```
clear
lose all
lc

%Problem 1
num=[-5 0 0];den=[5 253 20000];
sys=tf(num,den)
%Transfer function:
%          -5 s^2
%----------------------
%5 s^2 + 253 s + 20000
f=0:.01:50;
w=2*pi*f;
bode(sys,w)

%Problem 2
chareq=den/5
%chareq =
% 1 s^2 + 50.6 s + 4000

%Problem 3
p=pole(sys)
%p =
%    -25.3 +       57.96473065580481i
%    -25.3 -       57.96473065580481i

%Problem 4
   %Method 1
damp(sys)
%         Eigenvalue              Damping      Freq. (rad/s)
  -2.53e+001 + 5.80e+001i      4.00e-001       6.32e+001
% -2.53e+001 - 5.80e+001i      4.00e-001       6.32e+001
   %Method 2
wnr=sqrt(4000)
%In Radians/Sec
%wnr =
%          63.2455532033676
z=50.6/(2*wnr)
%z =
%           0.4000281240113

%Problem 5
wnh=wnr/(2*pi)
%In Hz
%wnh =
%          10.0658424208974

%Problem 6
freqresp(sys,20*2*pi)
%ans =
%      -1.03752137764646 -     0.5594912211170341i

resp=freqresp(sys,w);
Resp(1,:)=resp(:,:,:);
figure(2)
subplot(2,1,1)
semilogx(f,20*log10(abs(Resp)))
grid on
  abel('Frequency (Hz)')
abel('Magnitude (dB)')

subplot(2,1,2)
semilogx(f,(180/pi)*angle(Resp))
grid on
```

Characteristic Eq

$s^2 + 50.6s + 4000 = 0$

Poles

$-25.3 \pm 57.964\, i$

$\omega_n^2 = 4000$

$\omega_n = 63.245$ r/s

$2\zeta\omega_n = 50.6$

$\zeta = \frac{50.6}{2(63.245)} = 0.4$

$f_n = 10$ Hz

Damping Ratio $\zeta = 0.4$

$\omega_n = 2\pi f_n \rightarrow f_n = \frac{\omega_n}{2\pi} = \frac{63.245}{2\pi} = 10$ Hz

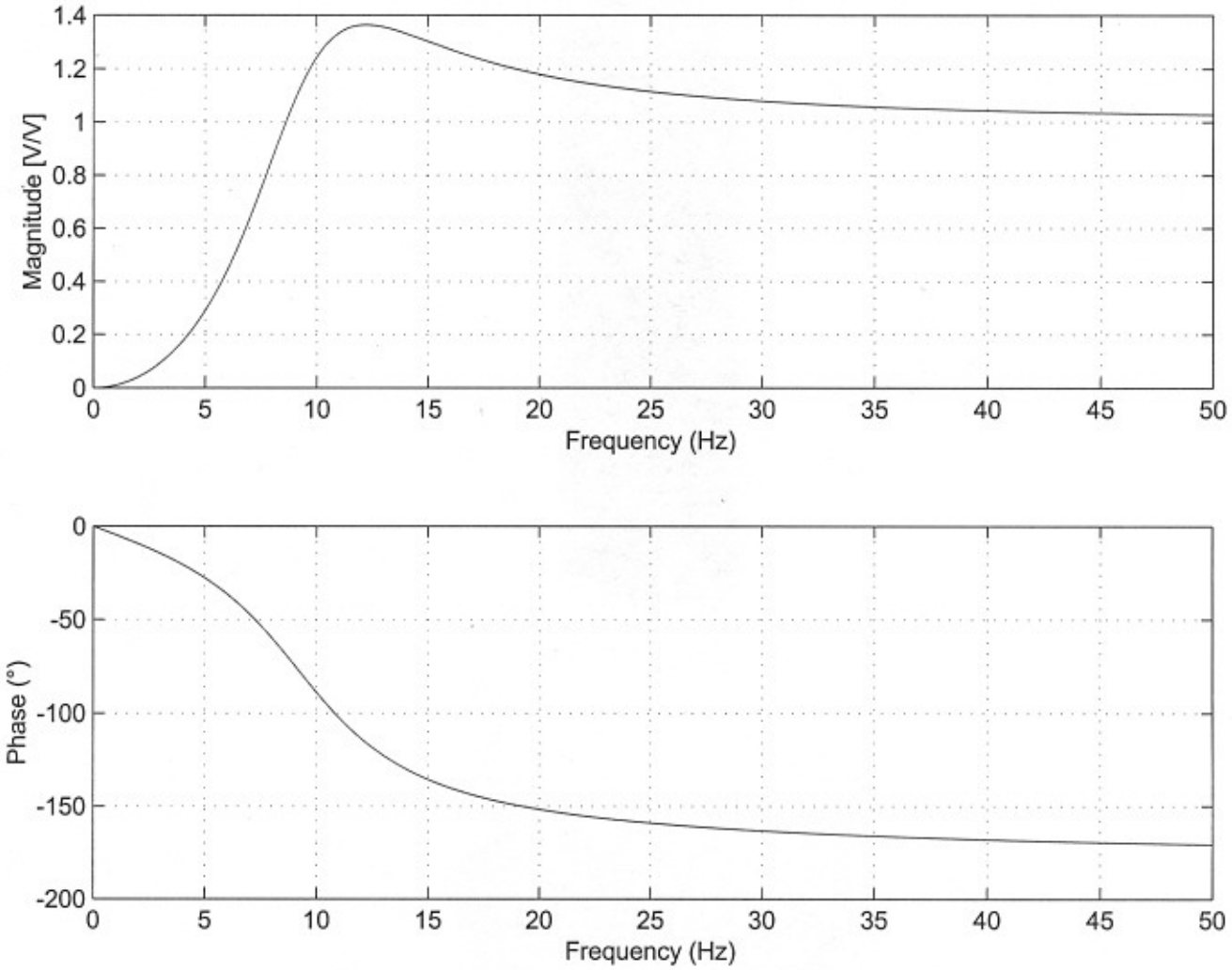
Natural frequency 10Hz

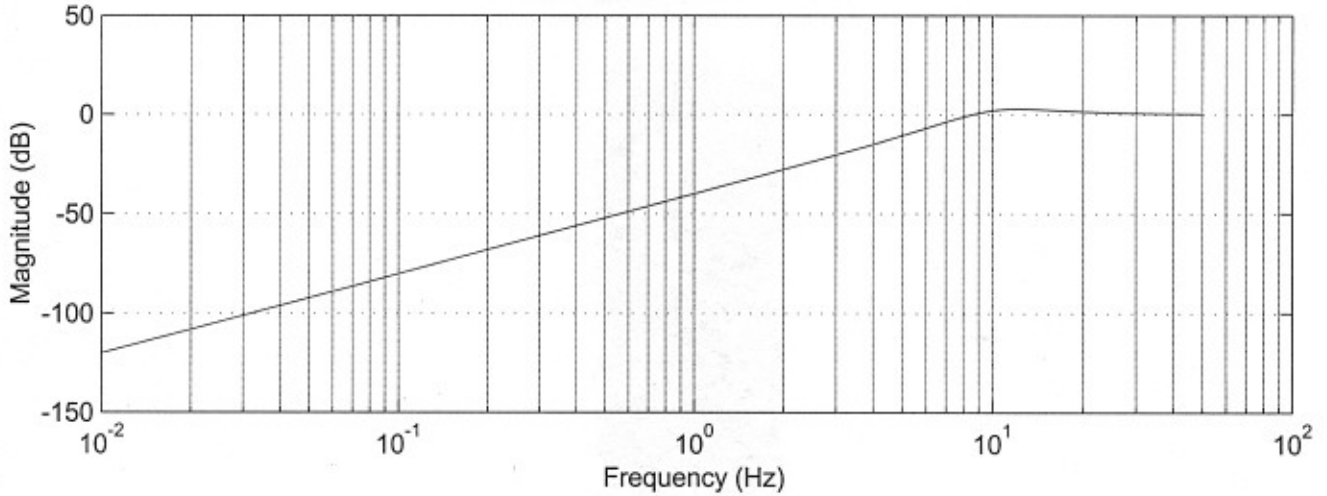
Substitute in for $j\omega = j(2\pi(20\text{Hz}))$

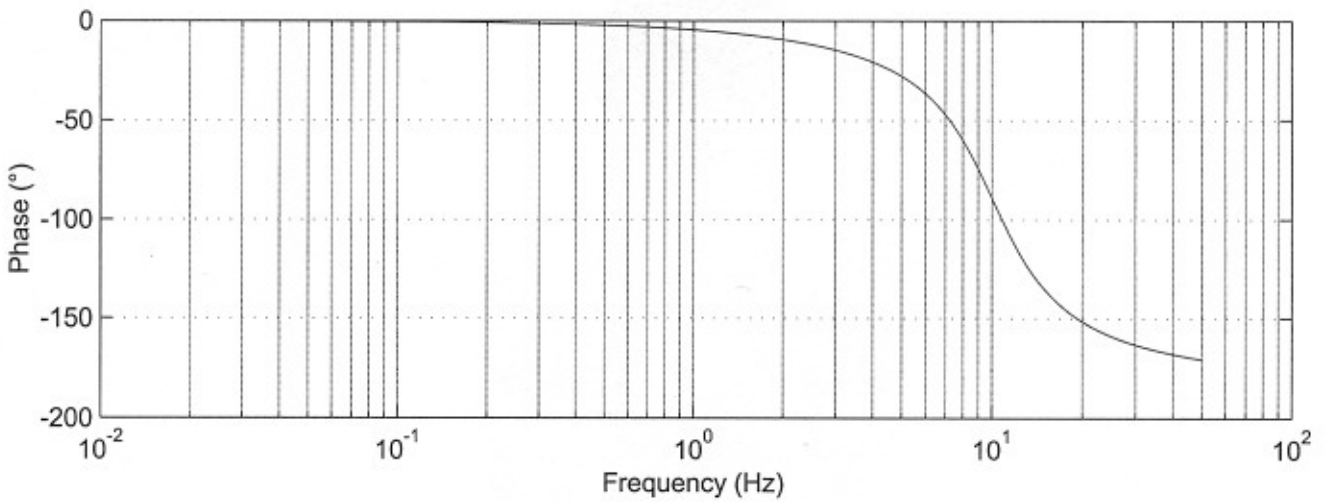
$$G(s)\Big|_{s=j\omega} = \frac{-5(j\,2\pi(20))^2}{5(j\,2\pi(20))^2 + 253(j\,2\pi(20)) + 20000}$$

Value of Transfer Function (20Hz)

$G(j\omega) = -1.0375 - 0.5595$


Magnitude [V/V]
1.4
1.2
1
0.8
0.6
0.4
0.2
0
0
5
10
15
20
25
30
35
40
45
50
Frequency (Hz)
Phase (°)
0
-50
-100
-150
-200
0
5
10
15
20
25
30
35
40
45
50
Frequency (Hz)


50
0
-50
-100
-150
Magnitude (dB)
10^{-2}
10^{-1}
10^{0}
10^{1}
10^{2}
Frequency (Hz)


0
-50
-100
-150
-200
Phase (°)
10^{-2}
10^{-1}
10^{0}
10^{1}
10^{2}
Frequency (Hz)