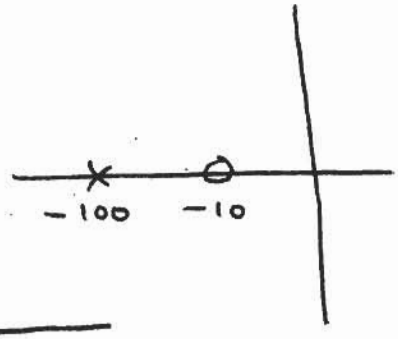
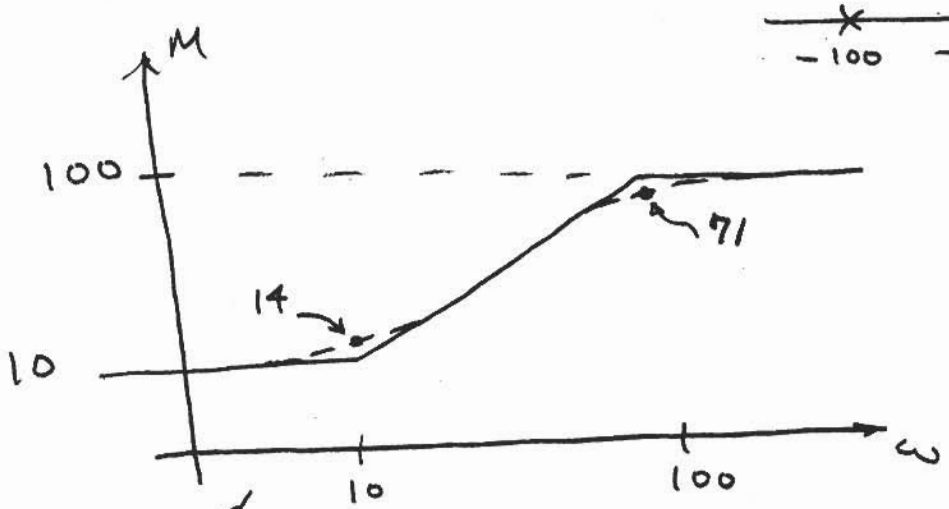
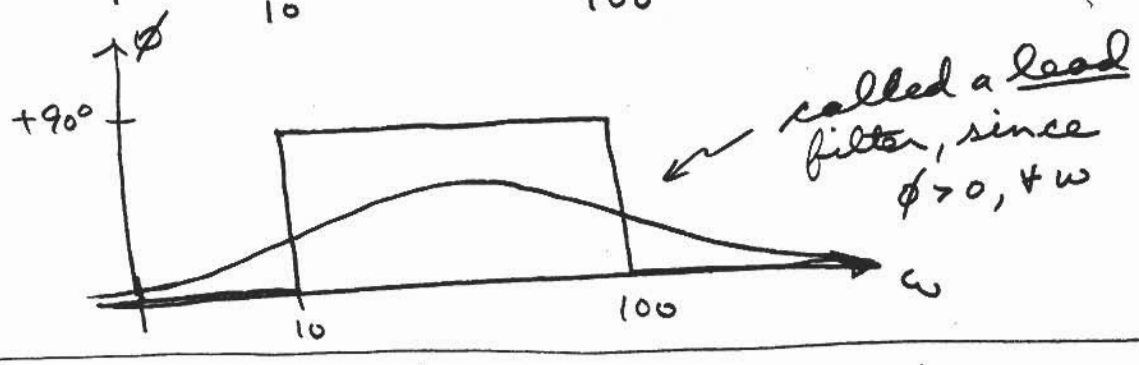
Example Bode plots

1) $H(s) = 10\,\dfrac{0.1s+1}{0.01s+1}$

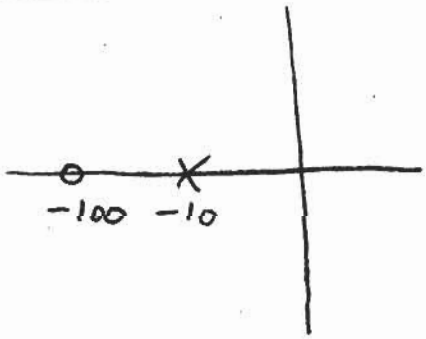


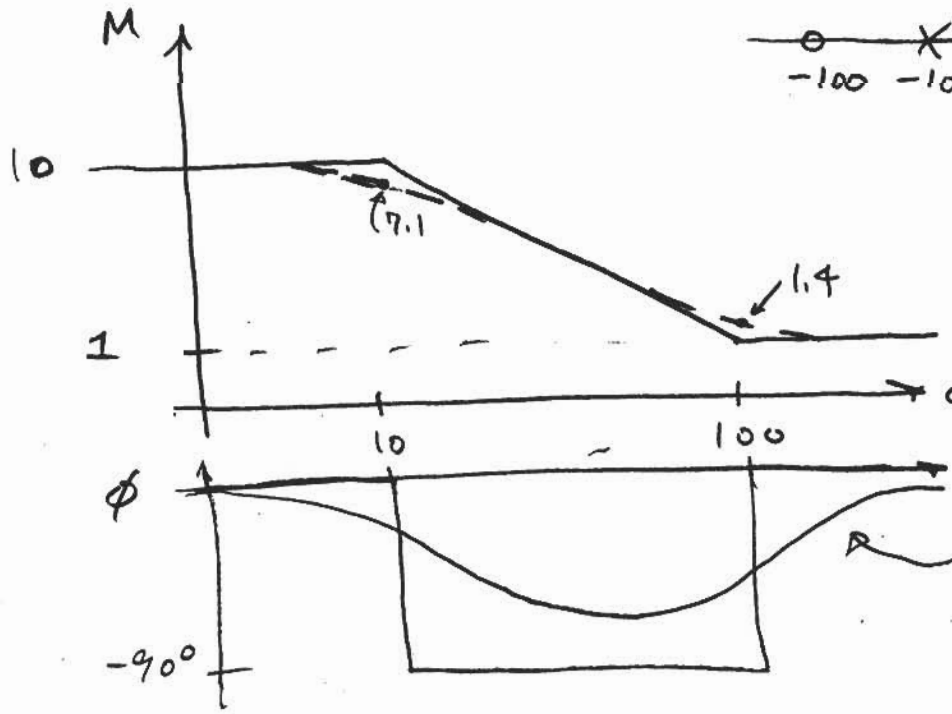




called a lead filter, since $\phi > 0, \forall \omega$

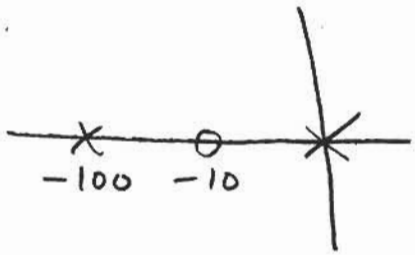
2) $H(s) = 10\,\dfrac{0.01s+1}{0.1s+1}$

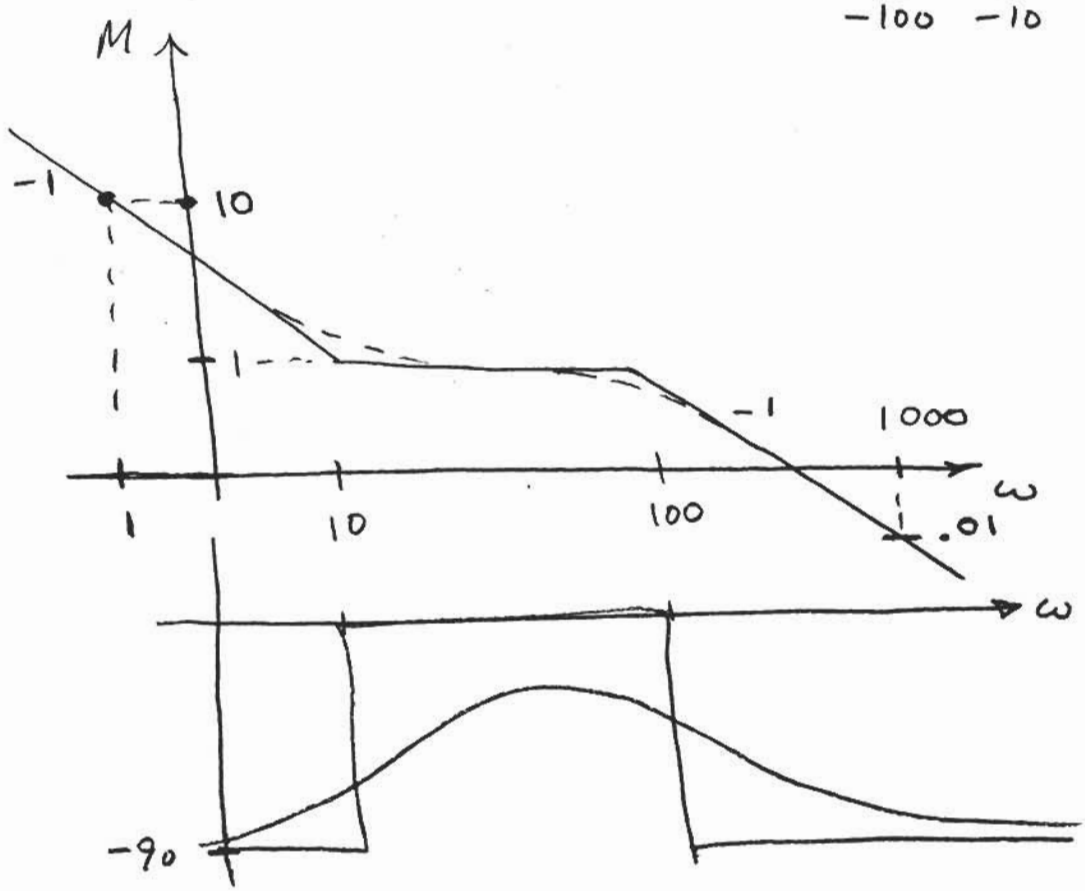




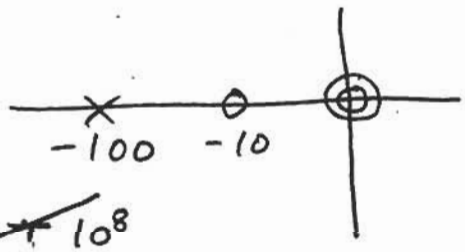
a lag filter because $\phi < 0, \forall \omega$

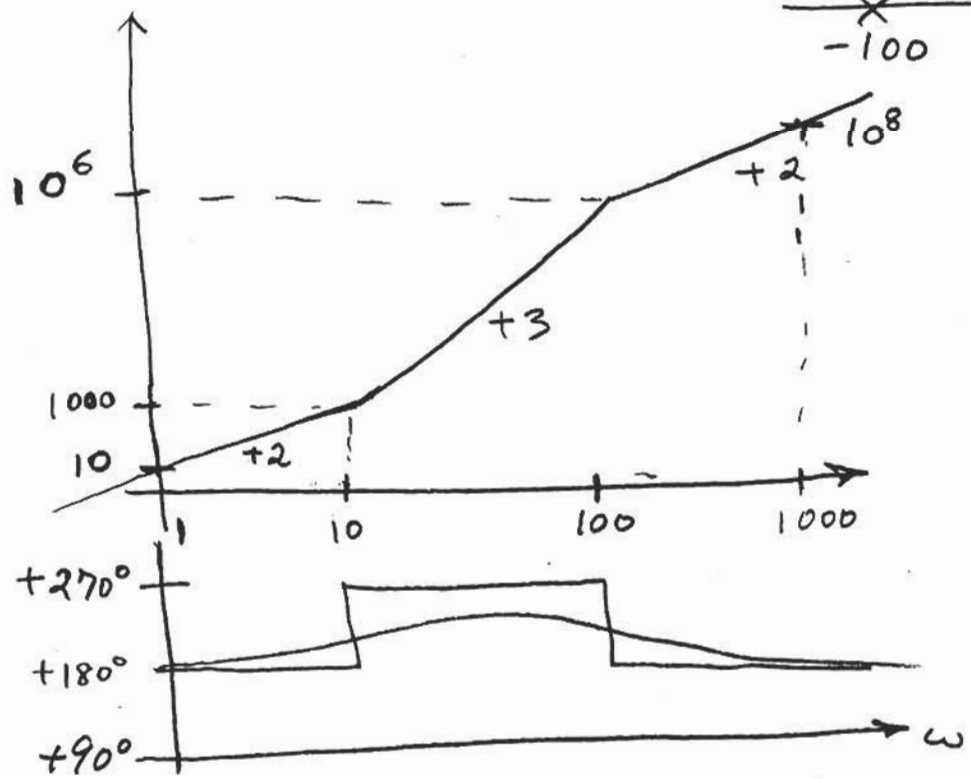
3) $H(s) = \frac{10}{s} \frac{0.1s+1}{0.01s+1}$





4) $H(s) = 10s^2 \frac{0.1s+1}{0.01s+1}$





$$H(s) = 10^{-2}\,\frac{\frac{s^2}{100^2} + \frac{0.2s}{100} + 1}{\frac{s^2}{1000^2} + \frac{0.1s}{1000} + 1}$$

Complex zeros

$\omega_n = 100$ $\quad \sigma = \zeta\omega_n = 10$

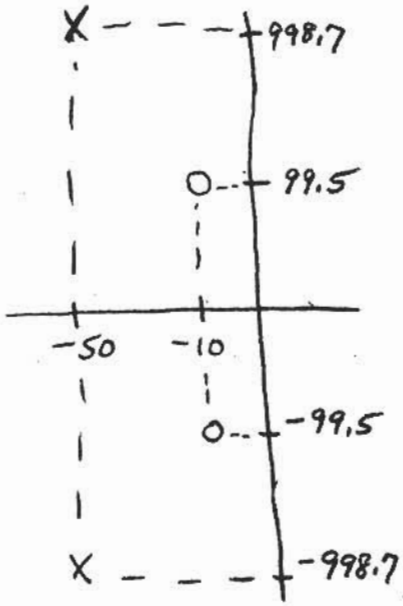
$\zeta = 0.1$ $\quad \omega_d = \omega_n\sqrt{1-\zeta^2}$

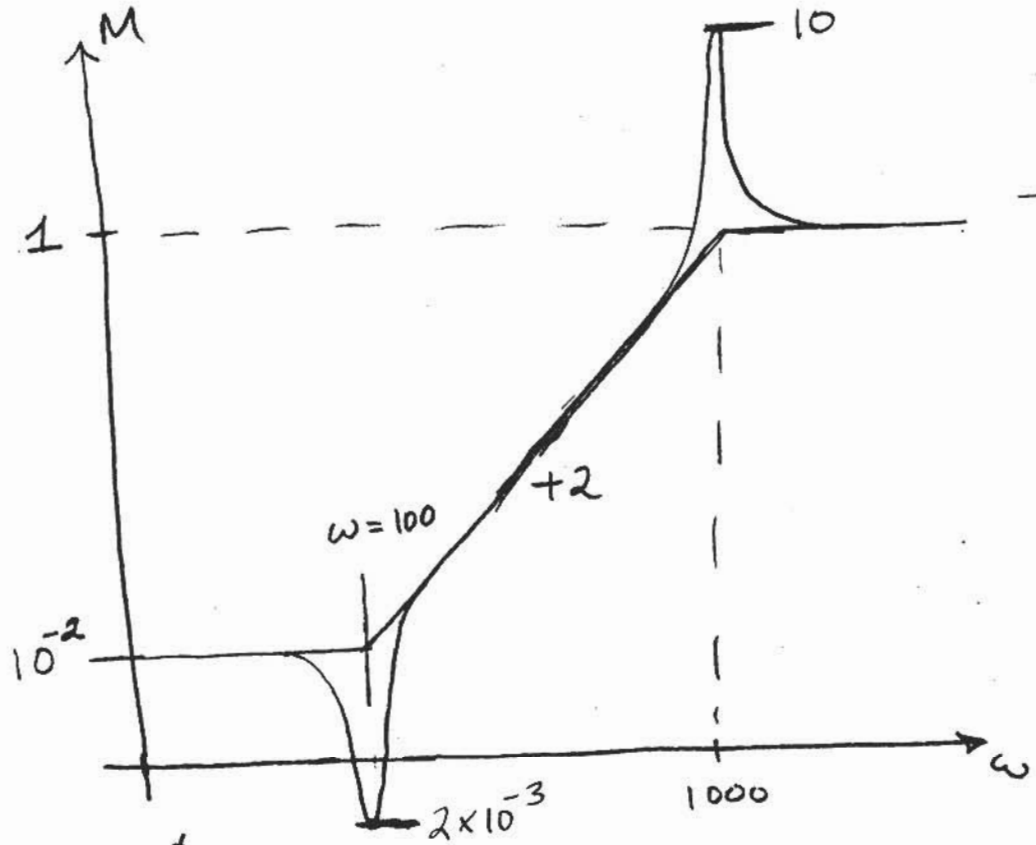
$= 99.5$ rad/sec

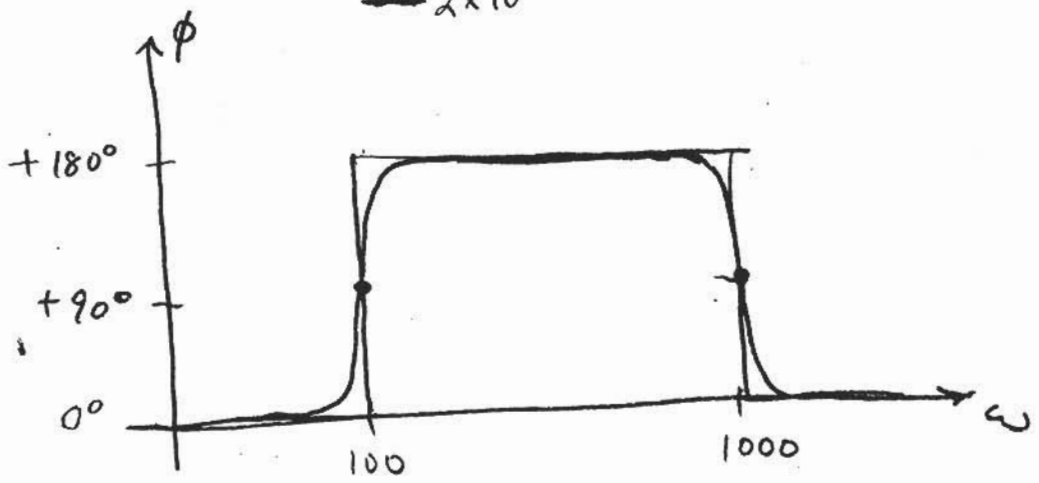
Complex poles

$\omega_n = 1000$ $\quad \sigma = 50$

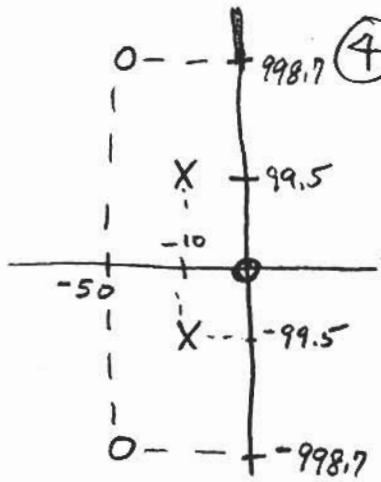
$\zeta = 0.05$ $\quad \omega_d = 998.7$





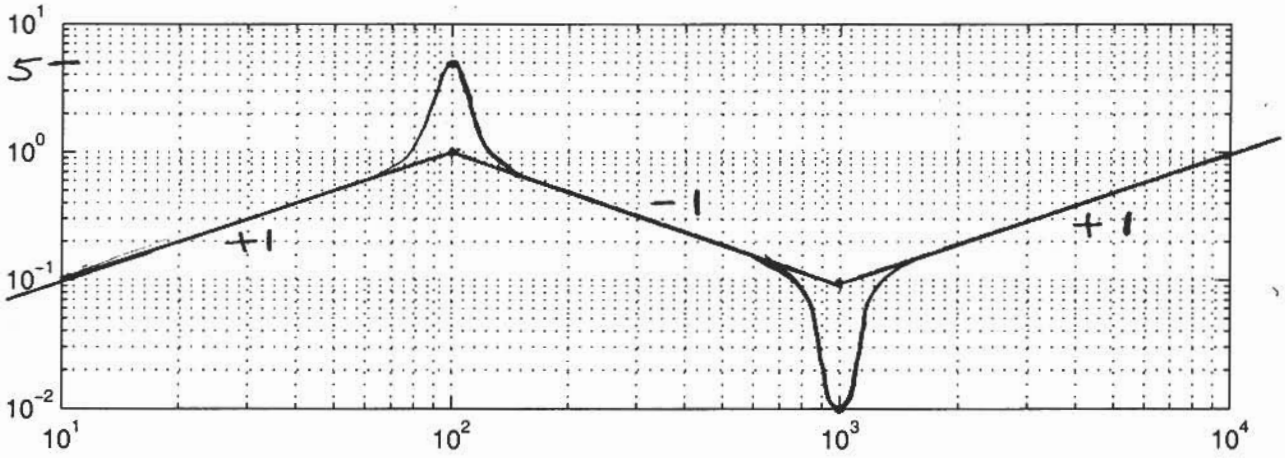


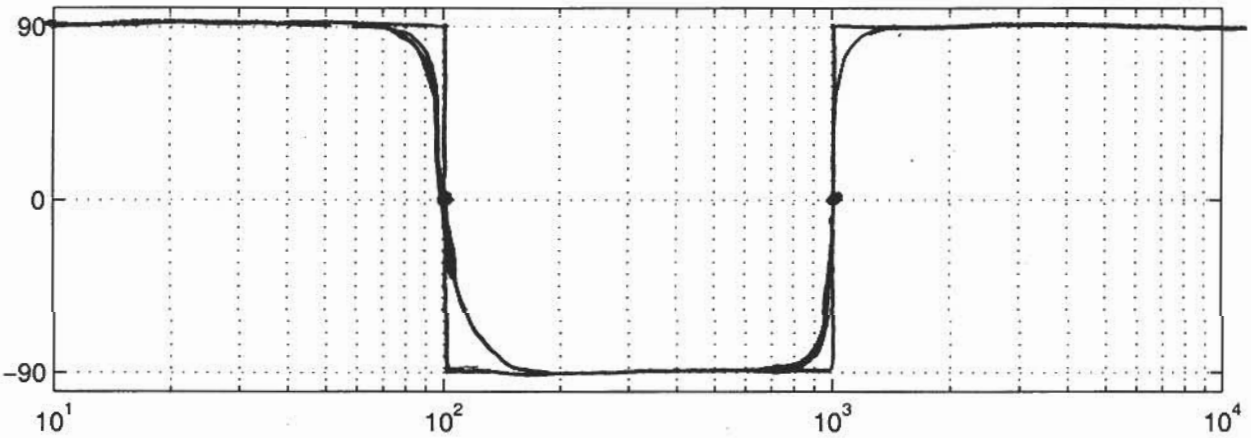
$$H(s) = 10^{-2} s \, \frac{\frac{s^2}{1000^2} + \frac{0.1s}{1000} + 1}{\frac{s^2}{100^2} + \frac{0.2s}{100} + 1}$$



④

Using the Bodeproperim routine I sent by email gives the axes used below:

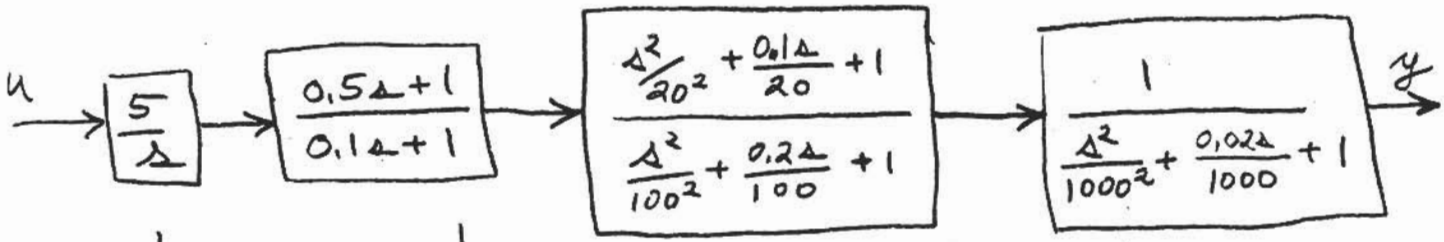


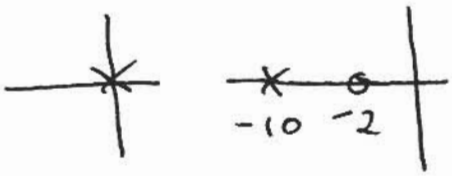


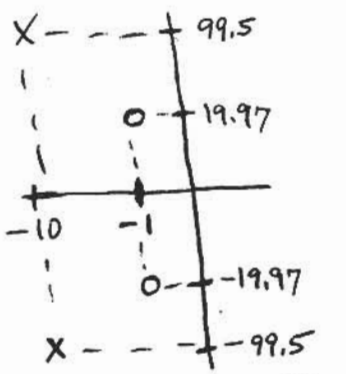

```
figure(1); clf
subplot(2,1,1)
loglog(.1,.1)
axis([1e1 1e4 1e-2 1e1])
grid on

subplot(2,1,2)
semilogx(.1,0)
axis([1e1 1e4 -100 100])
set(gca,'YTick',[-360:90:360])
grid on

print
```

commands to generate axes

A complicated example:

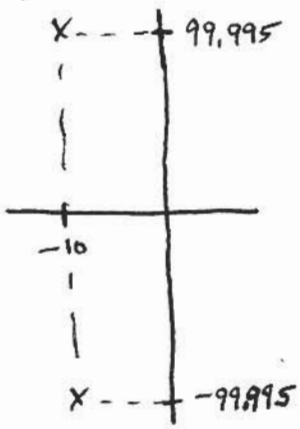




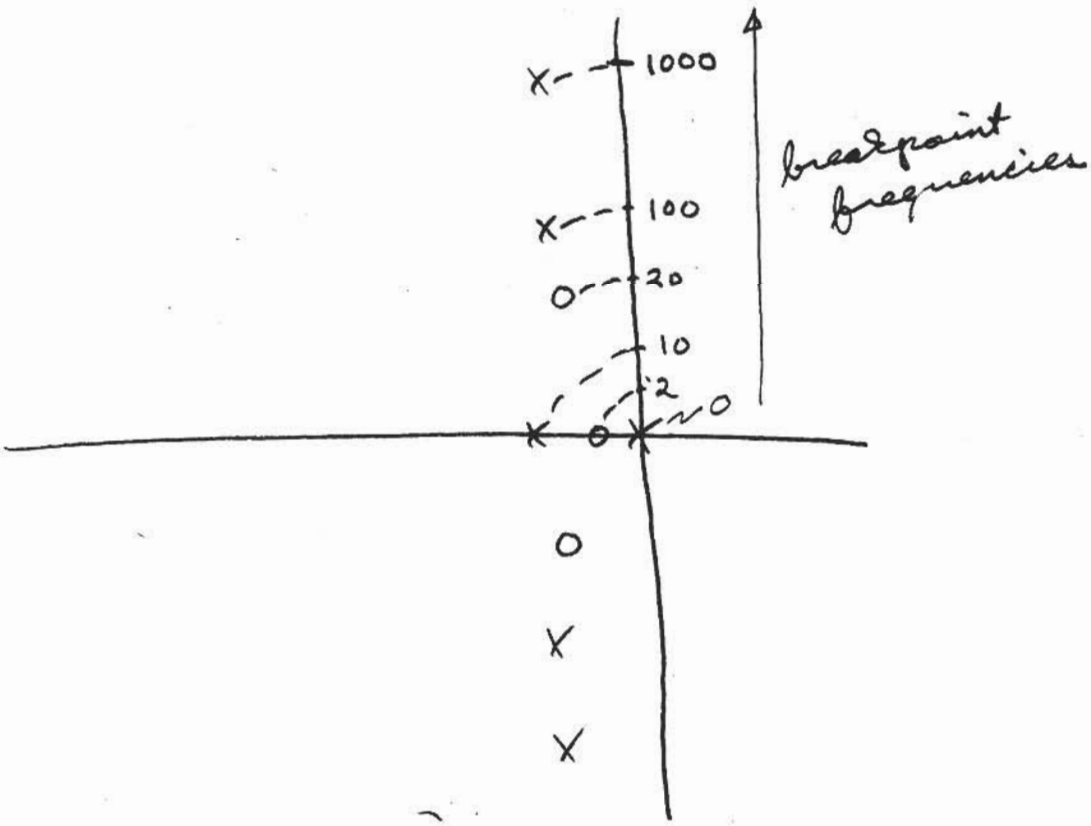


zeros: $\omega_n = 20$
$\zeta = 0.05$

poles $\omega_n = 100$
$\zeta = 0.1$

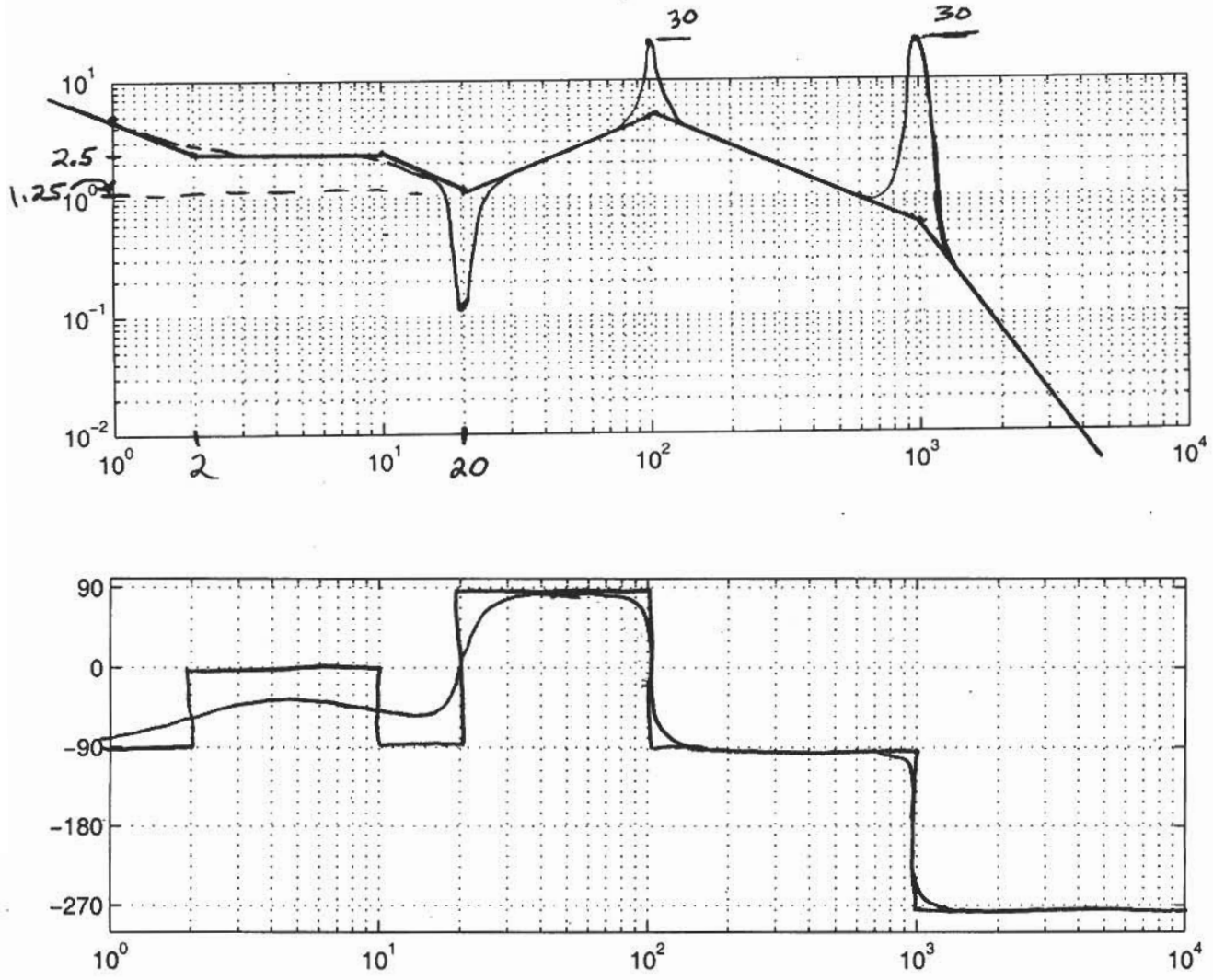


poles
$\omega_n = 1000$
$\zeta = 0.01$

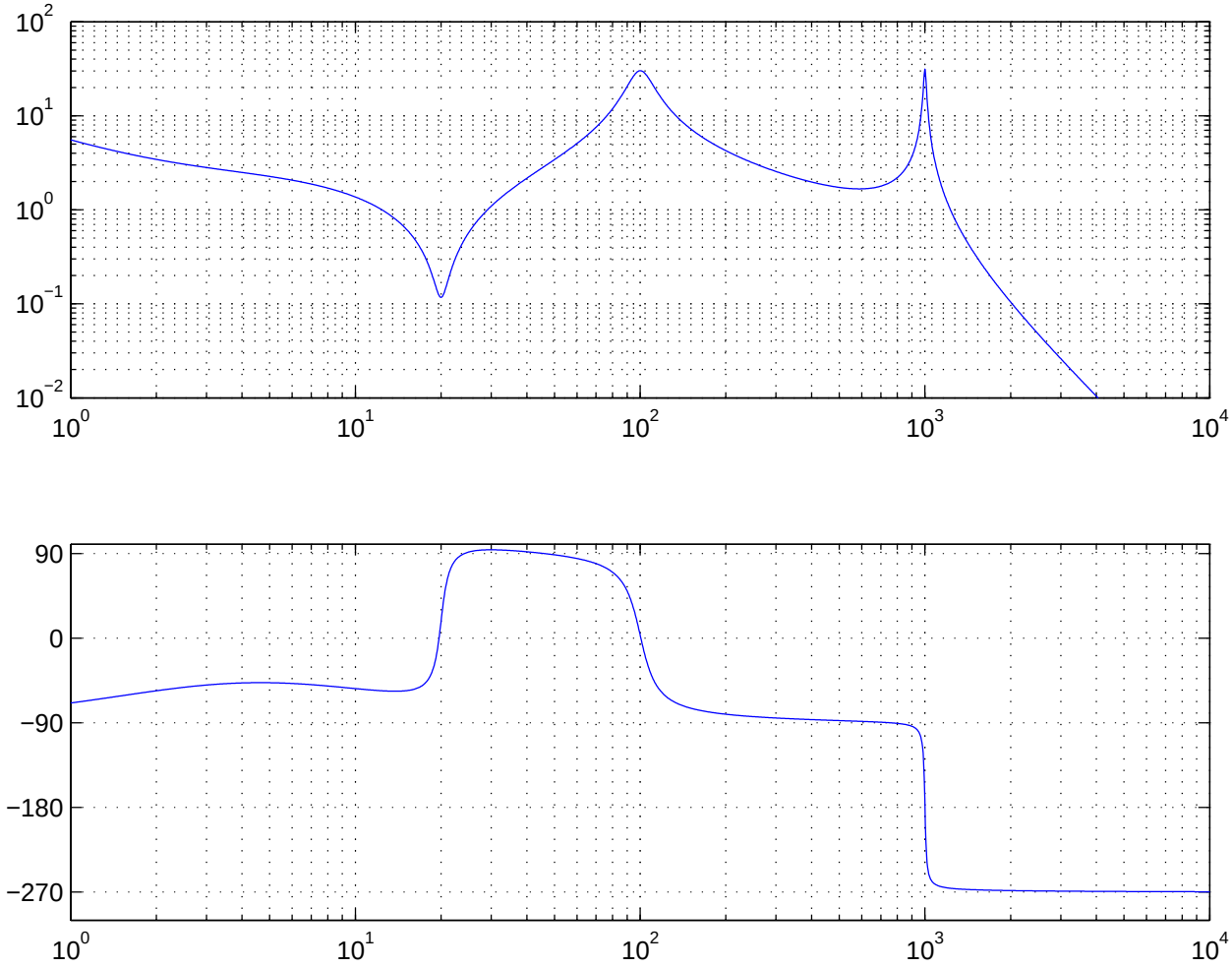


(6)

$$H(s) = \frac{5}{s} \cdot \frac{0.5s+1}{0.1s+1} \cdot \frac{\frac{s^2}{20^2} + \frac{0.1s}{20} + 1}{\frac{s^2}{100^2} + \frac{0.2s}{100} + 1} \cdot \frac{1}{\frac{s^2}{1000^2} + \frac{0.02s}{1000} + 1}$$



```
% define systems individually and then combine via
% multiplications (probably should use state space for higher
% accuracy in real computations
% D L Trumper 11/8/04

sys1 = tf(5,[1 0]);
sys2 = tf([0.5 1],[0.1 1]);
sys3 = tf([1/20^2 0.1/20 1],[1/100^2 0.2/100 1]);
sys4 = tf([1],[1/1000^2 0.02/1000 1]);

ww = logspace(0,4,2000);
totalsys = sys1*sys2*sys3*sys4;

[mag,phase] = bode(totalsys,ww);
mag2 = mag(:);
phase2 = phase(:);

figure(1); clf
subplot(2,1,1)
loglog(ww,mag2)
axis([1e0 1e4 1e-2 1e2])
grid on

subplot(2,1,2)
semilogx(ww,phase2)
axis([1e0 1e4 -300 100])
set(gca,'YTick',[-360:90:360])
grid on
```


10^{2}
10^{1}
10^{0}
10^{-1}
10^{-2}
10^{0}
10^{1}
10^{2}
10^{3}
10^{4}
90
0
−90
−180
−270
10^{0}
10^{1}
10^{2}
10^{3}
10^{4}