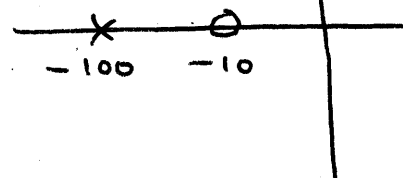
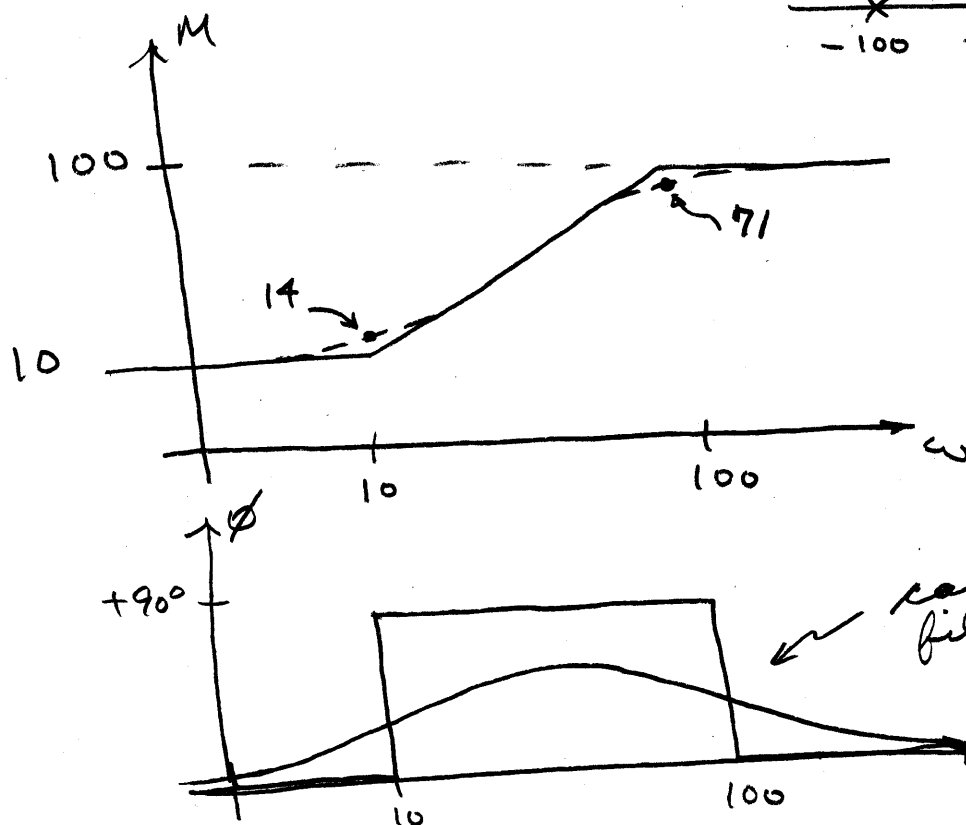


Example Bode plots

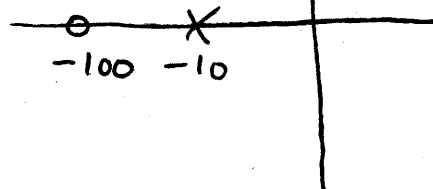
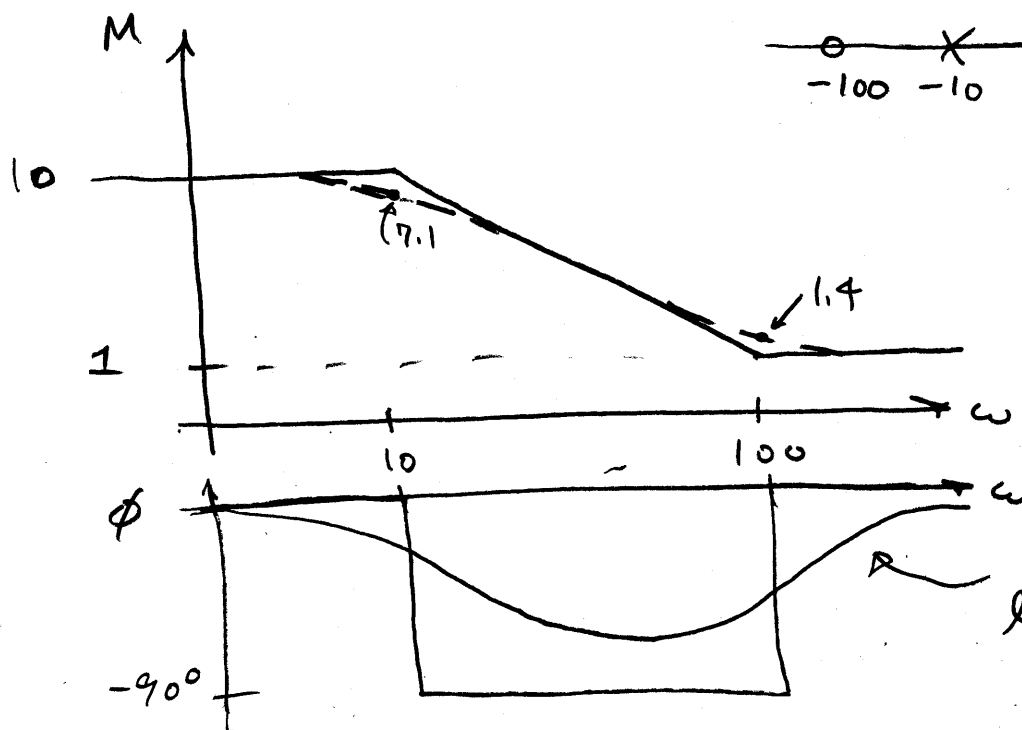
1

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



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

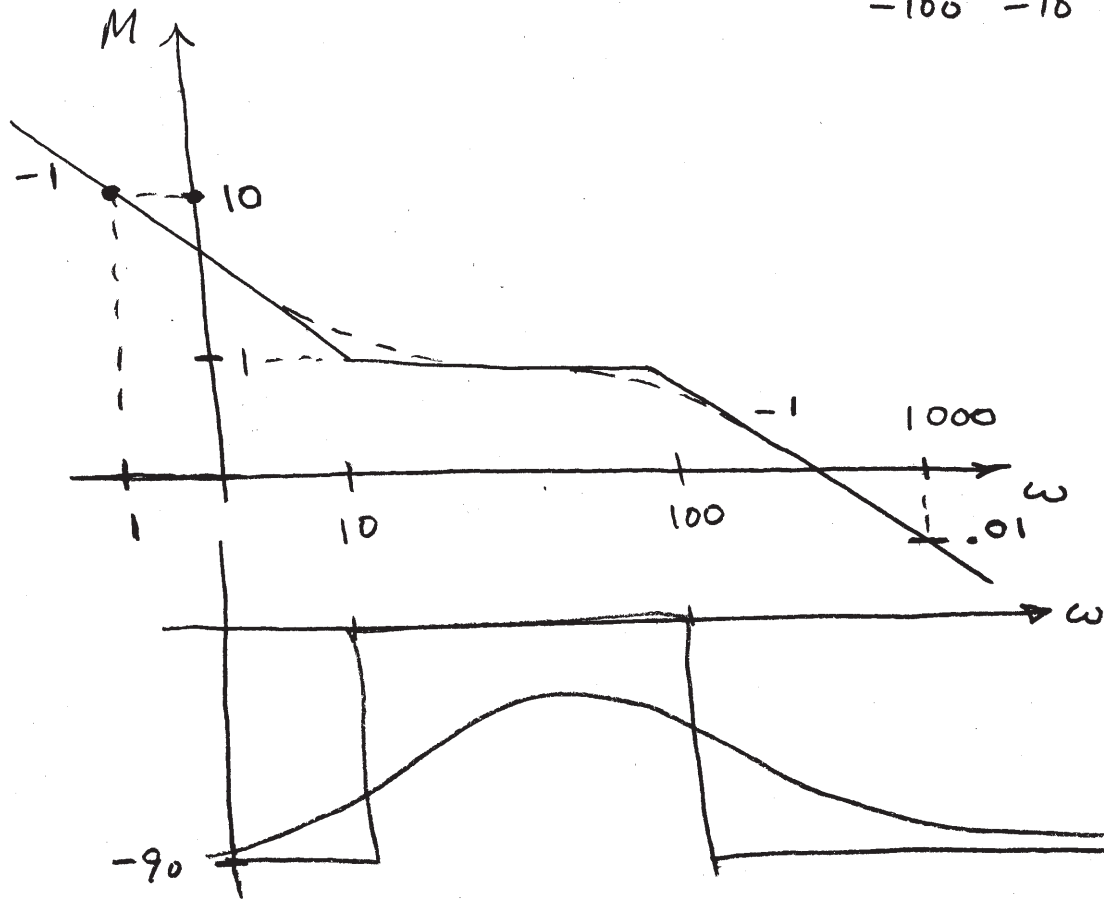
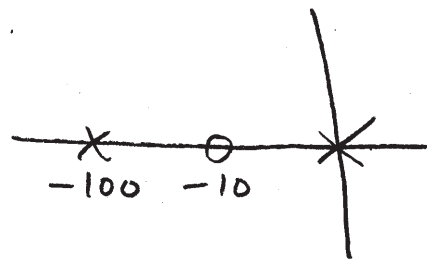
$$2) H(s) = 10 \frac{0.01s + 1}{0.1s + 1}$$



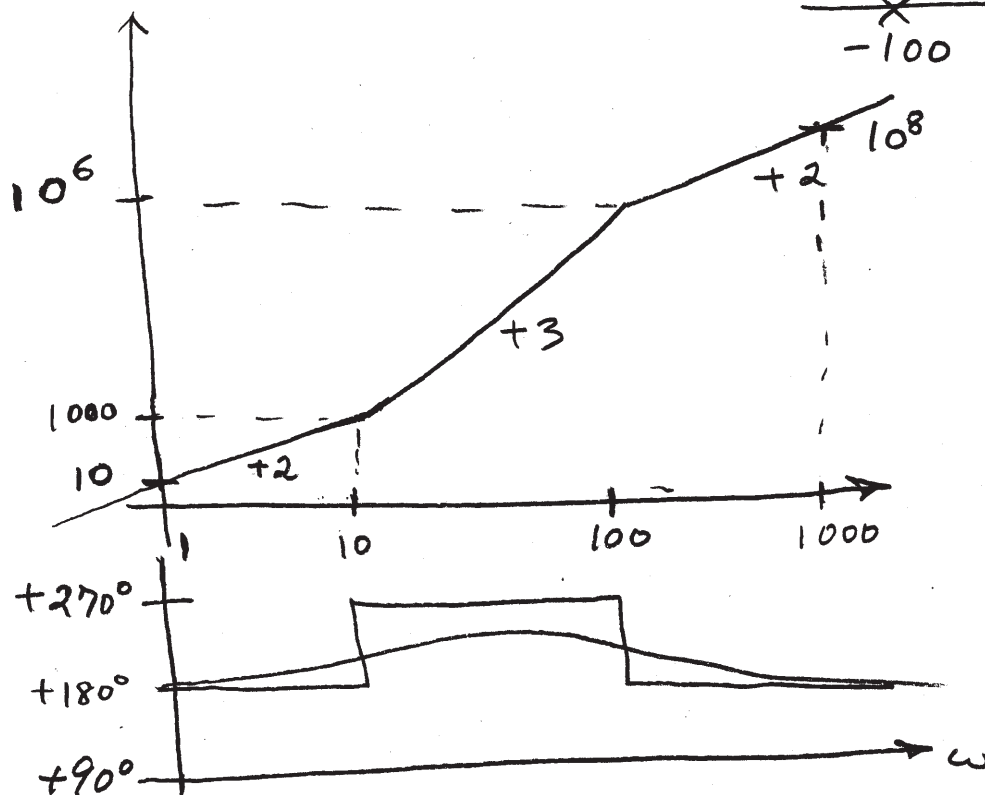
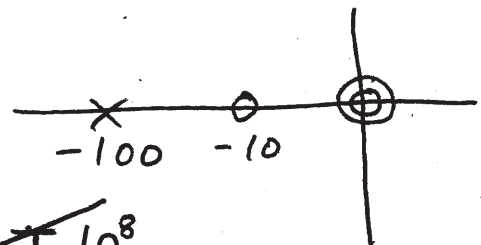
a lag filter because $\phi < 0, \forall \omega$

2

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



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



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

Complex zeros

$$\omega_n = 100$$

$$\xi = 0.1$$

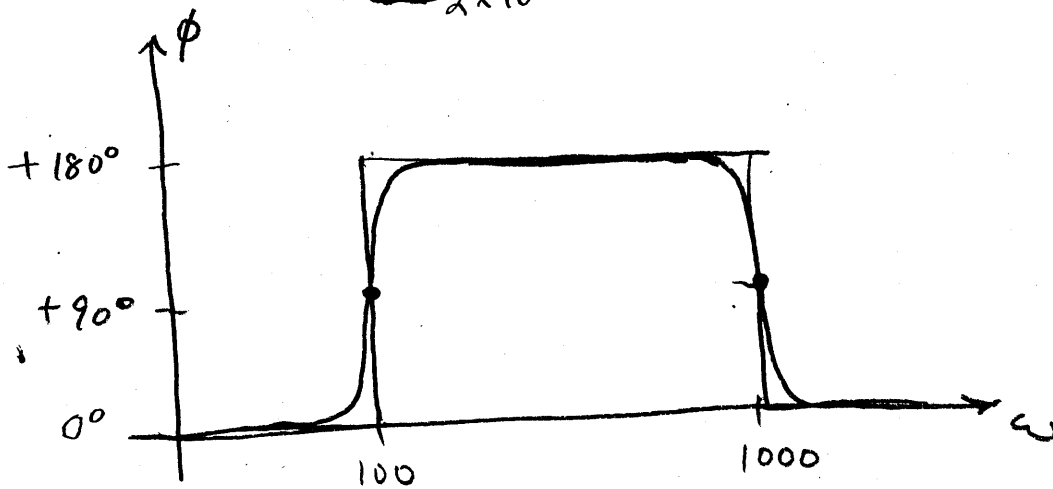
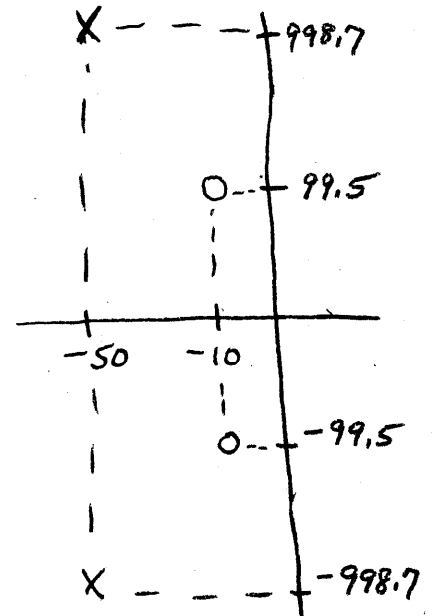
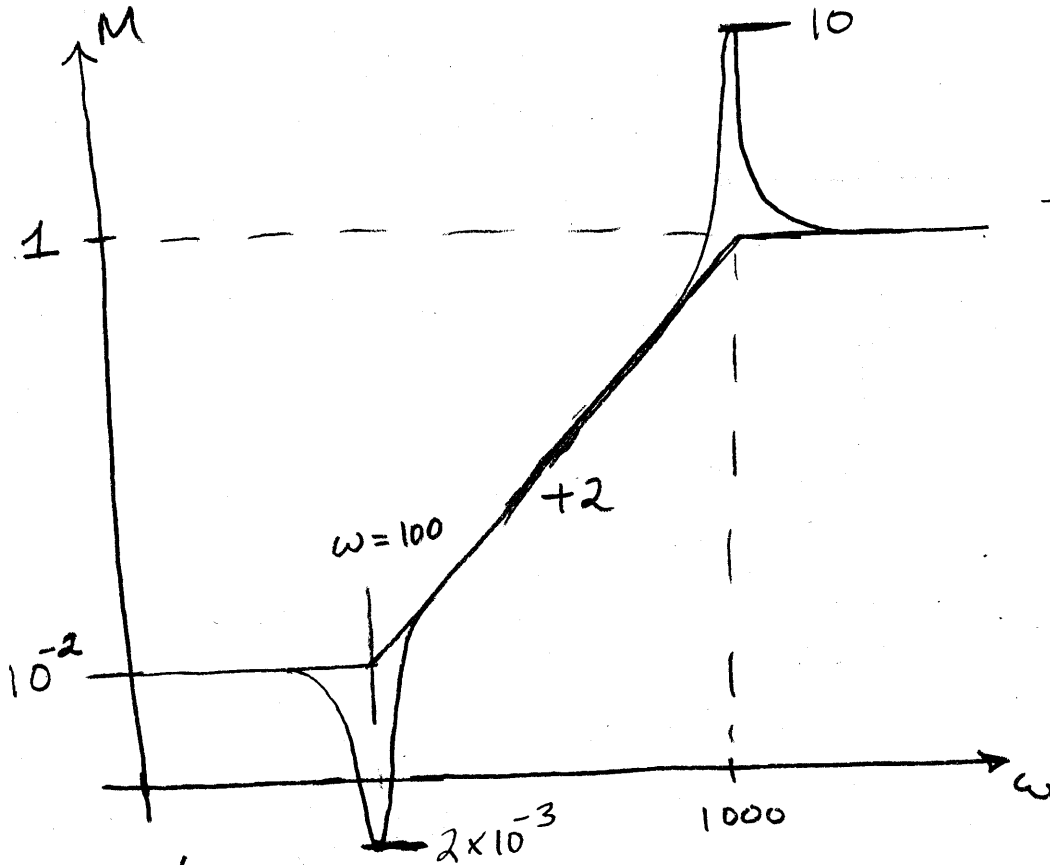
$$\sigma = \xi \omega_n = 10$$

$$\omega_d = \omega_n \sqrt{1 - \xi^2} = 99.5 \text{ rad/sec}$$

Complex poles

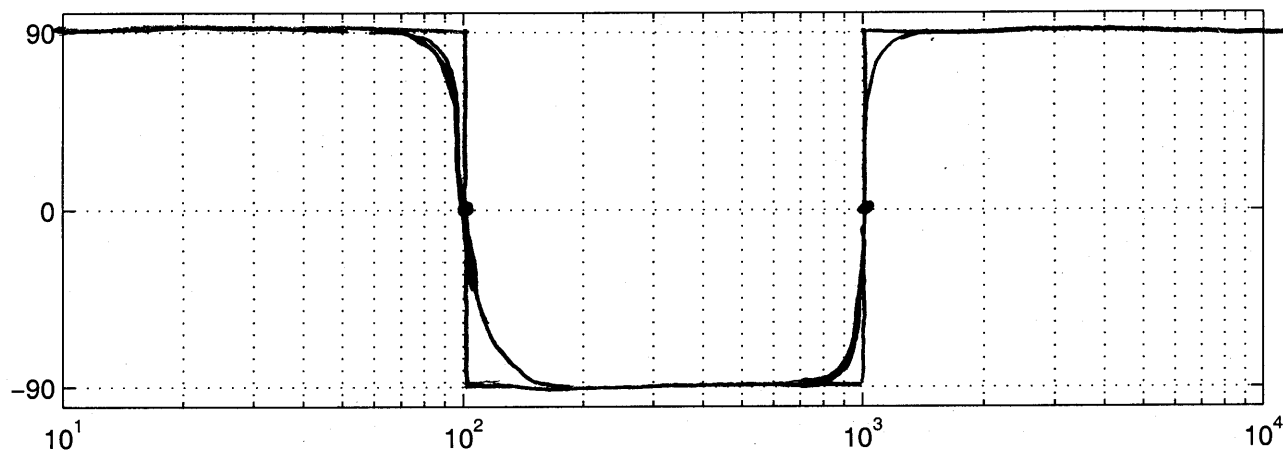
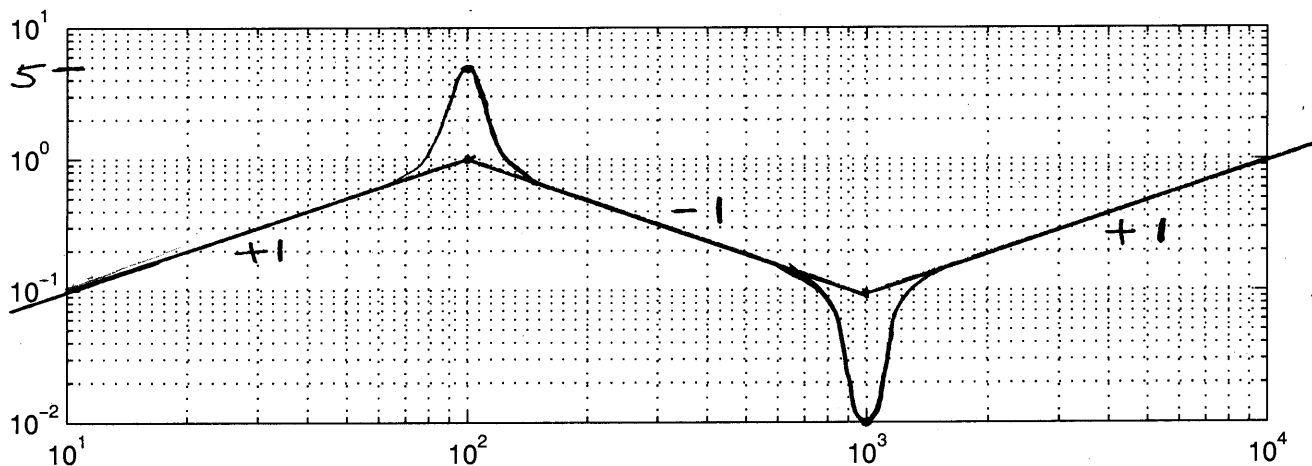
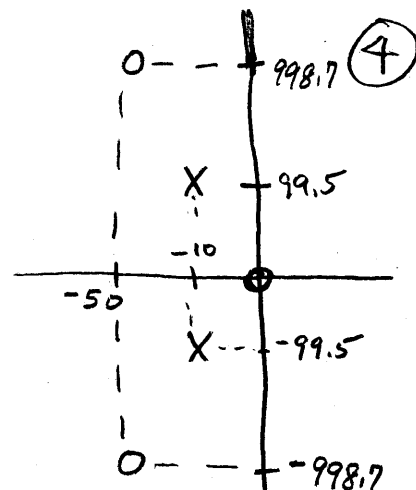
$$\omega_n = 1000 \quad \sigma = 50$$

$$\xi = 0.05 \quad \omega_d = 998.7$$



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

Using the Bodepaper.m 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

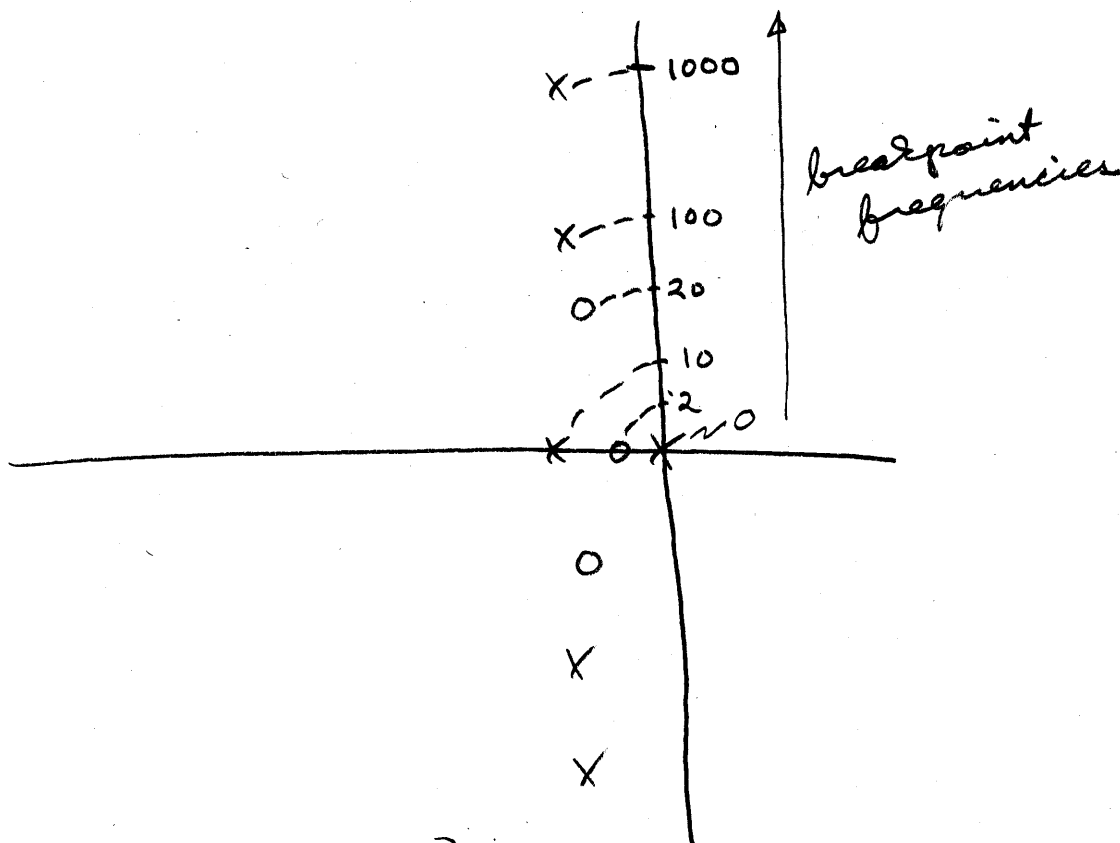
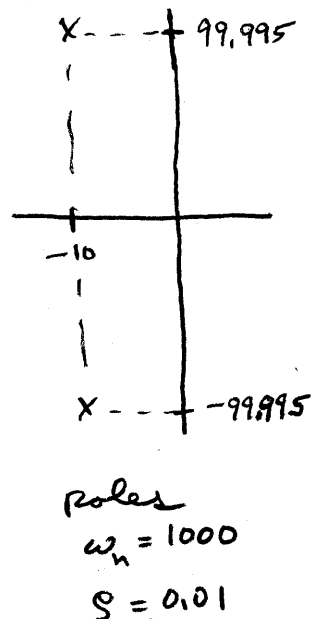
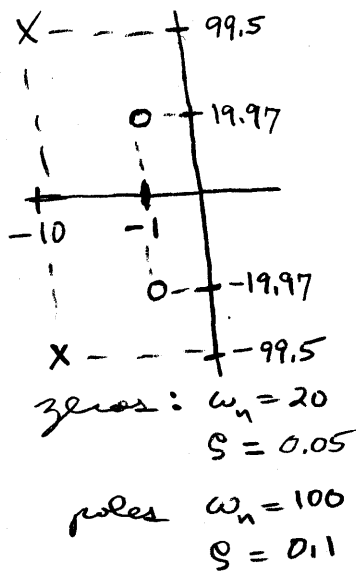
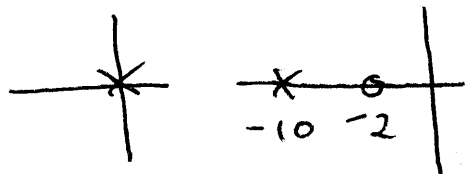
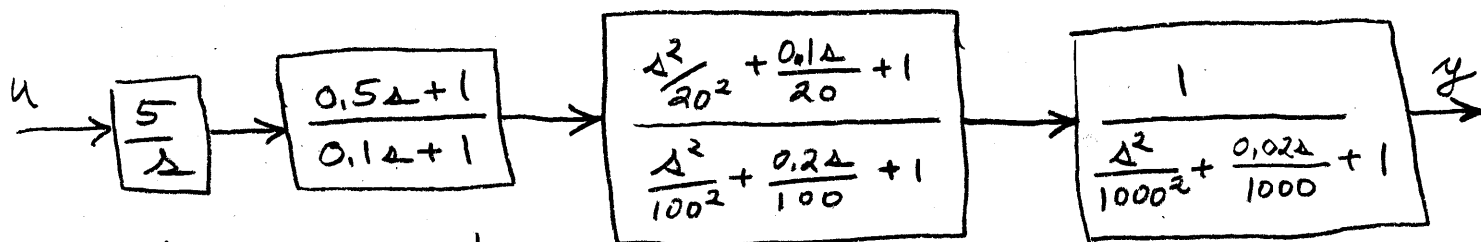
subplot(2,1,2)
semilogx(.1,0)
axis([1e1 1e4 -100 100])
set(gca, 'YTick', [-360:90:360])
grid on

print
```

← commands to generate axes

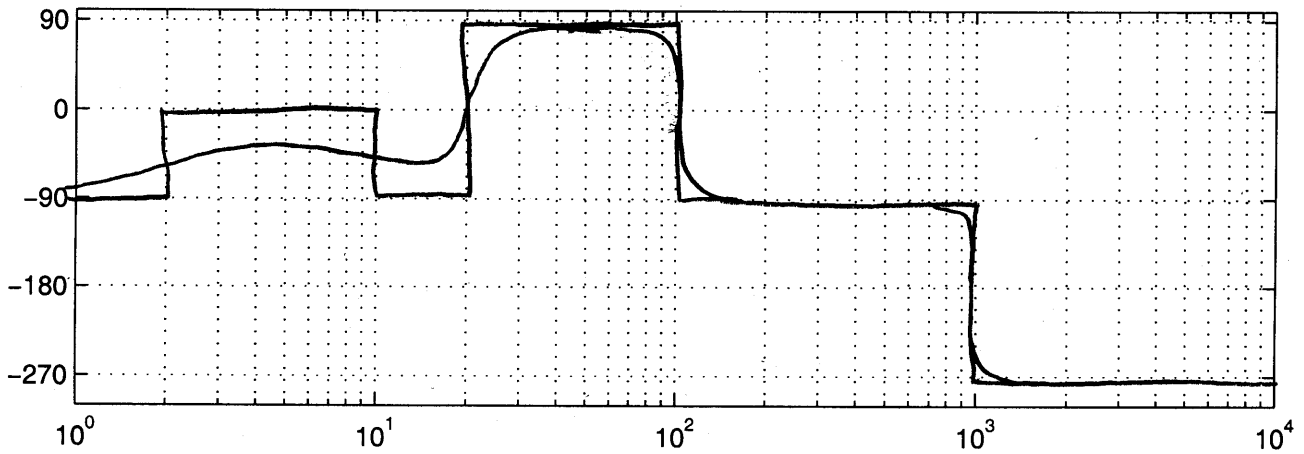
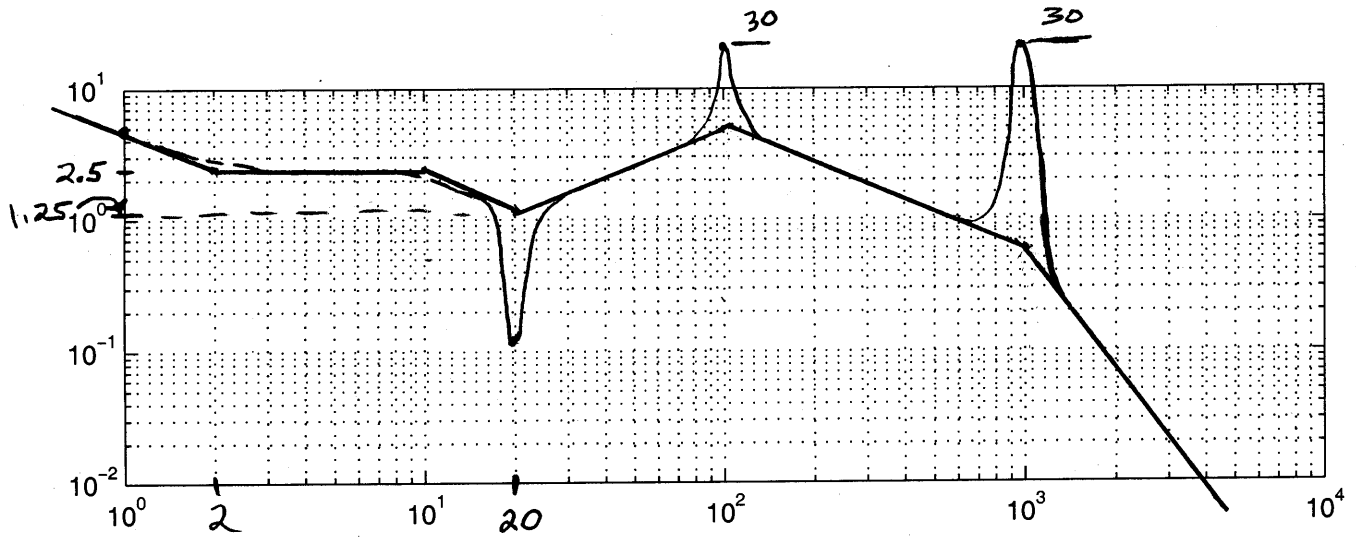
A complicated example:

5



6

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



```
% 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
```

