AAE 364 HW #11 Fall 2019

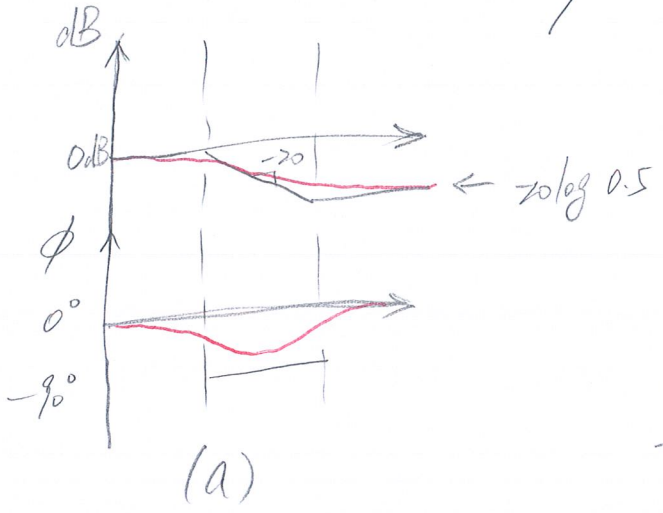
Problem 1

B-7-3 (a) $G_1 = \dfrac{1+s}{1+2s}$

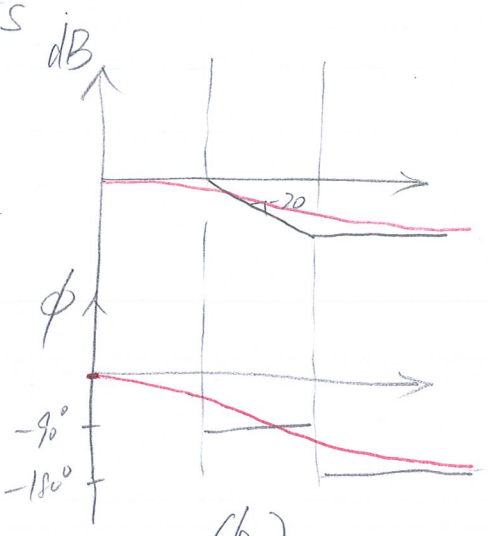
(b) $G_2 = \dfrac{1-s}{1+2s}$

Solution:

Let's recall the Bode plots

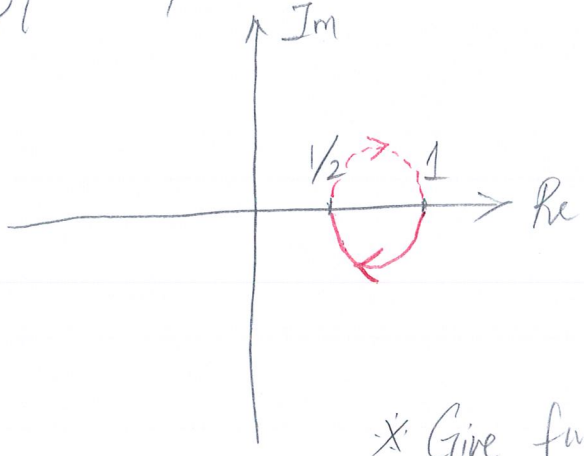


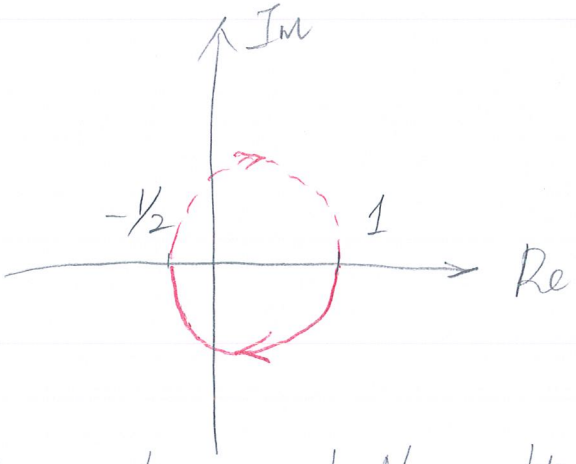
(a)



(b)

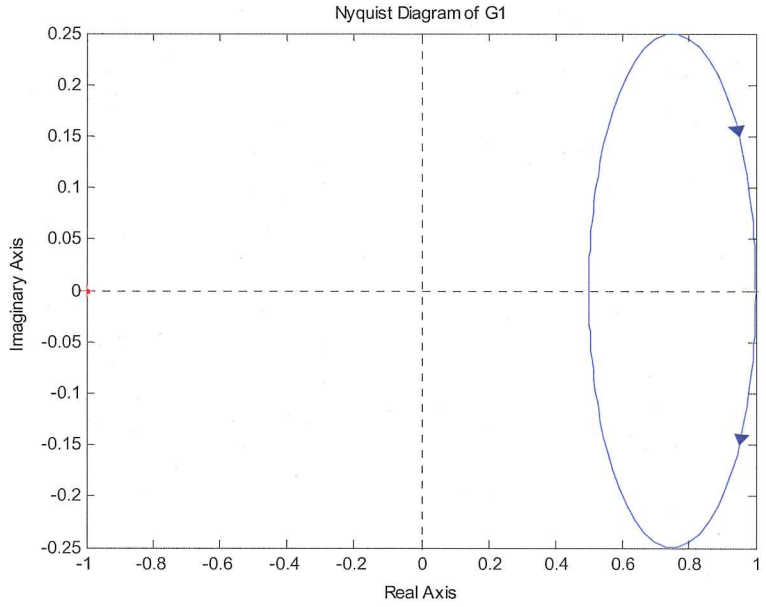
Nyquist plots:

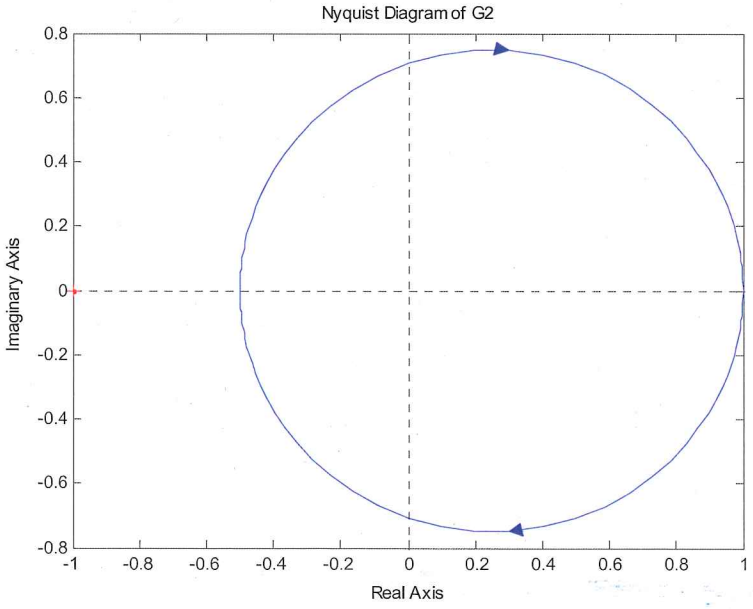




※ Give full points as long as the Nyquist plots are correct.

B-7-3


Nyquist Diagram of G1
Imaginary Axis
Real Axis
0.25
0.2
0.15
0.1
0.05
0
-0.05
-0.1
-0.15
-0.2
-0.25
-1
-0.8
-0.6
-0.4
-0.2
0
0.2
0.4
0.6
0.8
1


Nyquist Diagram of G2
Imaginary Axis
Real Axis
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1
-0.8
-0.6
-0.4
-0.2
0
0.2
0.4
0.6
0.8
1

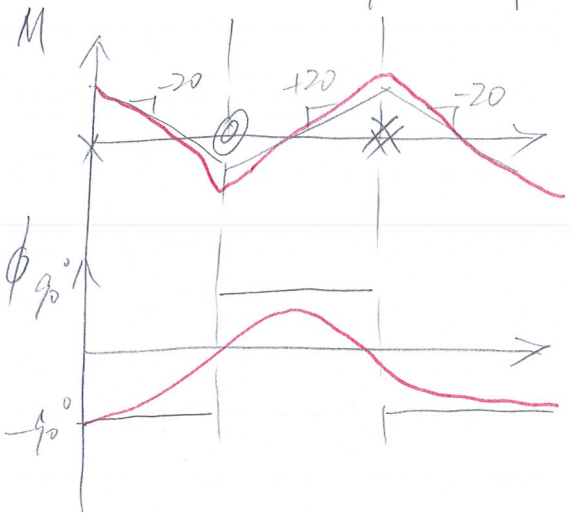
[Matlab code]

```
clear all; close all; clc

G1=tf([1 1], [2 1])
G2=tf([-1 1],[2 1])

figure(1)
nyquist(G1)
title('Nyquist Diagram of G1')

figure(2)
nyquist(G2)
title('Nyquist Diagram of G2')
```

B-T-4 $\quad G = \dfrac{10(s^2 + 0.4s + 1)}{s(s^2 + 0.8s + 9)}$

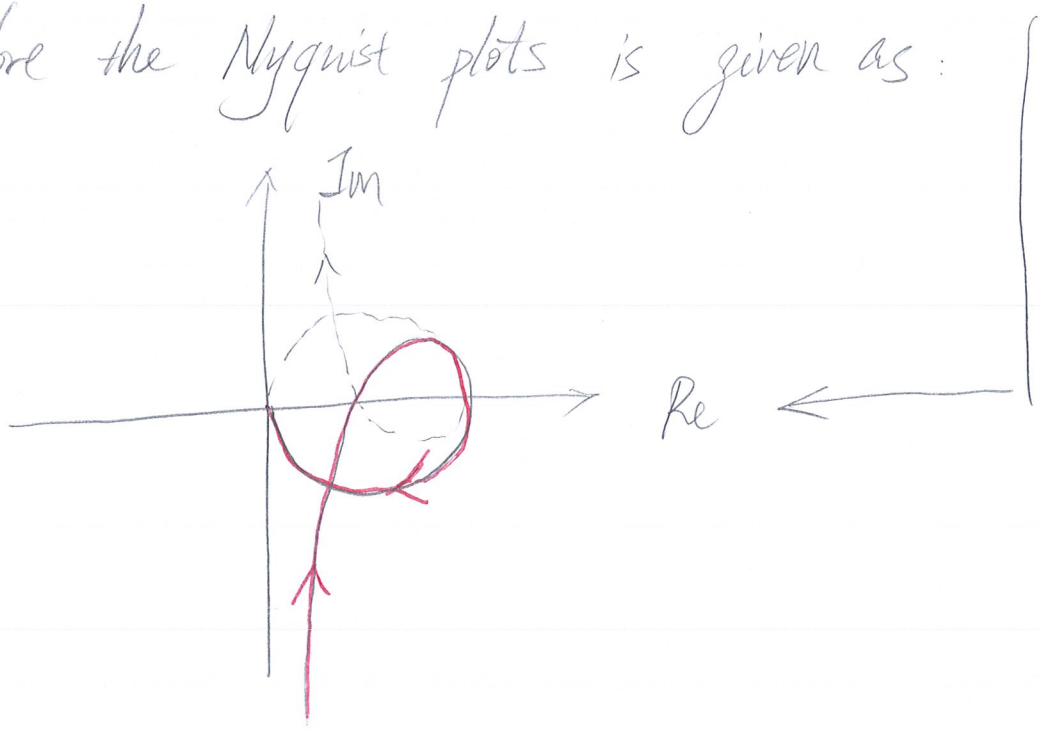
Solution:

Recall the Bode plot for G

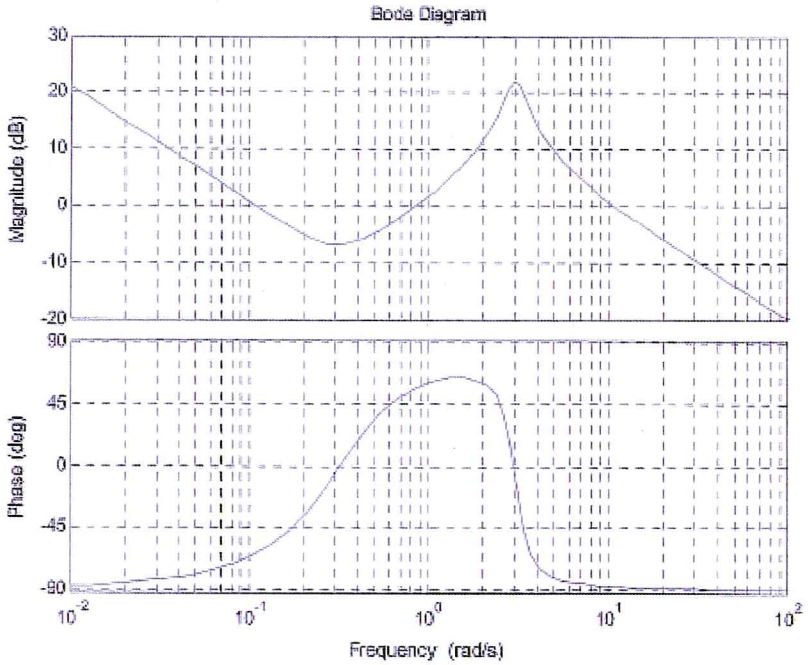


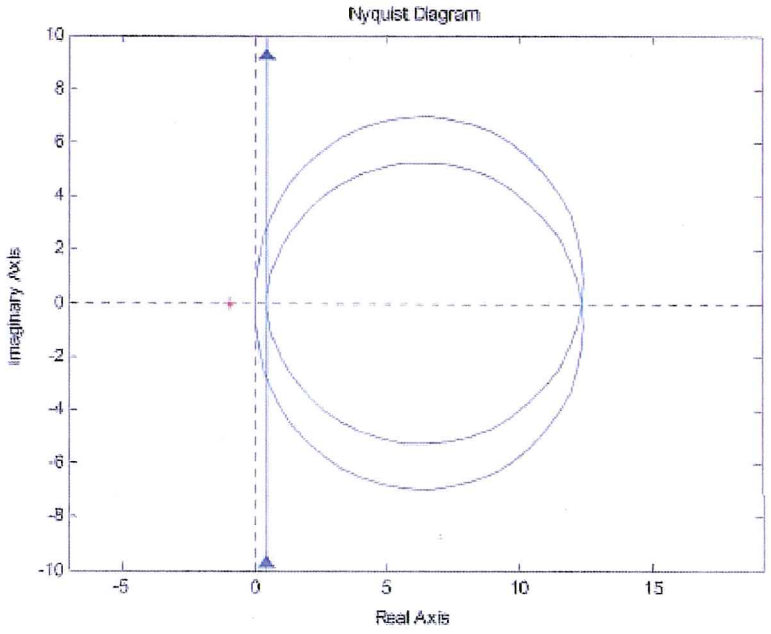
→ two intersections with Re-axis;
the first intersection is closer to the origin

Therefore the Nyquist plots is given as:



B-7-4


Bode Diagram
Magnitude (dB)
30
20
10
0
-10
-20
Phase (deg)
90
45
0
-45
-90
10^{-2}
10^{-1}
10^{0}
10^{1}
10^{2}
Frequency (rad/s)


Nyquist Diagram
Imaginary Axis
10
8
6
4
2
0
-2
-4
-6
-8
-10
-5
0
5
10
15
Real Axis

[Matlab code]

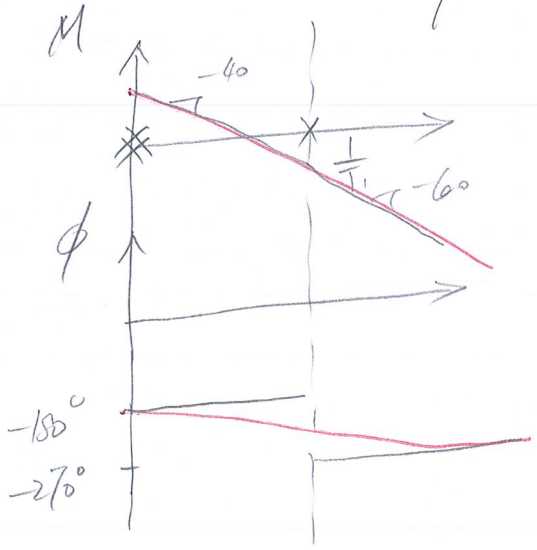
```
clear all; close all; clc

sys=tf([10 4 1],[1 0.8 9 0]);

figure(1)
bode(sys)
grid on

figure(2)
nyquist(sys)
```

B-7-9:

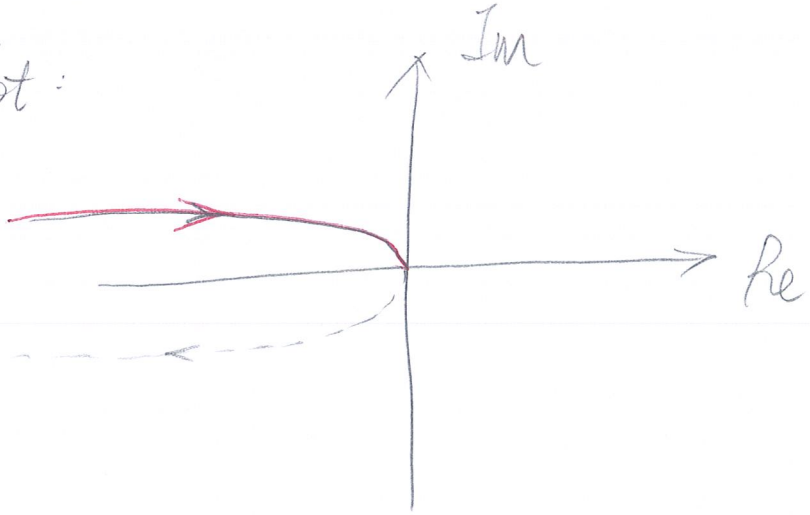
$$G = \frac{K}{s^2(T_1 s + 1)}$$

Solution:

Recall the Bode plot first:



Nyquist plot:

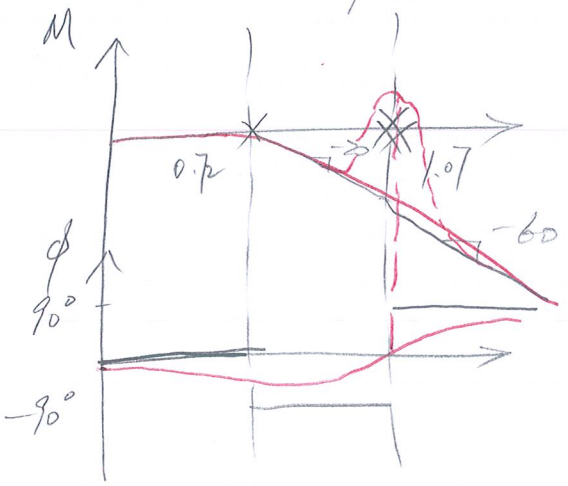


B-7-13.

$$G(s) = \frac{1}{s^3 + 0.2s^2 + s + 1}$$

Solution:

Recall the Bode plot:



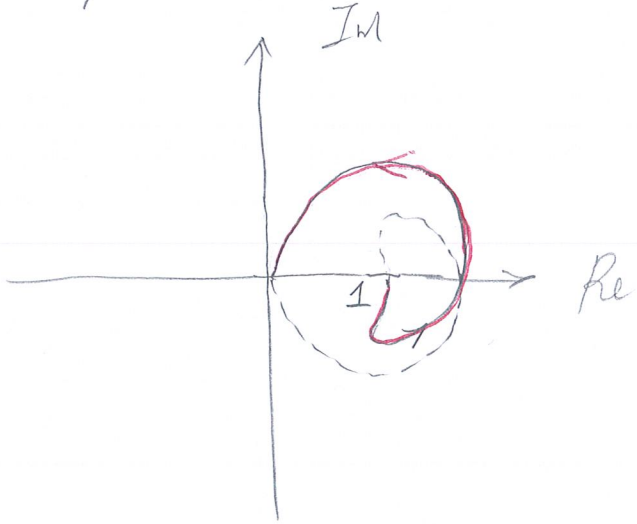
$|G(j\omega)| = 1$

← 2 intersection with Re-axis;

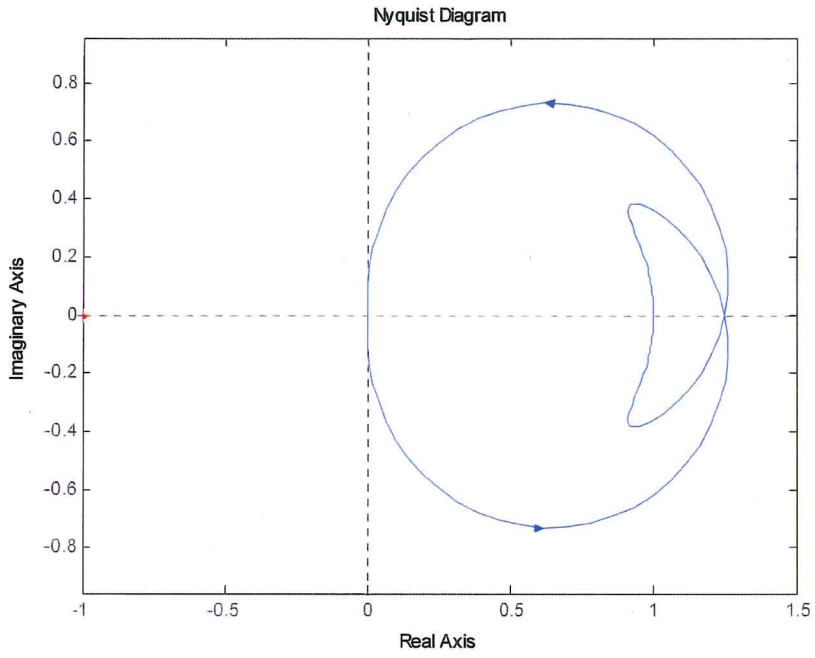
$|G(j\omega)|$ decreases first and then increases;

The first intersection is closer to the origin.

Nyquist plot:



B-7-13



[Matlab code]

```
clear all; close all; clc

sys=tf(1,[1 0.2 1 1]);

nyquist(sys)
axis equal
```

Problem 2

$$G_1 = \frac{1.1057s + 0.1900}{s^3 + 0.7385s^2 + 0.8008s}$$

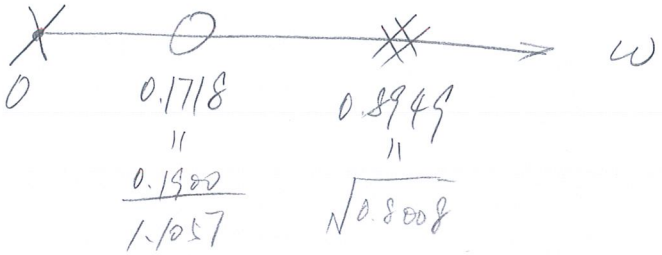
$$G_2 = \frac{1.1057s - 0.19}{s^5 + 17.95s^4 + 123.3s^3 + 366.3s^2 + 112.2s}$$

Required: Bode plots

Solution:

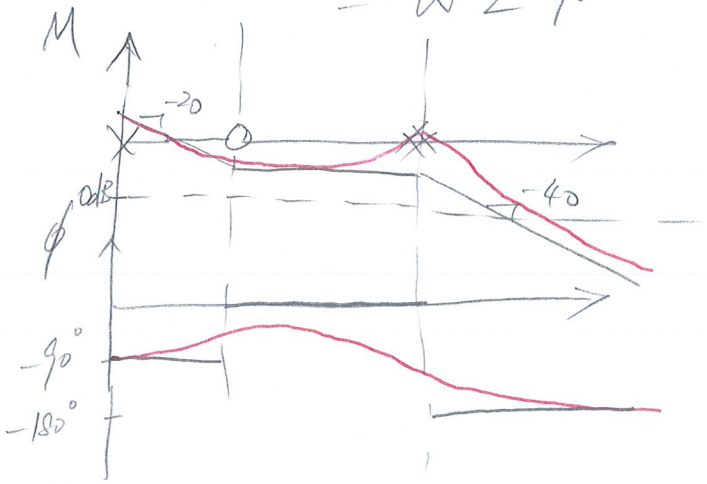
For G_1:

Corner frequencies:

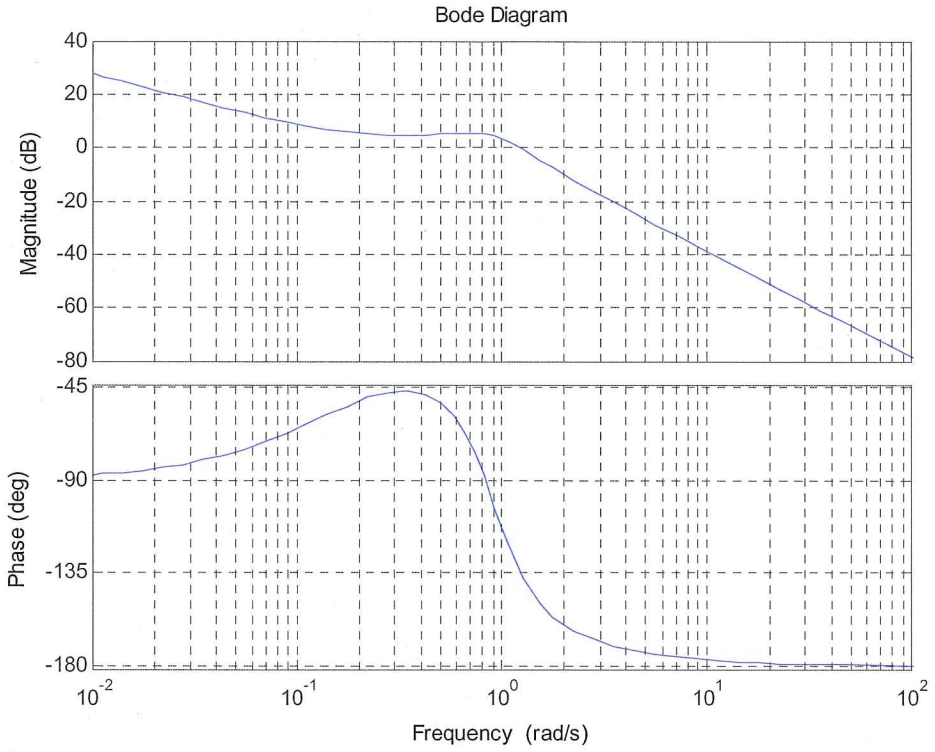


$$\lim_{\omega \to 0} G_1(j\omega) = \lim_{\omega \to 0} \frac{0.1900}{(j\omega)^3 + (0.7385 j\omega)^2 + 0.8008 j\omega}$$

$$= \infty \angle -90^\circ$$



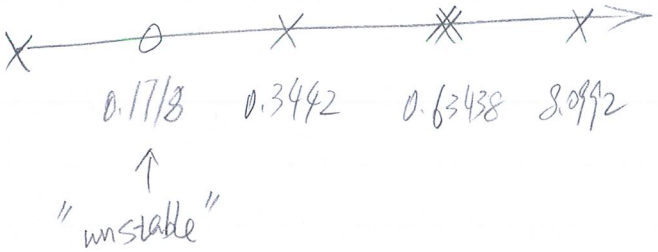
Problem 2-1



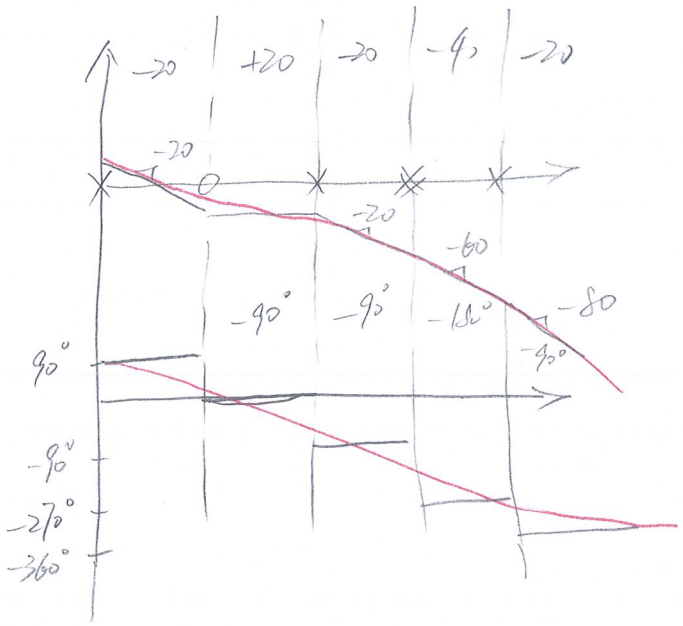
[Matlab code]

```
clear all; close all; clc

sys=tf([1.1057 0.1900], [1 0.7385 0.8008 0]);

bode(sys)
grid on
```

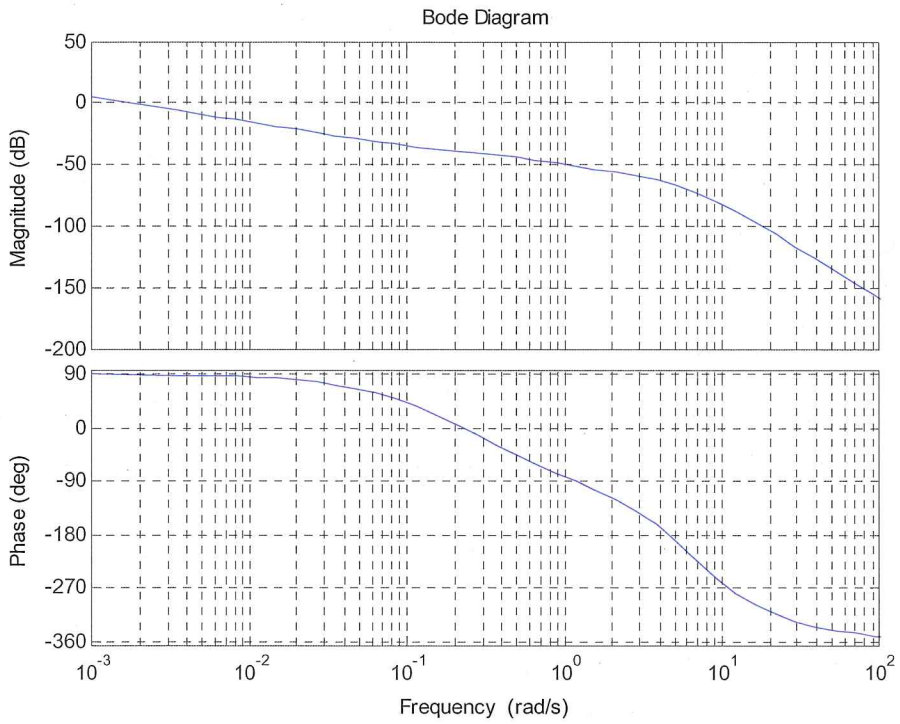
For G_2, corner frequencies are:



$$\lim_{\omega \to 0} G_2(j\omega) = \lim_{\omega \to 0} \frac{-0.19}{112.2 j\omega} = \infty \angle 90^\circ$$



Problem 2-2



[Matlab code]

```
clear all; close all; clc

sys=tf([1.1057 -0.1900], [1 17.95 123.3 366.3 112.2 0])

bode(sys)
grid on
```

Problem 3:

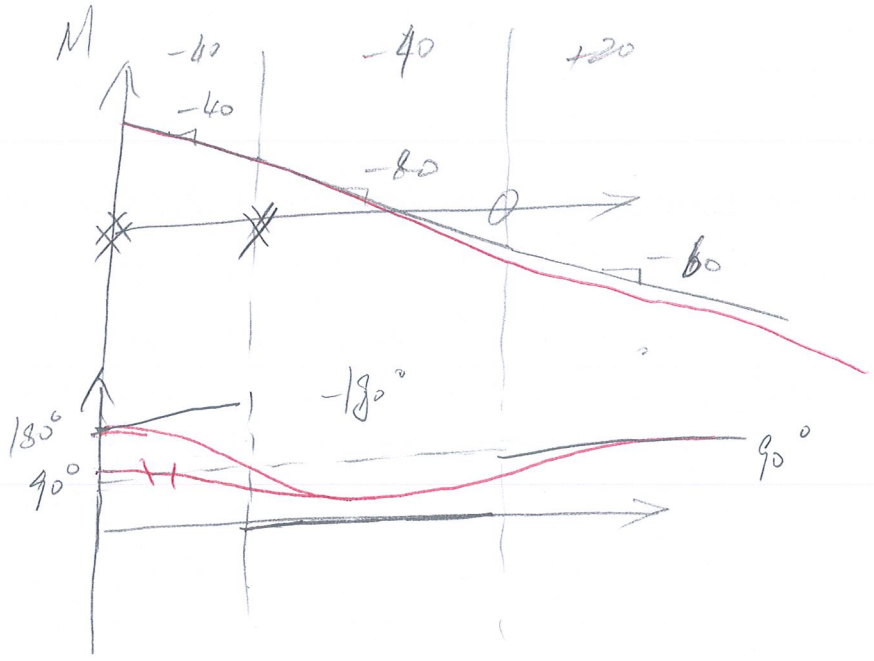
$$G(s) = \frac{0.036(s+25)}{s^2(s^2+0.04s+1)}$$

Solution:

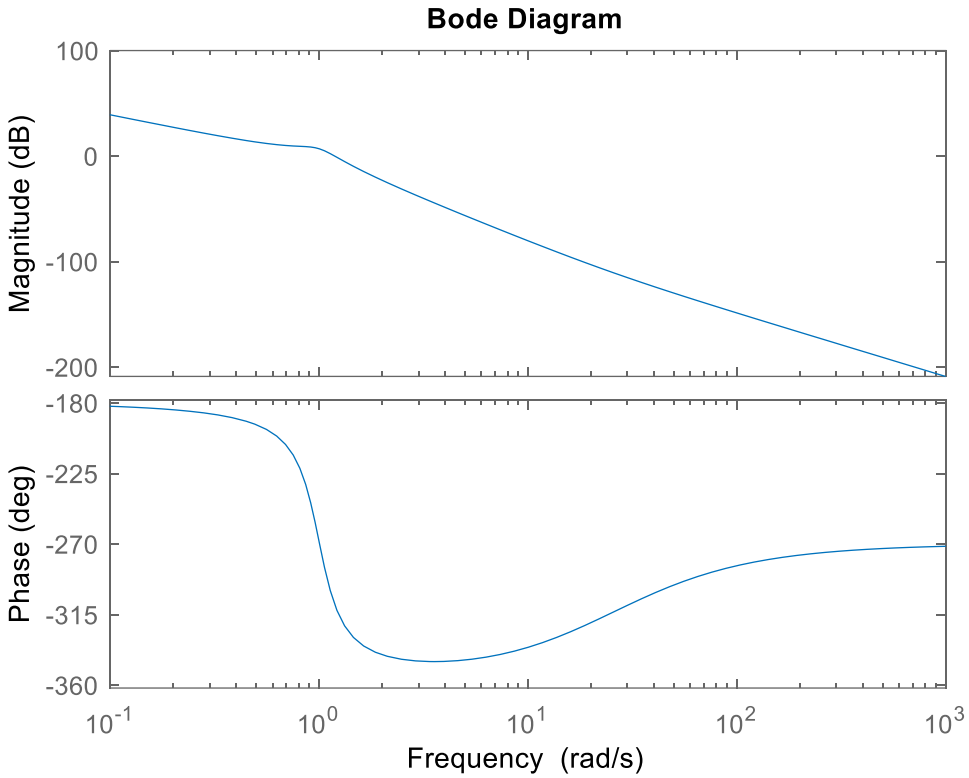
Corner frequencies:

$$\lim_{\omega \to 0} G(j\omega) = \lim_{\omega \to 0} \frac{0.036 \times 25}{(j\omega)^2}$$

$$= \infty \angle 180^\circ$$



Problem 3



> G = tf([0.036 0.036*25], [1 0.4 1 0 0])

>> bode(G)