T.C.

ONDOKUZ MAYIS ÜNİVERSİTESİ

MÜHENDİSLİK FAKÜLTESİ

BİLGİSAYAR MÜHENDİSLİĞİ BÖLÜMÜ

SAYISAL DENETİM - 2

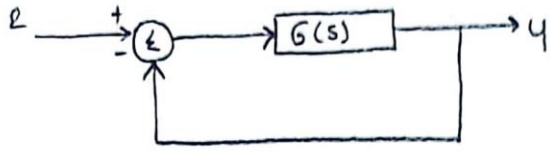
Dönem İçi Projesi

ALEYNA KAHRAMAN

20060355

2023-2024 Bahar Dönemi

Bil-364 Sayısal Denetim Dönem içi Projesi



$$G(s) = \frac{K(s+z)}{s^n(s+p)(s^2+as+b)}$$

$$G(s) = \frac{46(s+8)}{s^2(s+28)(s^2+13s+33)} \xrightarrow{\text{Eşitliği düzenlersek}} = \frac{368(0.125s+1)}{924(s)^2(0.035s+1)(0.03s^2+0.4s+1)}$$

$$S = jw \rightarrow \frac{368(0.125jw+1)}{924(jw)^2(0.035jw+1)(0.03(jw)^2+0.4jw+1)}$$

1) Sabit

$$K = 368/924 = 0.3982$$

$$|G(w)|_{dB} = 20\log|0.3982| = -7.9979 \qquad \phi = 0$$

2) Sonal Terim

$$G(w) = \frac{1}{jw} \qquad |G(w)|_{dB} = 20\log\left|\frac{1}{jw}\right| = -20\log(w) \qquad \phi = -90$$

3) Birinci Derece Terim

Payda: $|G(w)|_{dB} = 20\log\left|\frac{1}{0.035s+1}\right|$

Köşe frekansı: $w = \frac{1}{0.035} = 28,57$ rad/s

Pay: $|G(w)|_{dB} = 20\log|0.125jw+1|$

Köşe frekansı: $w = \frac{1}{0.125} = 8$ rad/s

4) İkinci Derece Terim

$$\frac{1}{0.03(j\omega)^2 + 0.4j\omega + 1} = \frac{1}{1 + j \cdot 2 \cdot \xi \cdot \frac{\omega}{10\sqrt{3}} - \frac{\omega^2}{(10\sqrt{3})^2}}$$

$\omega_n = 10\sqrt{3}$ rad/s $= 17.32$

$\xi = 2\sqrt{3} = 3.46$

Eğim -40 dB/dekat ile orelma gösterir

Nyquist kararlılık Analizi

$1 + G(s) = 0 \qquad \frac{46s + 368}{s^5 + 41s^4 + 397s^3 + 924s^2} + 1 = 0$

$$\frac{s^5 + 41s^4 + 397s^3 + 924s^2 + 46s + 368}{s^5 + 41s^4 + 397s^3 + 924s^2} = 0$$

$$s^5 + 41s^4 + 397s^3 + 924s^2 + 46s + 368 = 0$$

s^5	1	397	46
s^4	41	924	368
s^3	b_1	b_2	0
s^2	c_1	c_2	0
s^1	d_1	d_2	0
s^0	e_1		

$b_1 = -\frac{(924 - 16277)}{41} =$

$= 374,46$

$b_2 = -\frac{(368 - 1886)}{41} = 37.02$

$c_1 = \frac{-((37.02 \times 41) - (374.46 \times 924))}{374,46} = 914,95$

$c_2 = \frac{-((0 \times 924) - (37.02 \times 368))}{37.02} = 368$

$d_1 = \frac{-((368 \times 374,46) - (914,95 \times 37.02))}{914,95} = -113,59$

$d_2 = 0 \qquad e_1 = \frac{-(0 - (-113,59 \times 368))}{-113,59} = 368$

s^5	1	397	46
s^4	41	924	368
s^3	374,46	37.02	0
s^2	914,95	368	0
s^1	-113,59	0	0
s^0	368		

Sağda 2 kök var

$p = 2$

$$G(s) = \frac{46(s+8)}{s^2(s+28)(s^2+13s+33s)}$$

Sistem sıfır = -8

Sistem kutupları = $-28, (-3,46), (-9,54)$

$Z = 0$

$Z = P + N$

$0 = 2 + 0$

↳ Sistem kararsızdır.

Sistemin $-\infty < \omega < +\infty$ değerinde saat yönünde kuşatma sayısı sıfırdır.

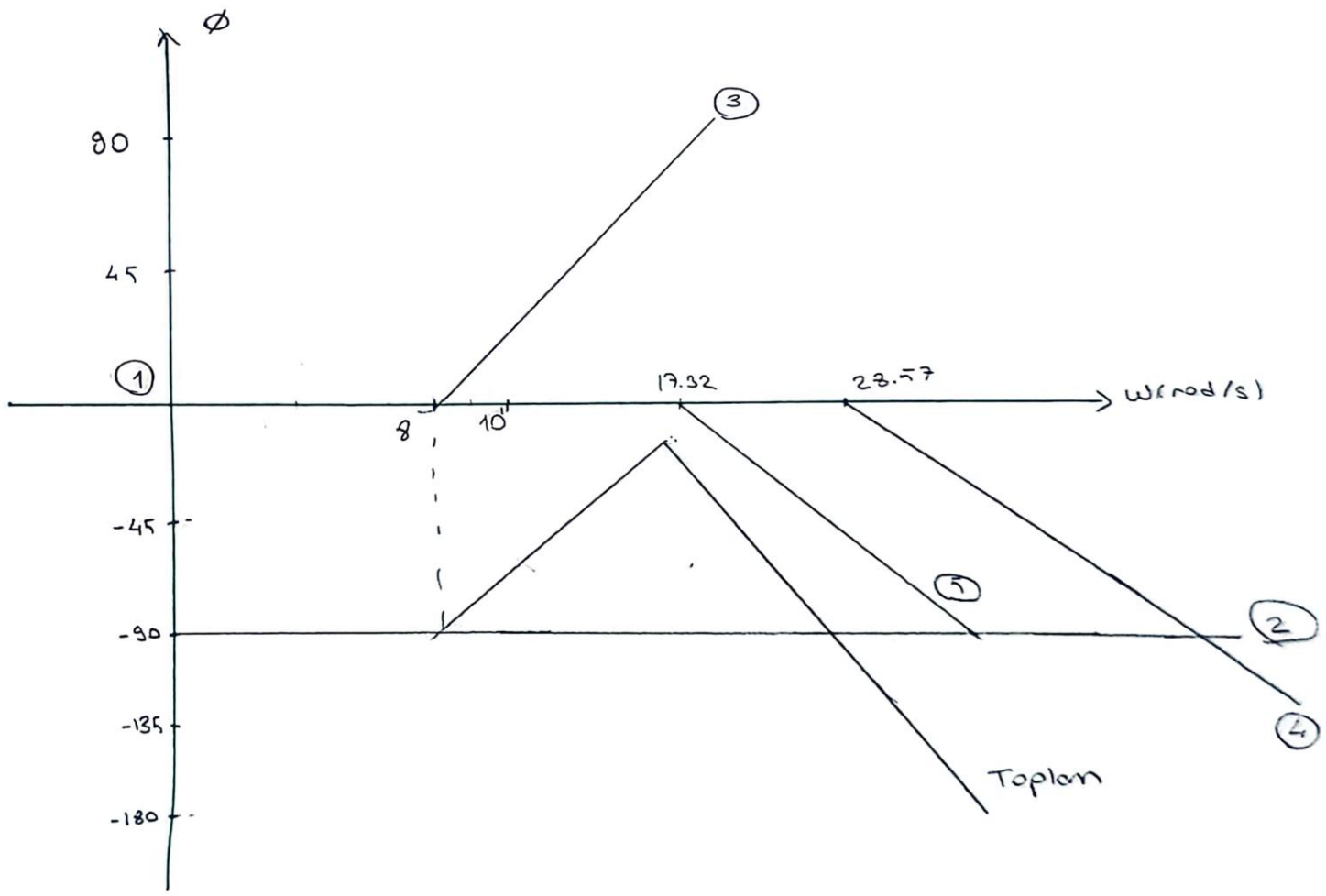
FAZ GEÇİŞ FREKANSI

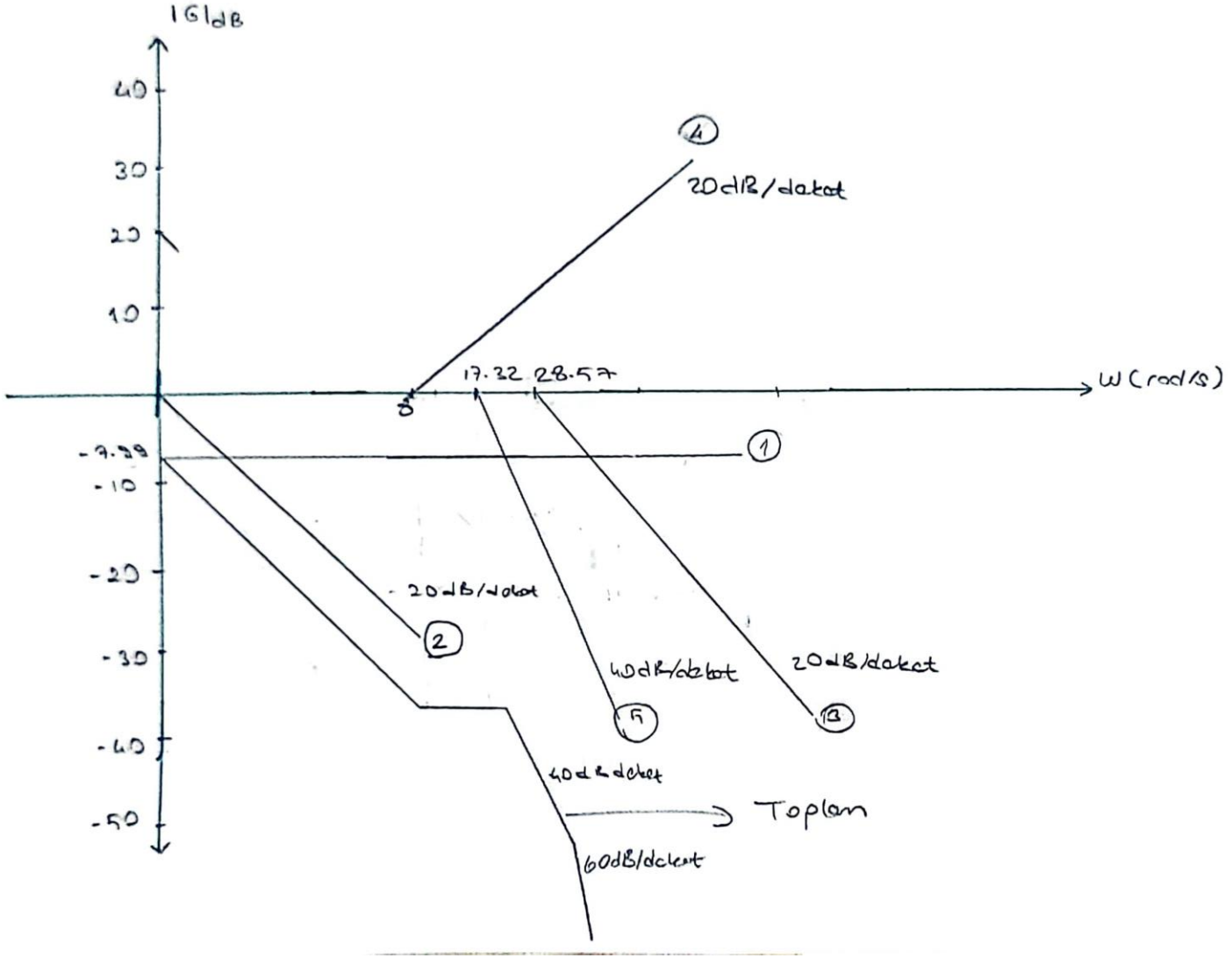
$k = 46$ → kritik kazanç

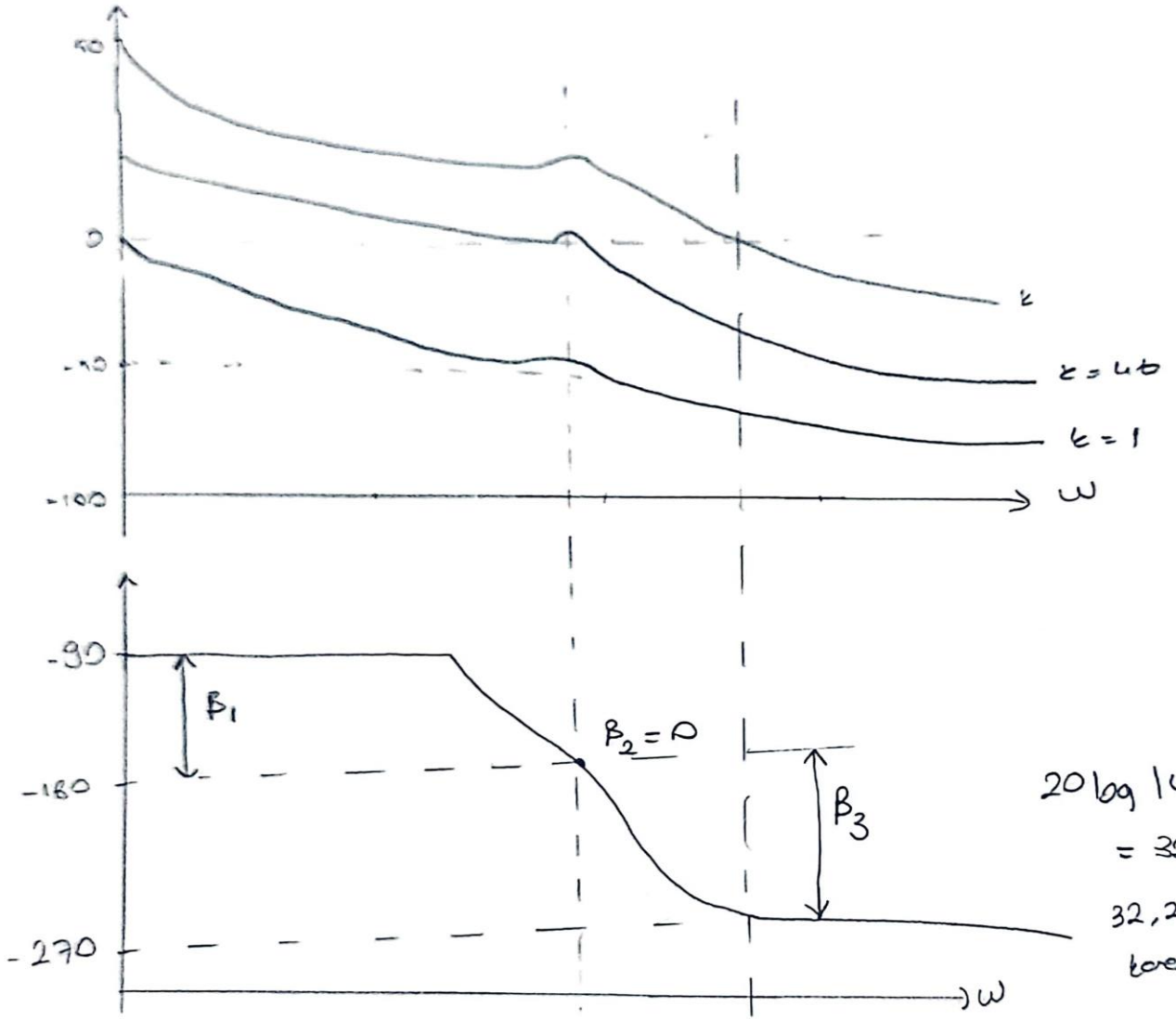
$k < 46$ kararlı.

$k > 46$ kararsızdır.

Fa2



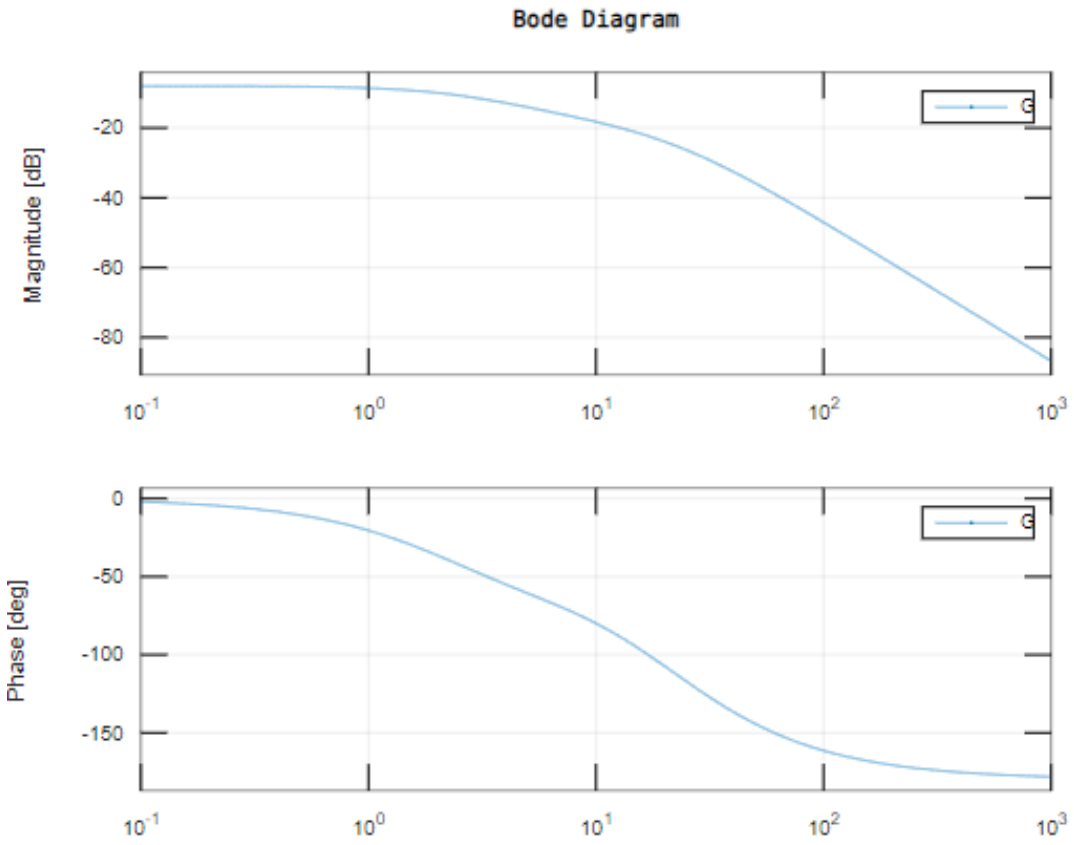

|G|dB
40
30
20
10
-9.99
-10
-20
-30
-40
-50
17.32
28.57
W (rad/s)
0
1
2
3
4
5
20dB/dekat
20dB/dekat
40dB/dekat
20dB/dekat
40dB/dekat
60dB/dekat
Toplam

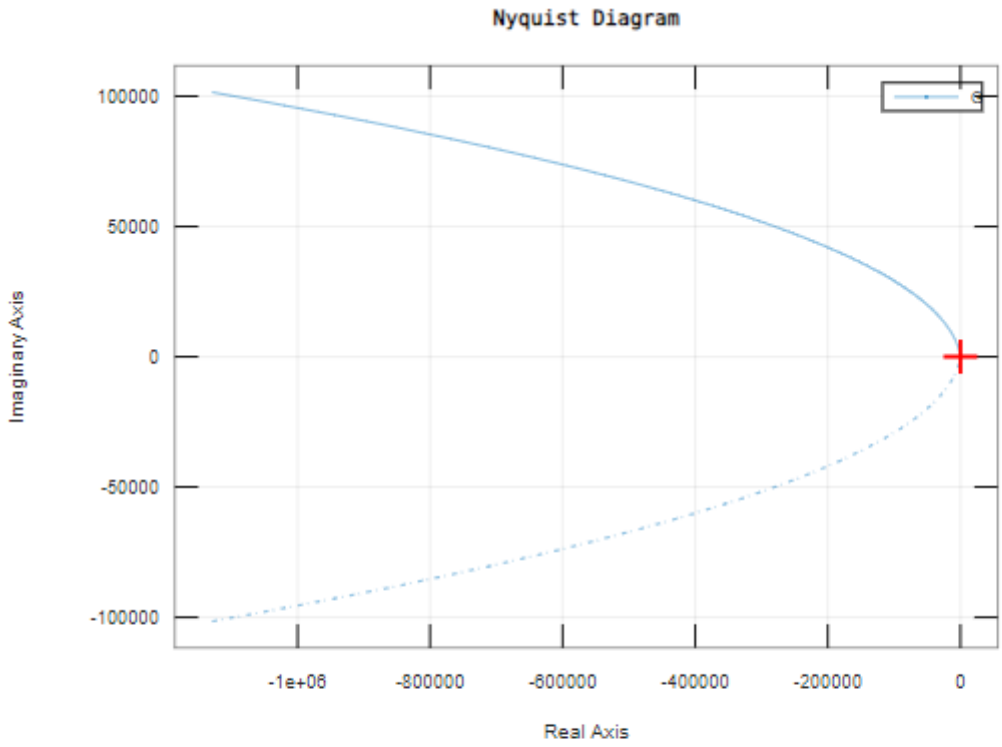


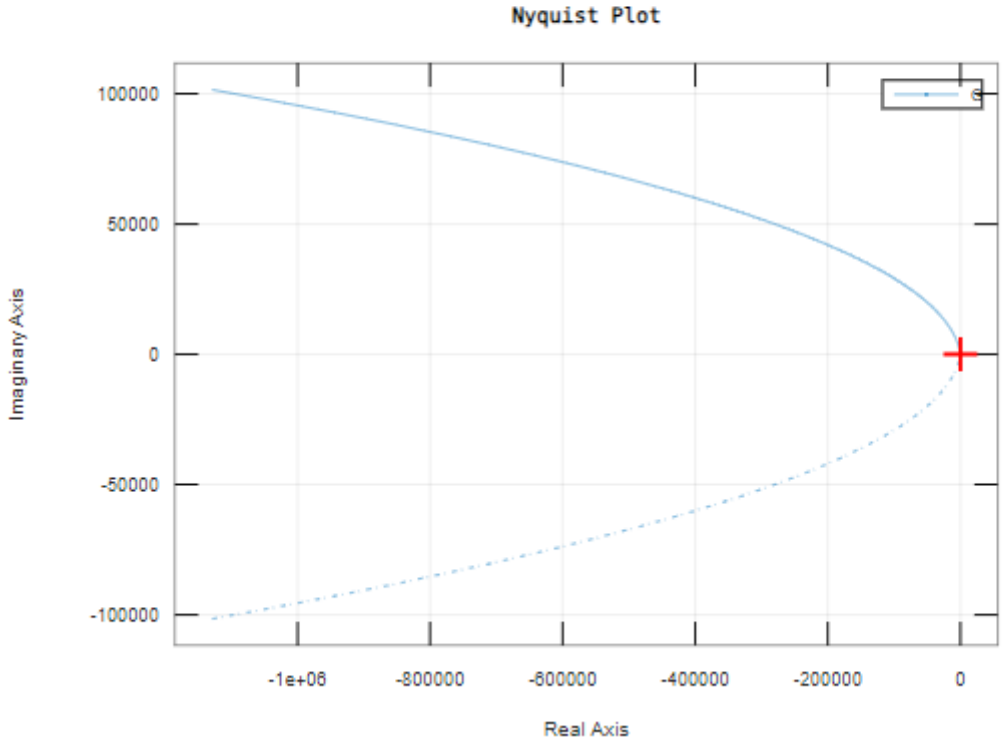
$20 \log |4b| = 30,25$

$32,25 > 1$

voorlidin


Bode Diagram
Magnitude [dB]
-20
-40
-60
-80
G
10^{-1}
10^{0}
10^{1}
10^{2}
10^{3}
Phase [deg]
0
-50
-100
-150
G
10^{-1}
10^{0}
10^{1}
10^{2}
10^{3}


Nyquist Diagram
100000
50000
0
-50000
-100000
Imaginary Axis
-1e+06
-800000
-600000
-400000
-200000
0
Real Axis


Nyquist Plot
100000
50000
0
-50000
-100000
Imaginary Axis
-1e+06
-800000
-600000
-400000
-200000
0
Real Axis