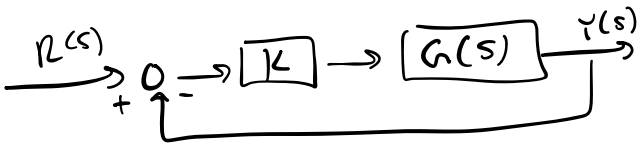
Recorded Examples

Problem 1



$$G(s) = \frac{5000}{(10s^2+s)(s+100)}$$

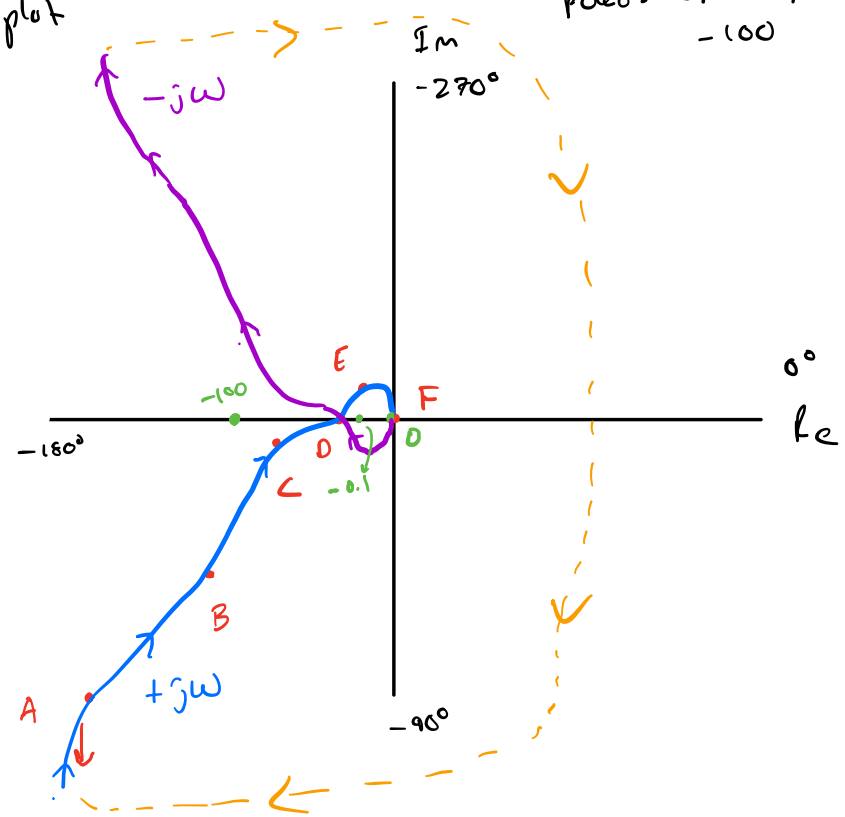
$$\Delta CL: \; s(10s+1)(s+100)$$

poles: 0, -0.1, -100

→ MATLAB: Bode plot

part 2

	ω	M	φ
A	→0	→∞	-90°
B	0.1	400	-135°
C	2	1	-178°
D	10.6	0.3	-180°
E	100	0.0003	-225°
F	→∞	→0	-270°

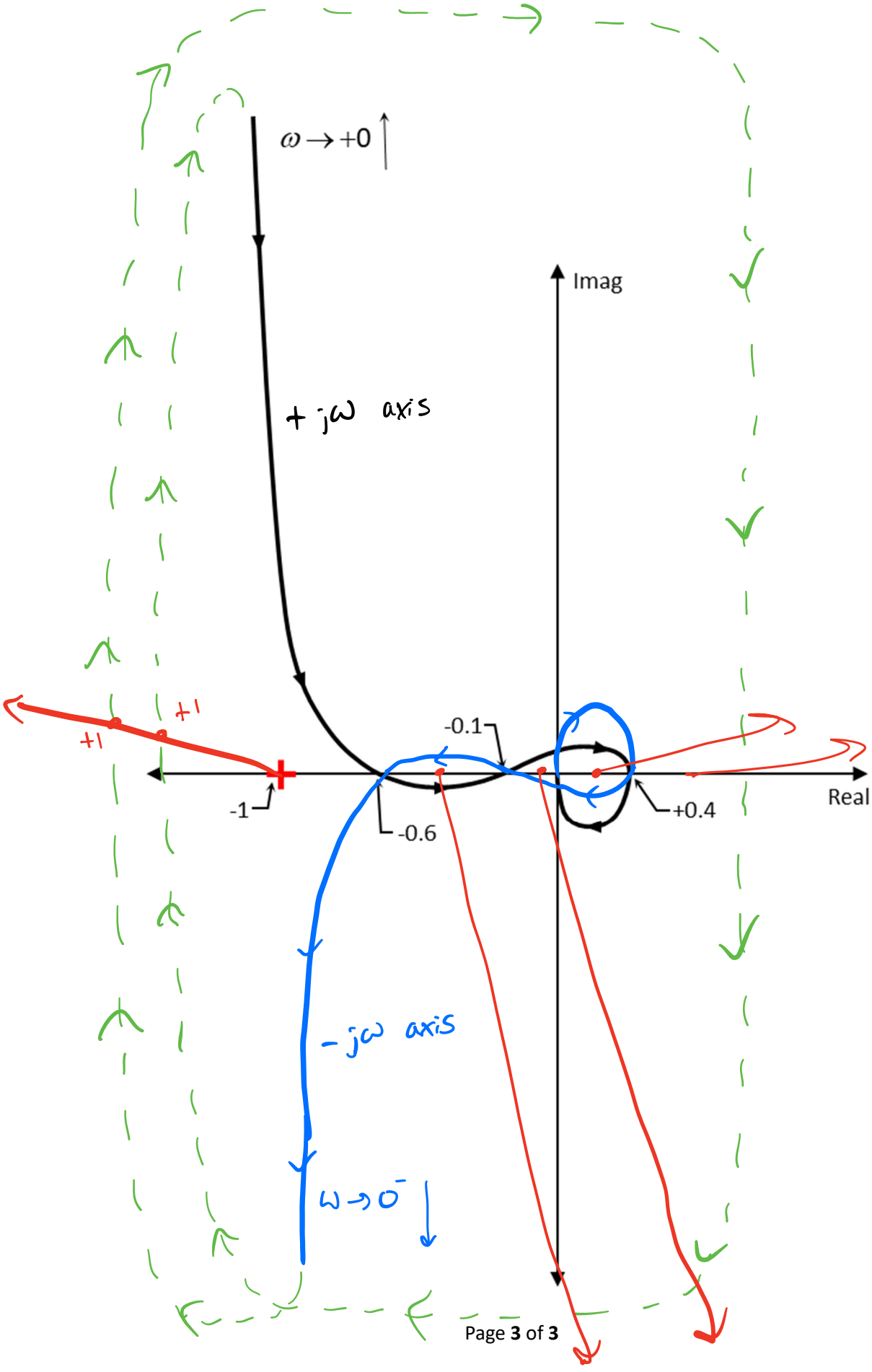


Part 4

Gain margin: $K = 1$

$$\frac{1}{GM} = |KG(j\omega)|_{\varphi=-180^\circ} : \quad |KG(j\omega)| = |G(j\omega)|$$

$$|G(j\omega)|_{\varphi=-180^\circ} \cong 0.3 \rightarrow \boxed{GM \cong \frac{1}{0.3} \cong 3.3}$$


ω → +0
+ jω axis
Imag
Real
+1
+1
-1
-0.1
-0.6
+0.4
- jω axis
ω → 0⁻

Problem 2

Part 2

$Z = N + P$

N: net CW encirclements of -1

P: # unstable open-loop poles

Z: # unstable closed-loop poles

Unity gain:

$N = +2$

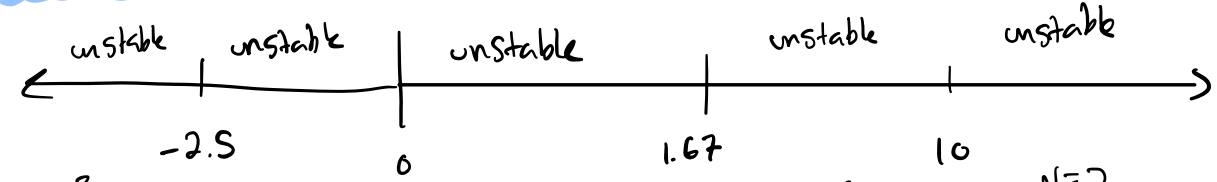
$P = 1$ → $Z = 3$

→ System unstable

Critical gain values:

$\frac{-1}{-0.6}, \frac{-1}{-0.1}, \frac{-1}{0.4} = 1.67, 10, -2.5$

Part 3



$N = 3$, $P = 1$, $Z = 4$ — 4 unstable CL poles

$N = 1$, $P = 1$, $Z = 2$ — 2 unstable CL poles

$N = 2$, $P = 1$, $Z = 3$ — 3 unstable CL poles

$N = 0$, $P = 1$, $Z = 1$ — 1 unstable CL pole

$N = 2$, $P = 1$, $Z = 3$ — 3 unstable CL poles

```
% Written by Kyle Adler for ME446
```

Problem 1

part 1: plot frequency response of G(s)

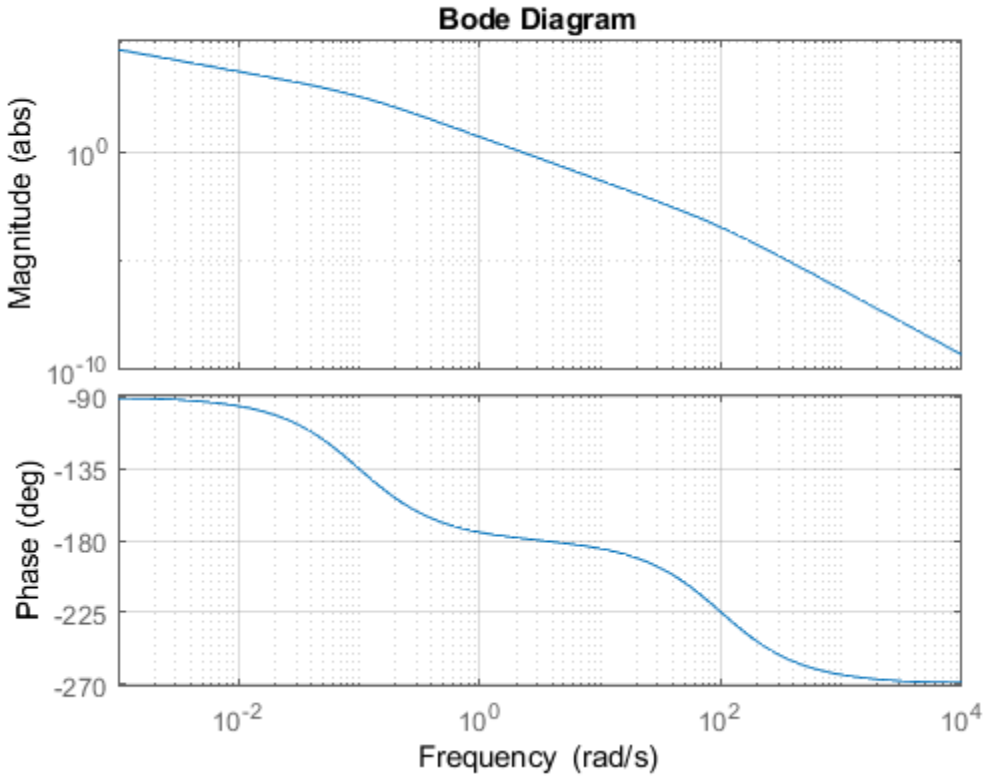
```
s = tf('s');
sysG = 5000/((10*s^2+s)*(s+100));

h = bodeplot(sysG)

p = getoptions(h);
p.MagUnits = 'abs';
p.MagScale = 'log';
setoptions(h,p);
grid on;
```

```
h =

 resppack.bodeplot
```



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