

# ⑦ Übungen Bode-Diagramm

**Zoltán Zomotor**

**Versionsstand: 23. September 2015, 18:31**



This work is licensed under the Creative Commons Attribution-NonCommercial-ShareAlike 3.0 Germany License.  
To view a copy of this license, visit <http://creativecommons.org/licenses/by-nc-sa/3.0/de/> or send a letter to Creative  
Commons, 171 Second Street, Suite 300, San Francisco, California, 94105, USA.

## Aufgabe 1: Review-Fragen

1. Warum schlug Bode vor, den Amplitudengang einer Frequenzantwort doppelt-logarithmisch darzustellen?
2. Definieren Sie Dezibel.
3. Was ist die Amplitude der Übertragungsfunktion bei einer Verstärkung von 14 dB

**Aufgabe 2: Bode-Diagramm**

Skizzieren Sie die Asymptoten des Amplituden- und Phasengangs folgender Übertragungsfunktionen. Verifizieren Sie Ihre Ergebnisse mit Hilfe von MATLAB.

1. [FPE10, Aufgabe 6.3]

$$(a) L(s) = \frac{2000}{s(s+200)}$$

$$(b) L(s) = \frac{100}{s(0.1s+1)(0.5s+1)}$$

$$(c) L(s) = \frac{1}{s(s+1)(0.02s+1)}$$

$$(d) L(s) = \frac{1}{(s+1)^2(s^2+2s+4)}$$

$$(e) L(s) = \frac{10(s+4)}{s(s+1)(s^2+2s+5)}$$

$$(f) L(s) = \frac{1000(s+0.1)}{s(s+1)(s^2+8s+64)}$$

$$(g) L(s) = \frac{(s+5)(s+3)}{s(s+1)(s^2+s+4)}$$

$$(h) L(s) = \frac{4s(s+10)}{(s+100)(4s^2+5s+4)}$$

$$(i) L(s) = \frac{s}{(s+1)(s+10)(s^2+2s+2500)}$$

2. [FPE10, Aufgabe 6.4] Reelle Pole und Nullstellen.

$$(a) L(s) = \frac{1}{s(s+1)(s+5)(s+10)}$$

$$(b) L(s) = \frac{s+2}{s(s+1)(s+5)(s+10)}$$

$$(c) L(s) = \frac{(s+2)(s+4)}{s(s+1)(s+5)(s+10)}$$

$$(d) L(s) = \frac{(s+2)(s+6)}{s(s+1)(s+5)(s+10)}$$

3. [FPE10, Aufgabe 6.5] Komplexe Pole und Nullstellen. Bestimmen / approximieren Sie den Wert des Amplitudengangs an den Eckfrequenzen der Terme zweiter Ordnung.

$$(a) L(s) = \frac{1}{s^2 + 3s + 10}$$

$$(b) L(s) = \frac{1}{s(s^2 + 3s + 10)}$$

$$(c) L(s) = \frac{s^2 + 2s + 8}{s(s^2 + 2s + 10)}$$

$$(d) L(s) = \frac{s^2 + 2s + 12}{s(s^2 + 2s + 10)}$$

$$(e) \ L(s) = \frac{s^2 + 1}{s(s^2 + 4)}$$

$$(f) \ L(s) = \frac{s^2 + 4}{s(s^2 + 1)}$$

4. [FPE10, Aufgabe 6.6] Mehrfache Pole im Ursprung.

$$(a) \ L(s) = \frac{1}{s^2(s+8)}$$

$$(b) \ L(s) = \frac{1}{s^3(s+8)}$$

$$(c) \ L(s) = \frac{1}{s^4(s+8)}$$

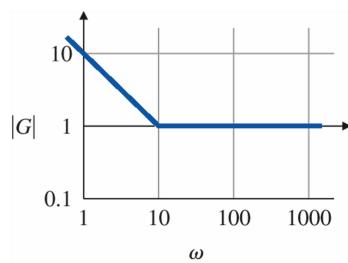
$$(d) \ L(s) = \frac{s+3}{s^2(s+8)}$$

$$(e) \ L(s) = \frac{s+3}{s^3(s+4)}$$

$$(f) \ L(s) = \frac{(s+1)^2}{s^3(s+4)}$$

$$(g) \ L(s) = \frac{(s+1)^2}{s^3(s+10)^2}$$

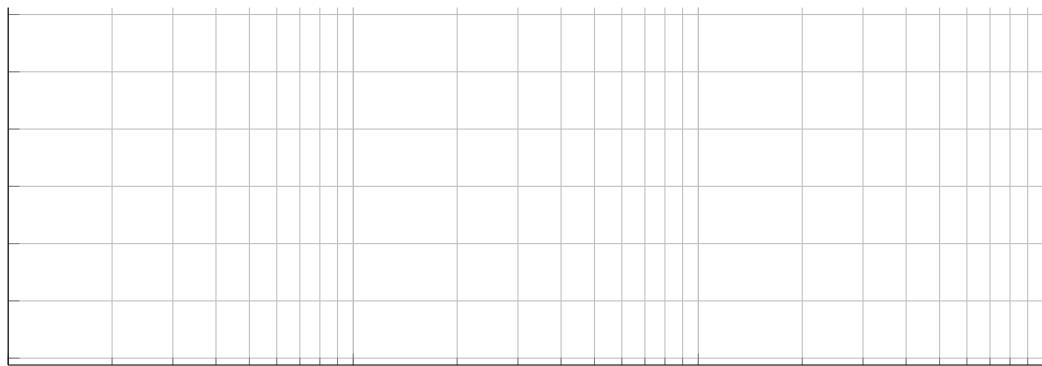
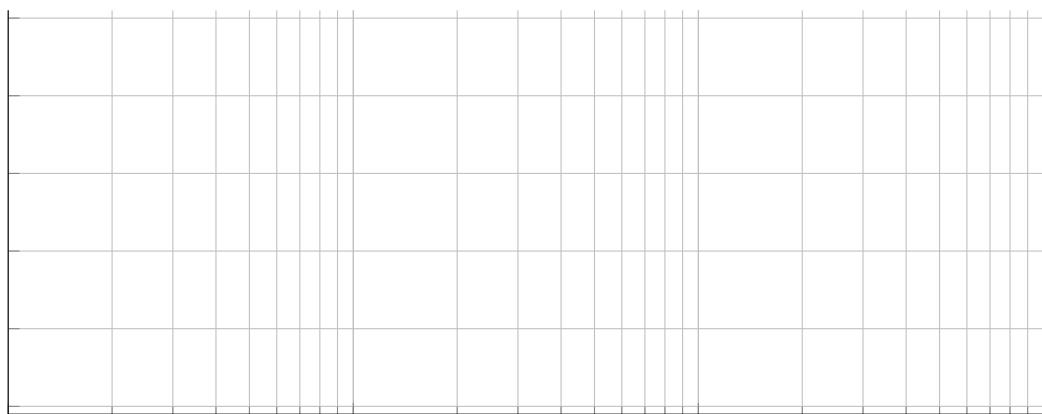
5. [FPE10, Aufgabe 6.9] Bestimmen sie die Übertragungsfunktion für folgendes asymptotisches Bodediagramm:



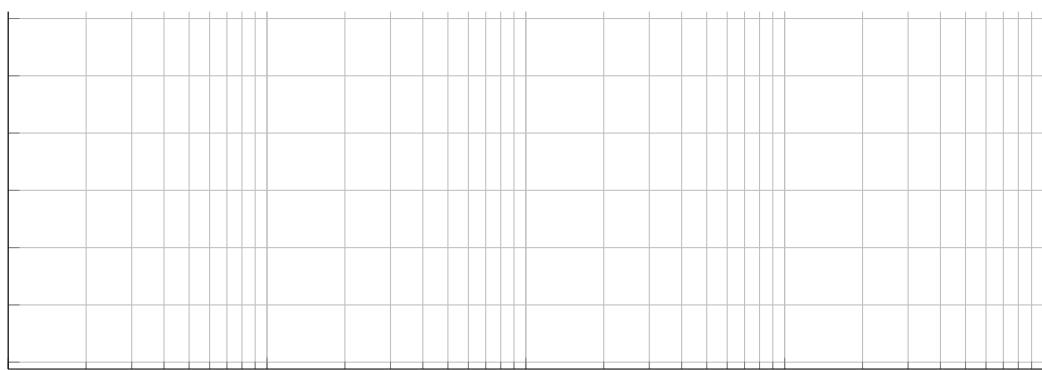
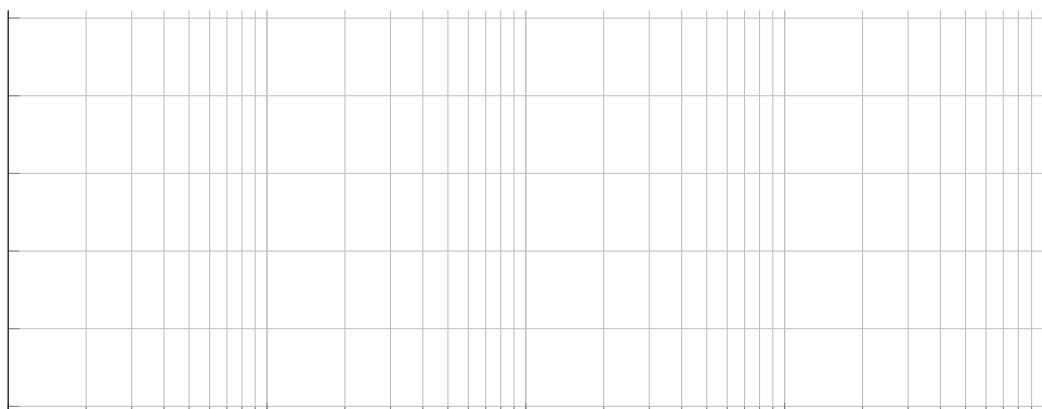
[FPE10, Figure 6.87]

Bestimmen Sie die Sprungantwort des Systems.

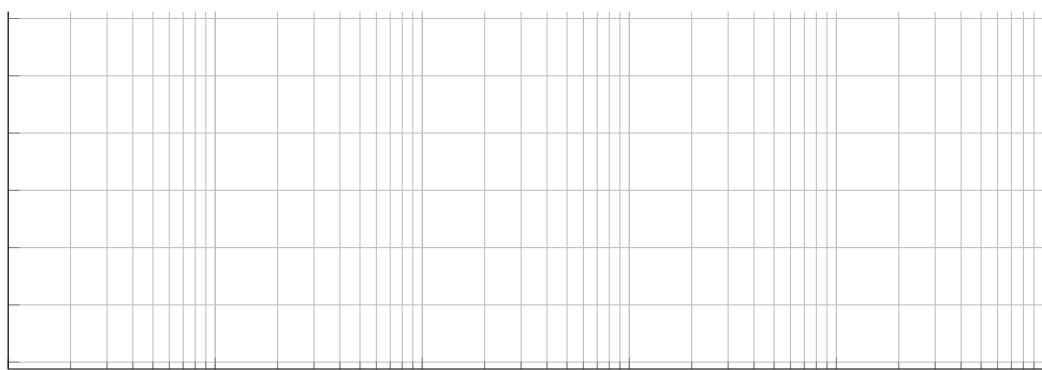
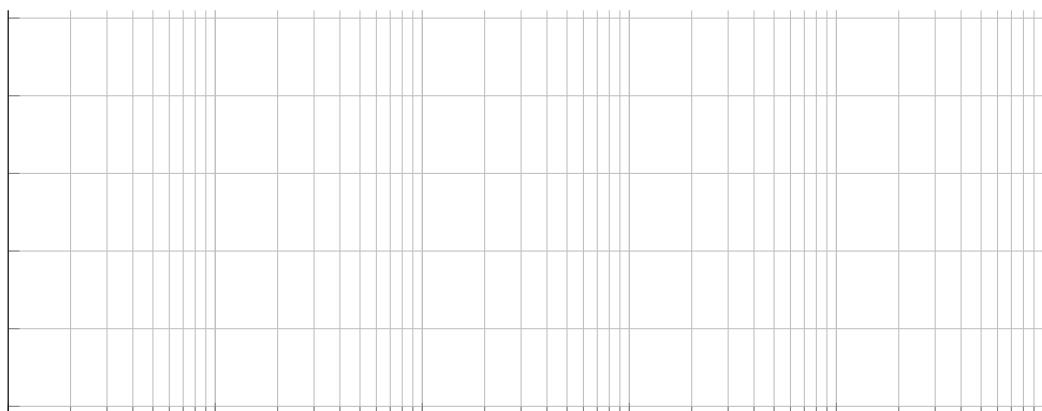
1. 1.(a)



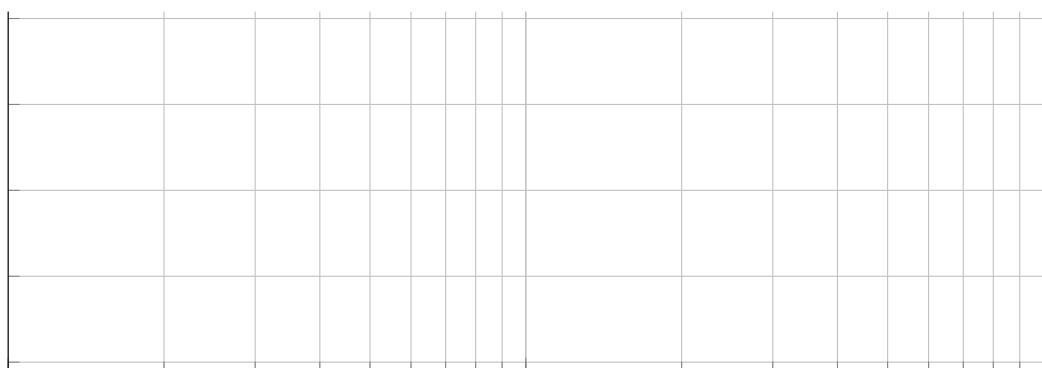
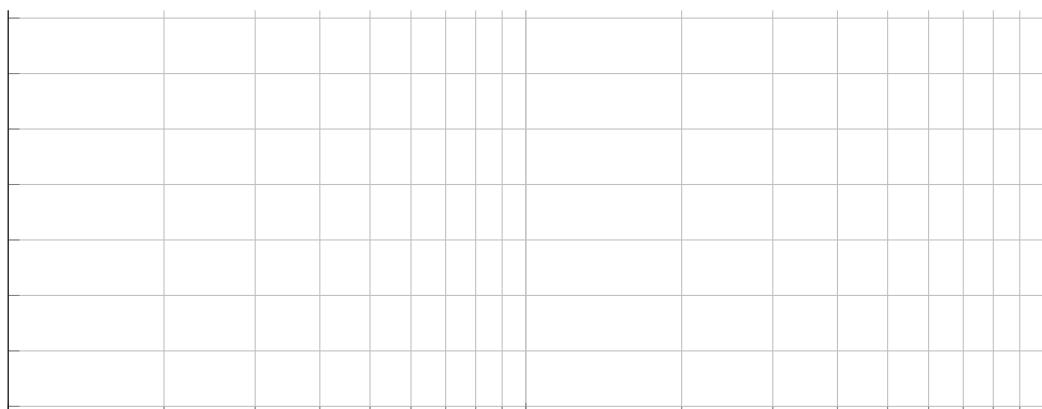
1.(b)



1.(c)



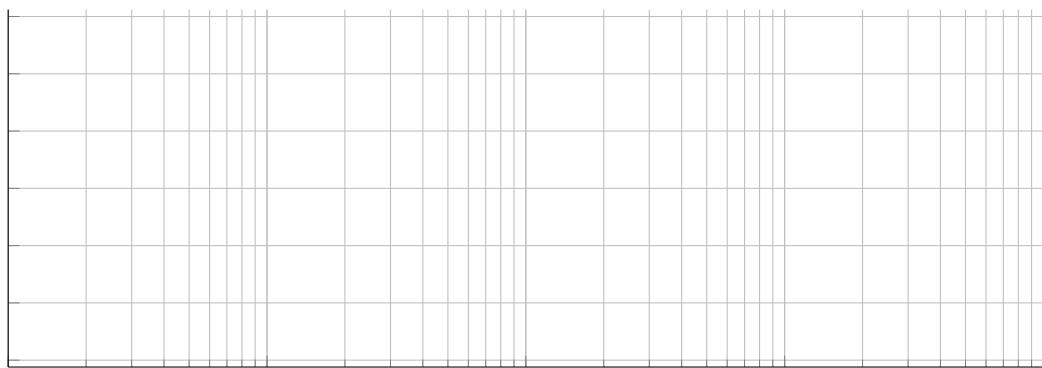
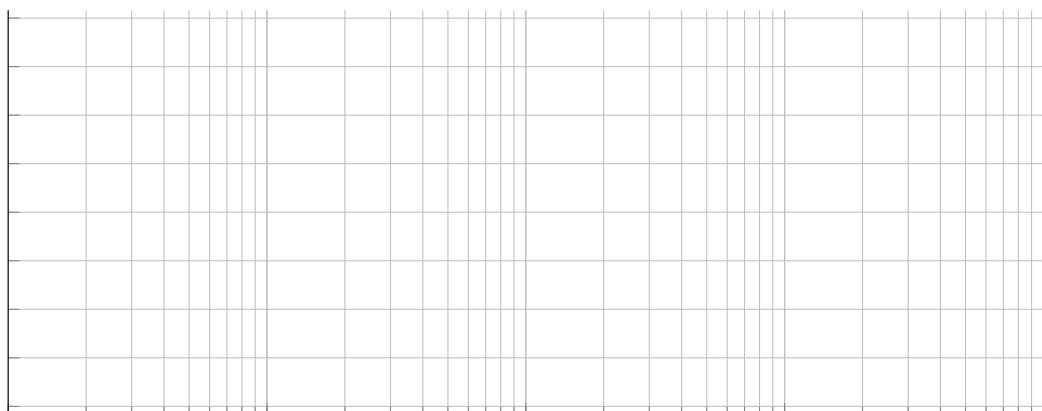
1.(d)



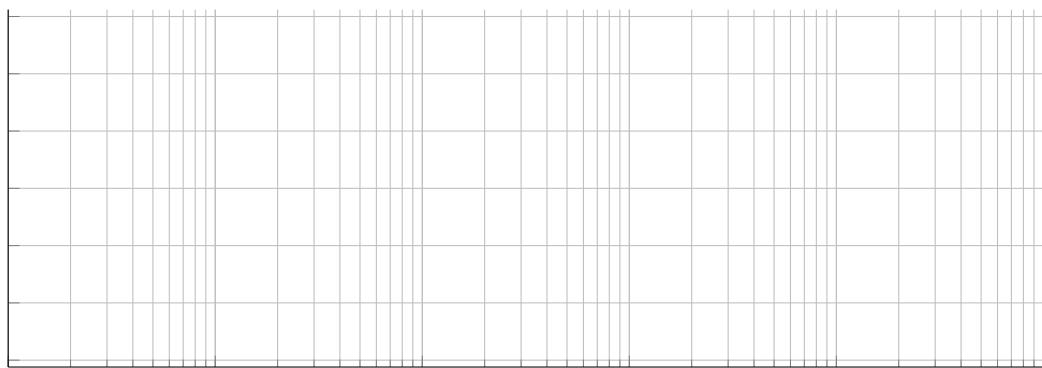
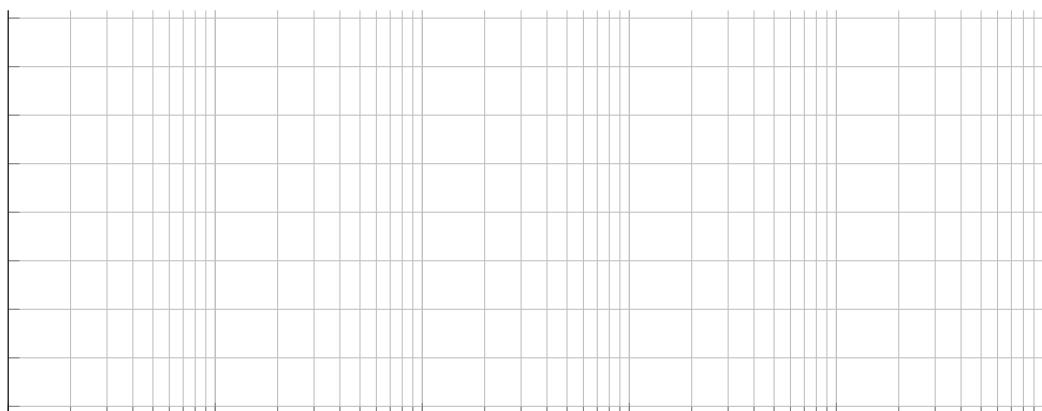
(7)

*Übungen Bode-Diagramm*

1.(e)



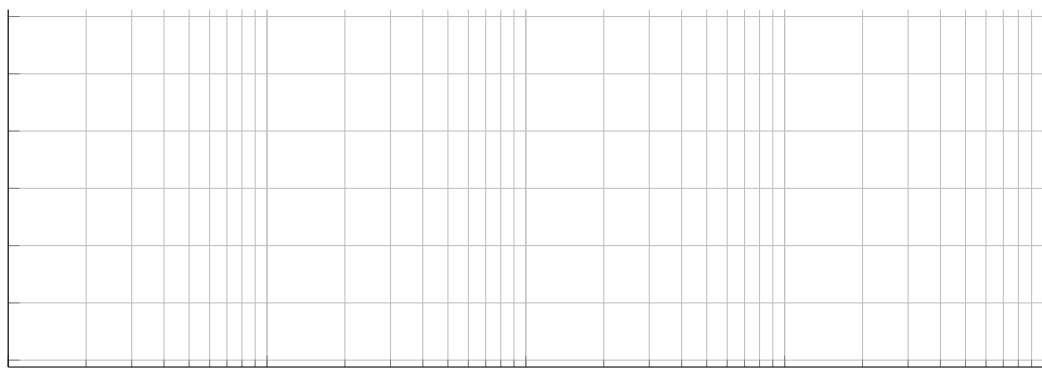
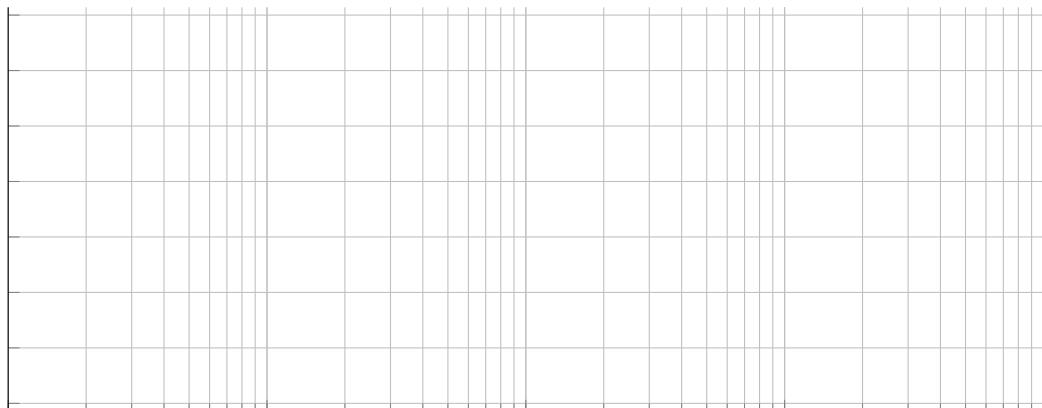
1.(f)



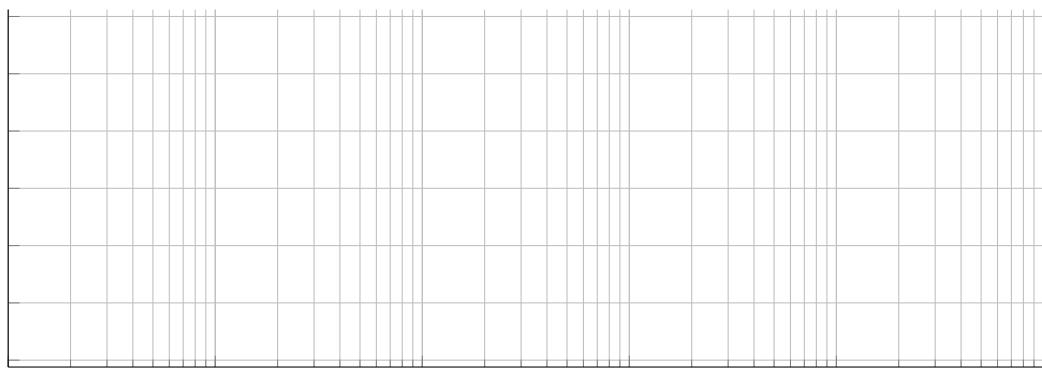
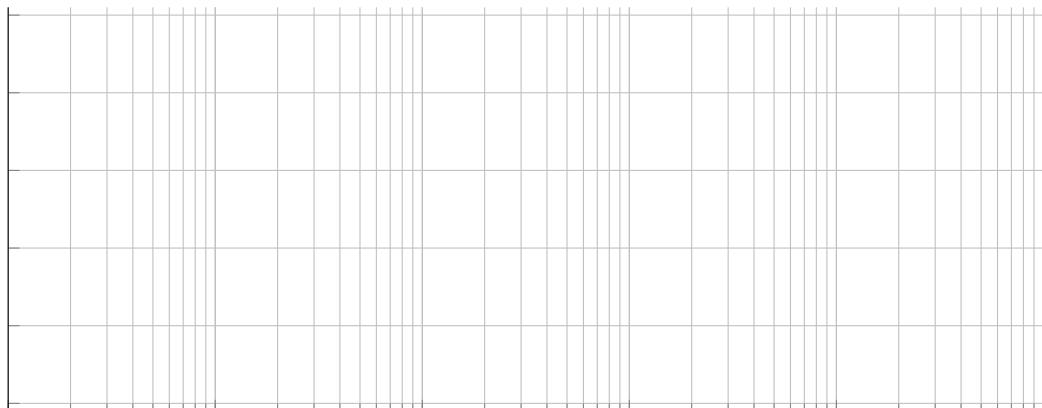
(7)

*Übungen Bode-Diagramm*

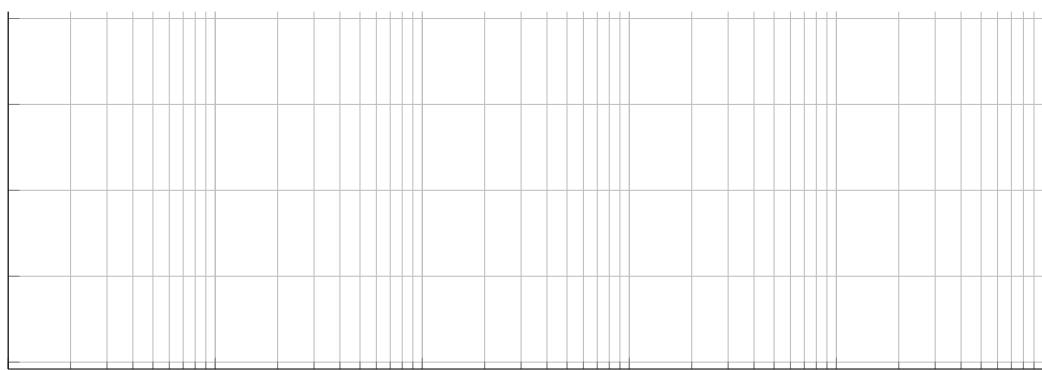
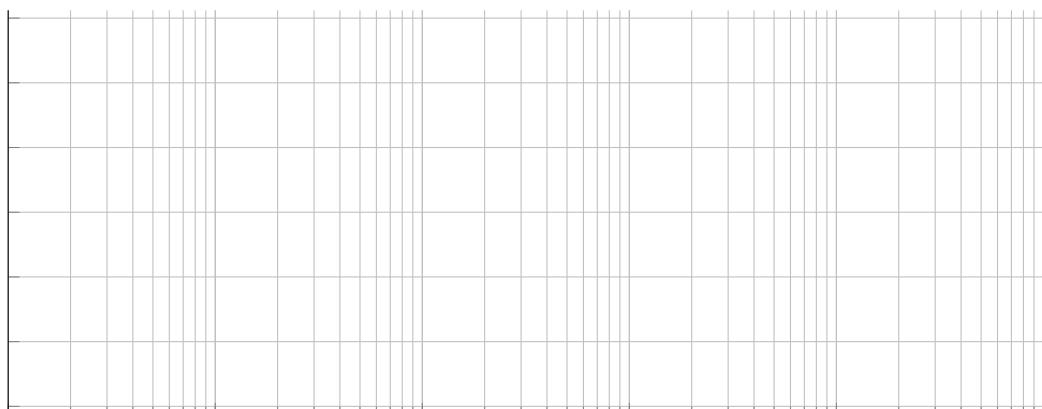
1.(g)



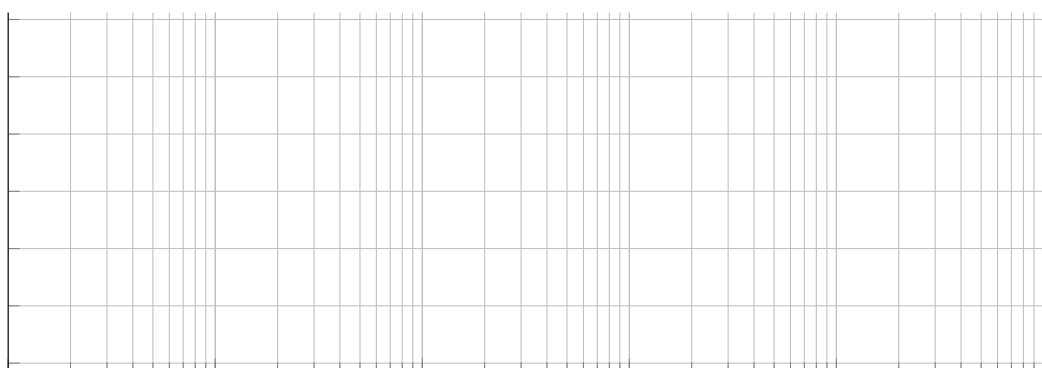
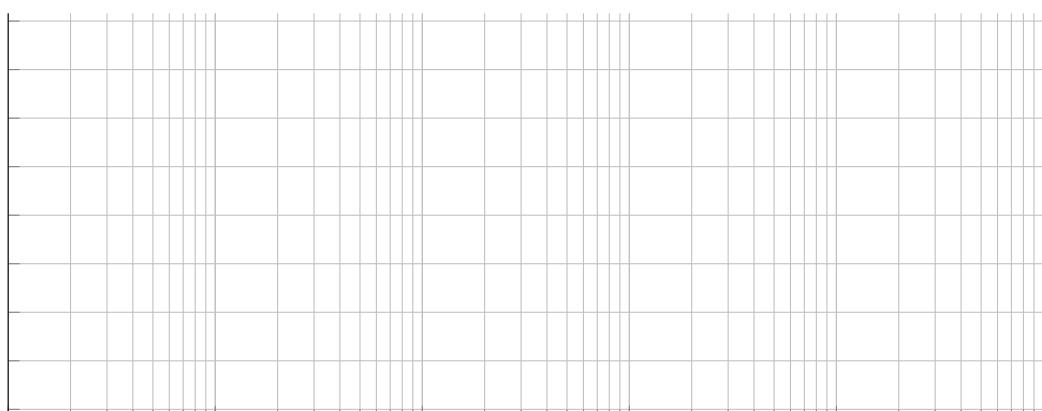
1.(h)



1.(i)



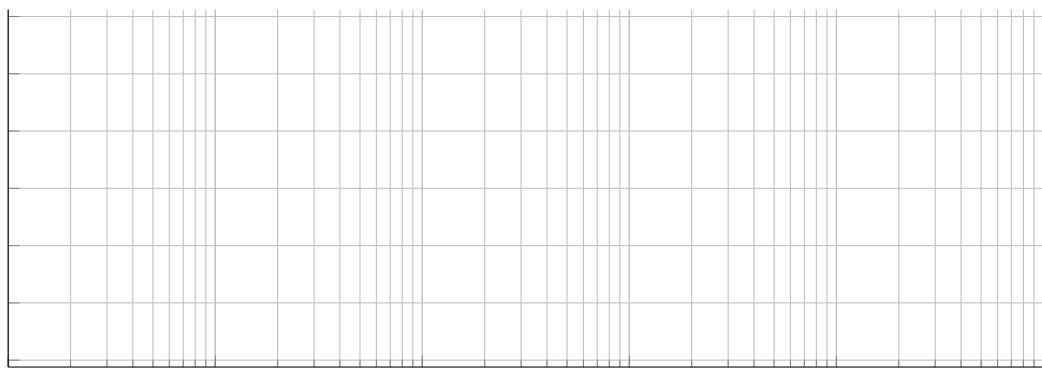
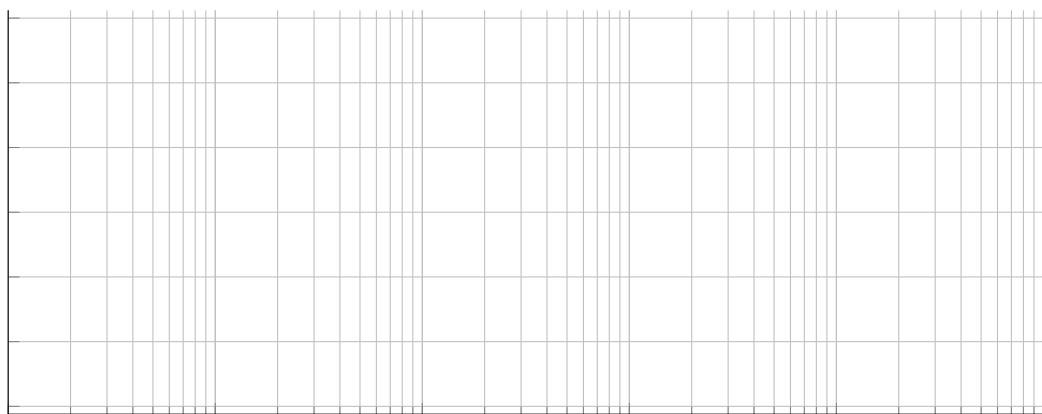
2. 2.(a)



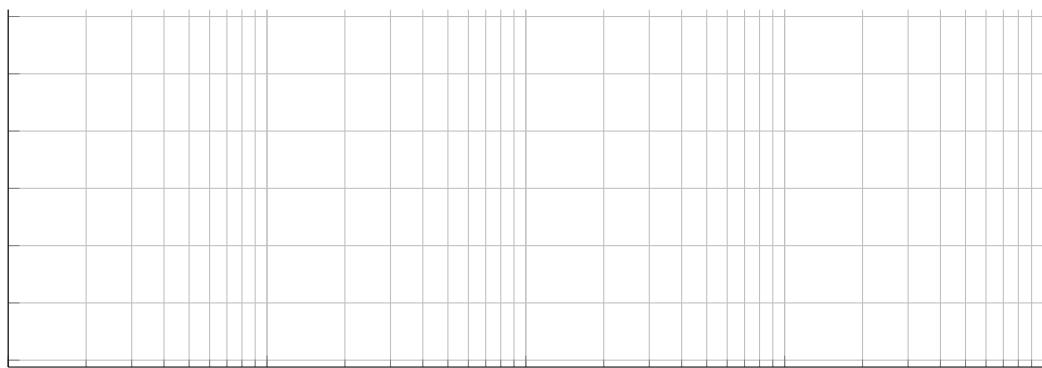
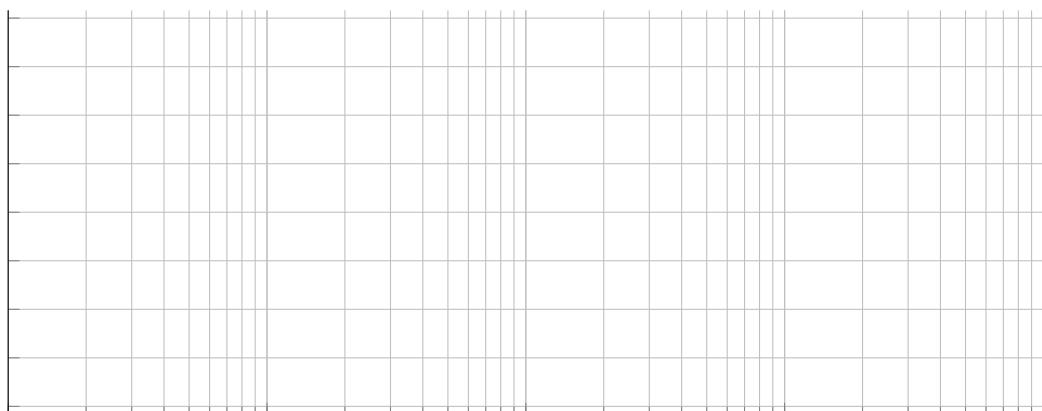
(7)

*Übungen Bode-Diagramm*

2.(b)



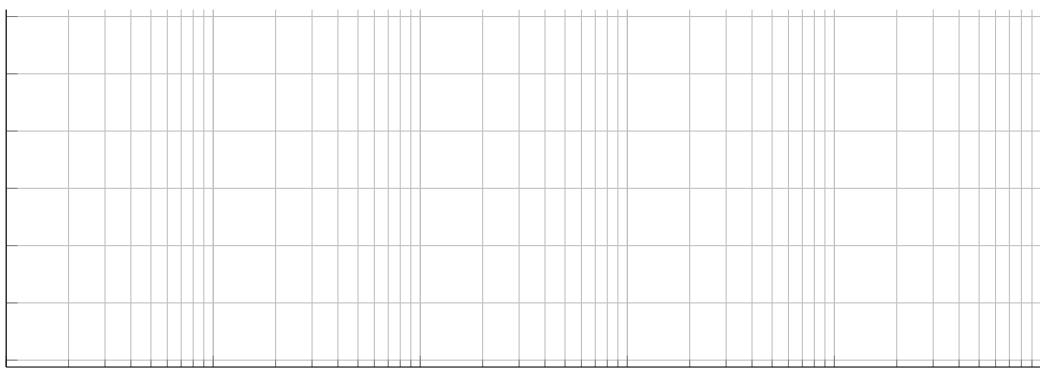
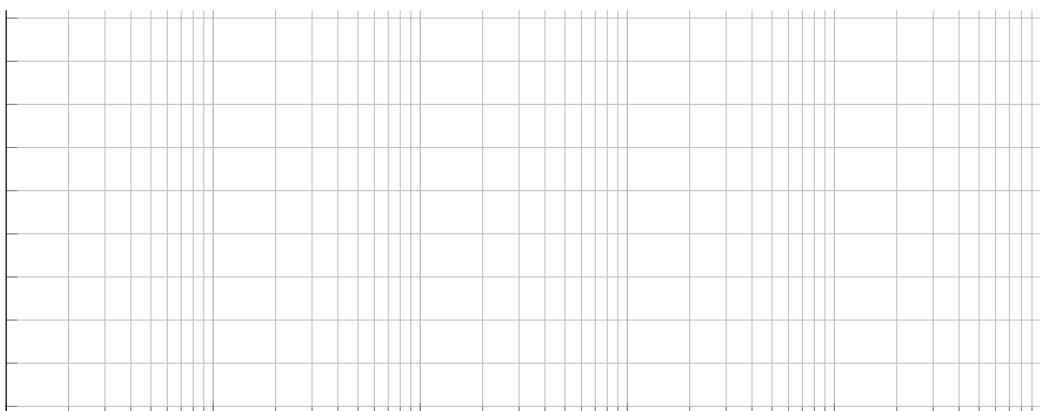
2.(c)



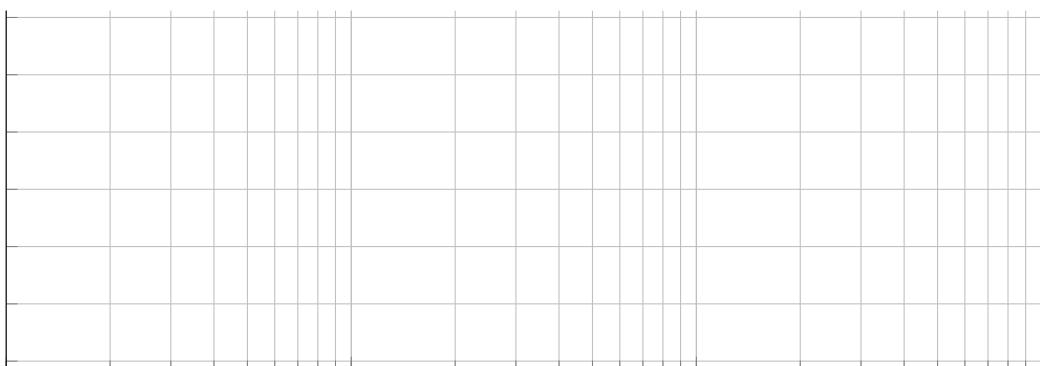
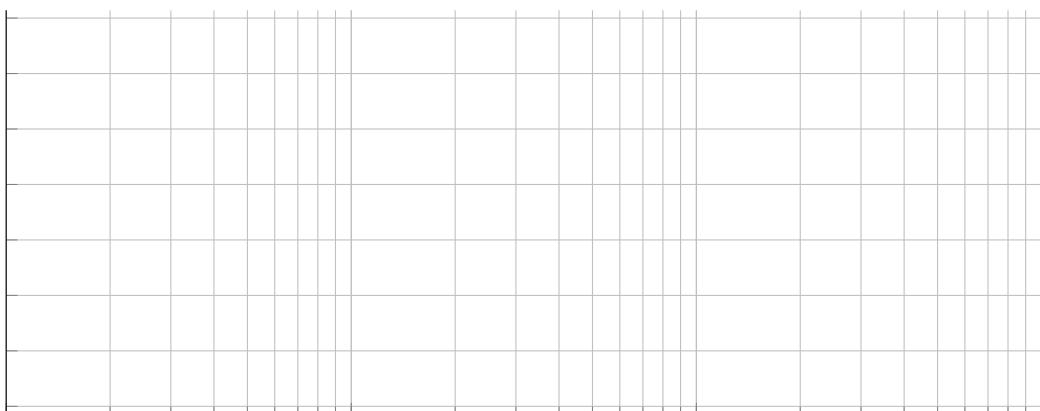
(7)

*Übungen Bode-Diagramm*

2.(d)



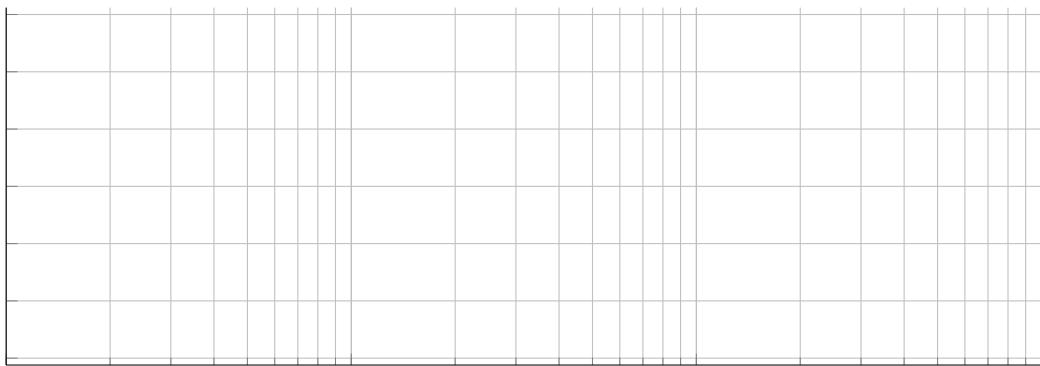
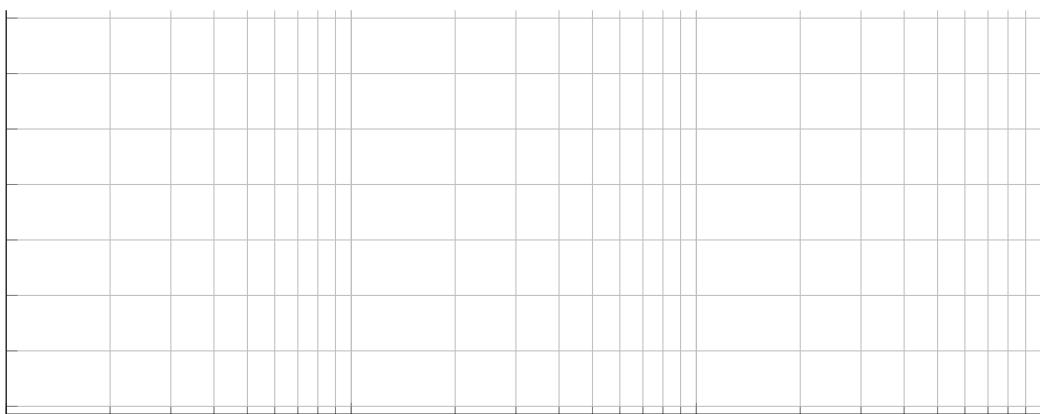
3. 3.(a)



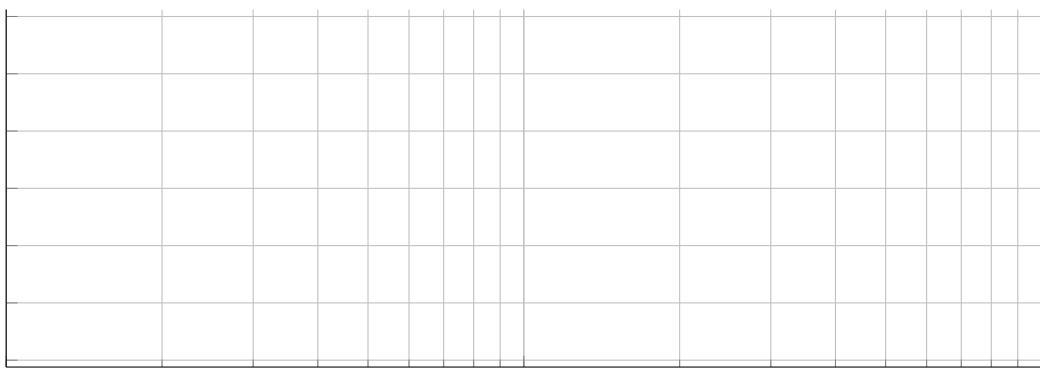
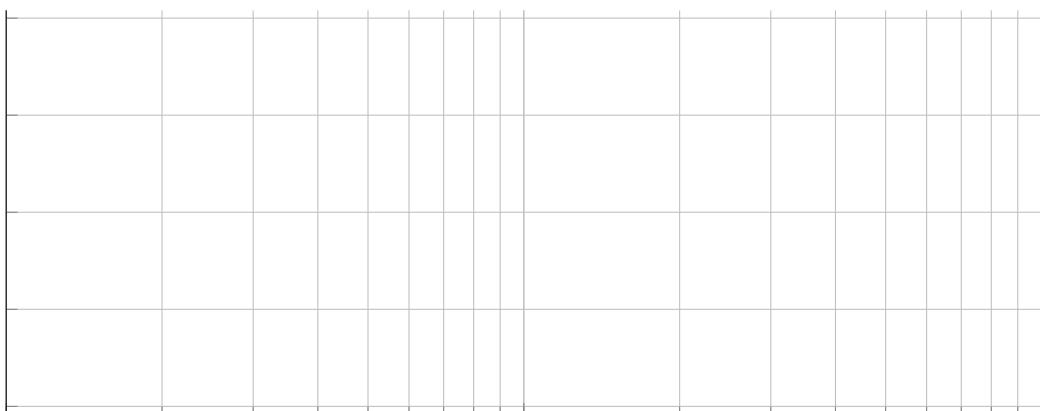
(7)

*Übungen Bode-Diagramm*

3.(b)



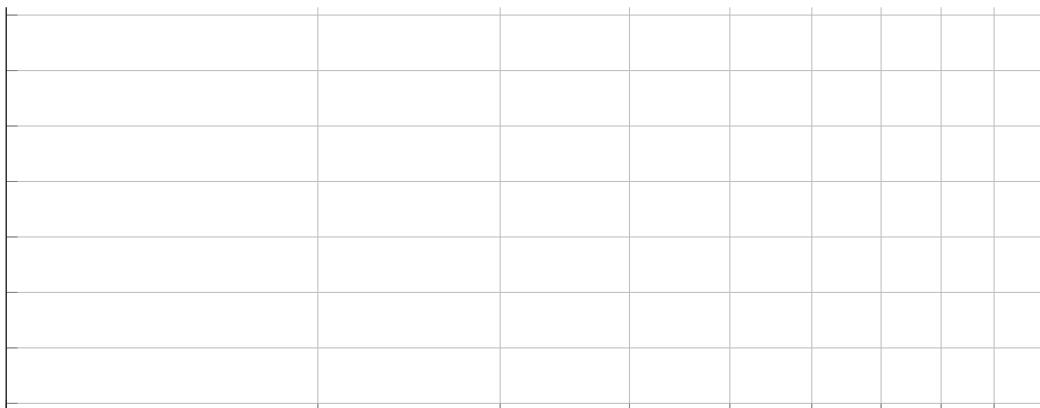
3.(c)



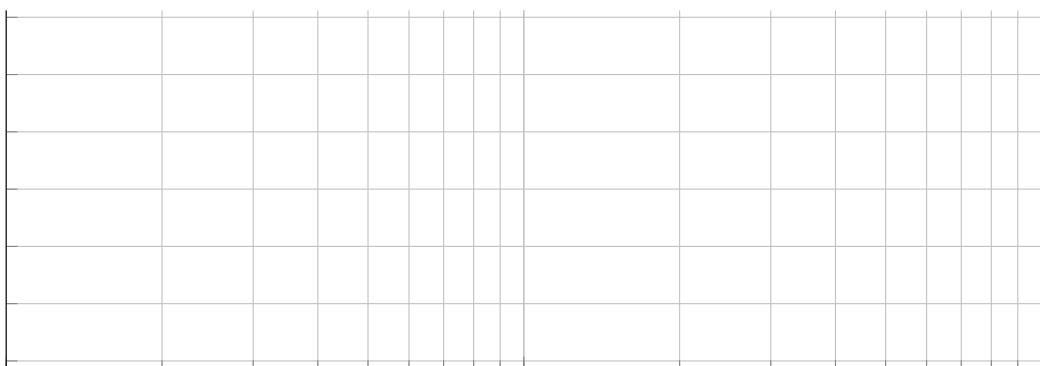
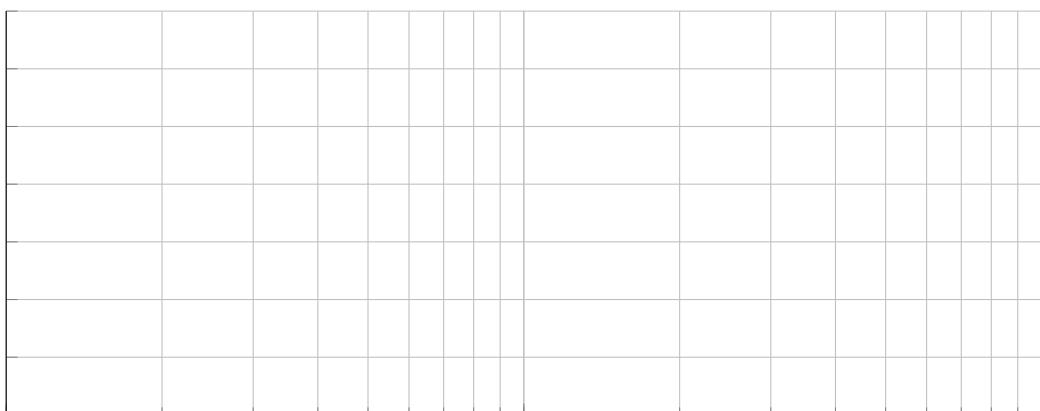
(7)

*Übungen Bode-Diagramm*

3.(d)



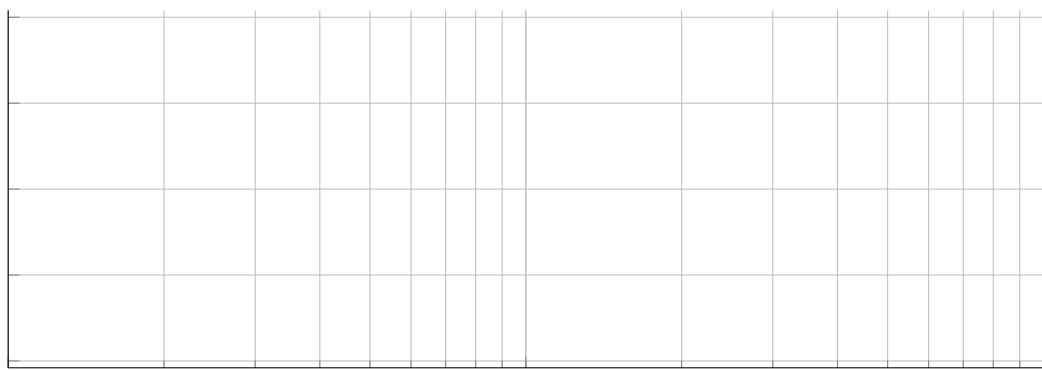
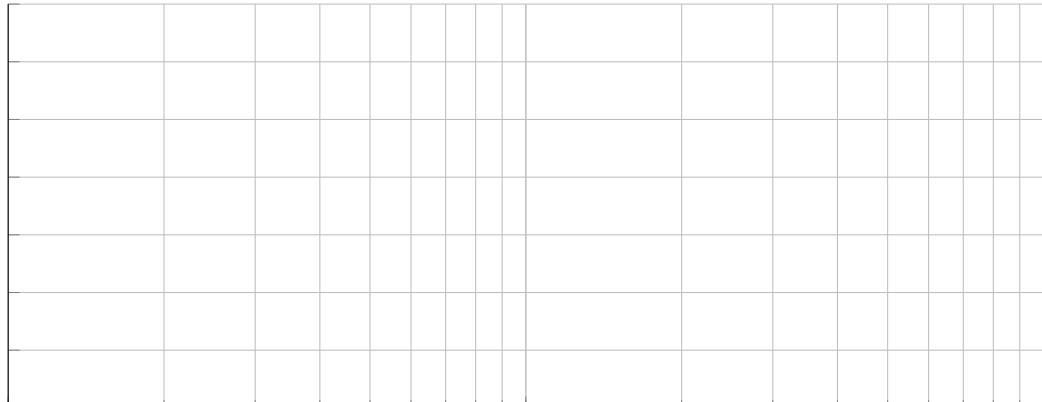
3.(e)



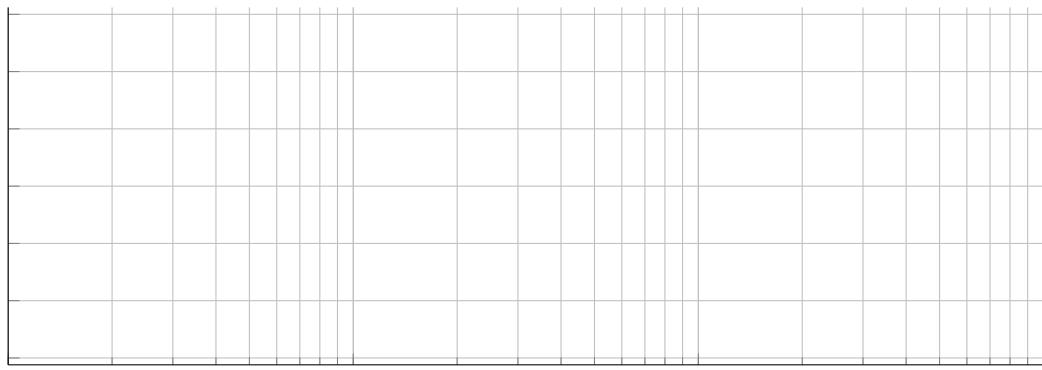
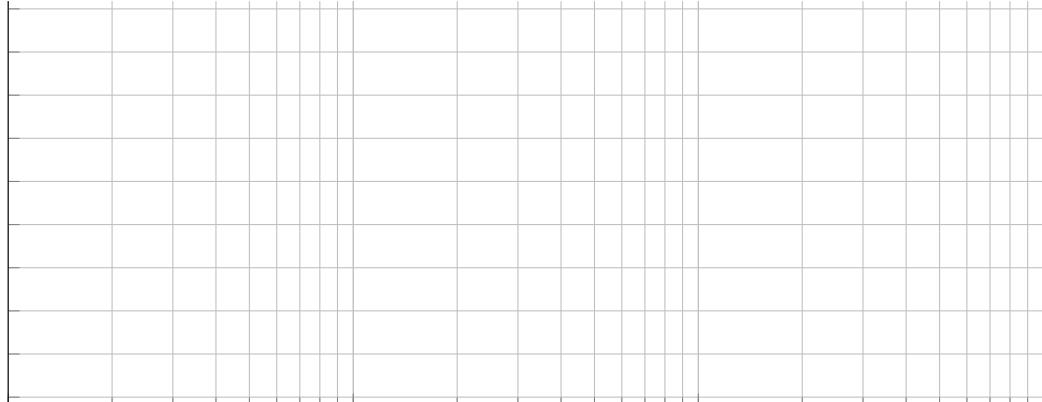
(7)

*Übungen Bode-Diagramm*

3.(f)



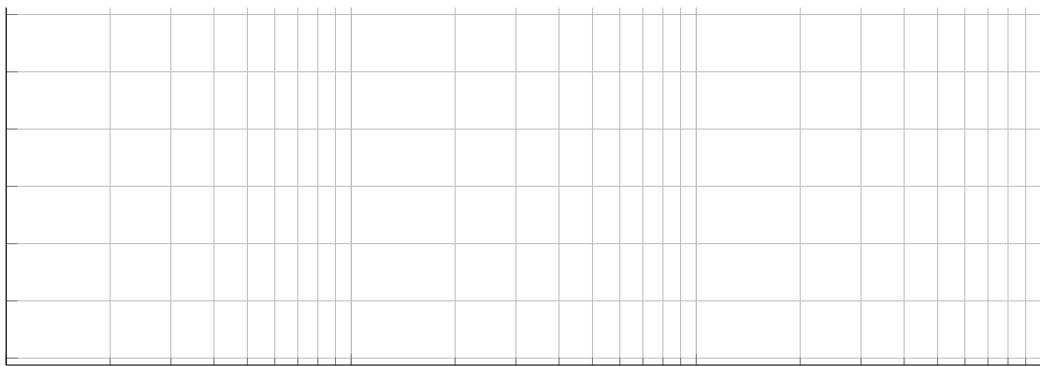
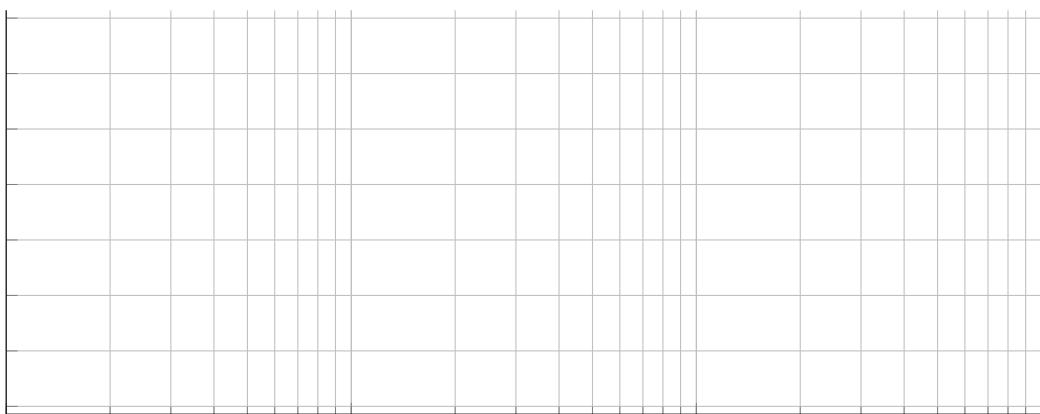
4. 4.(a)



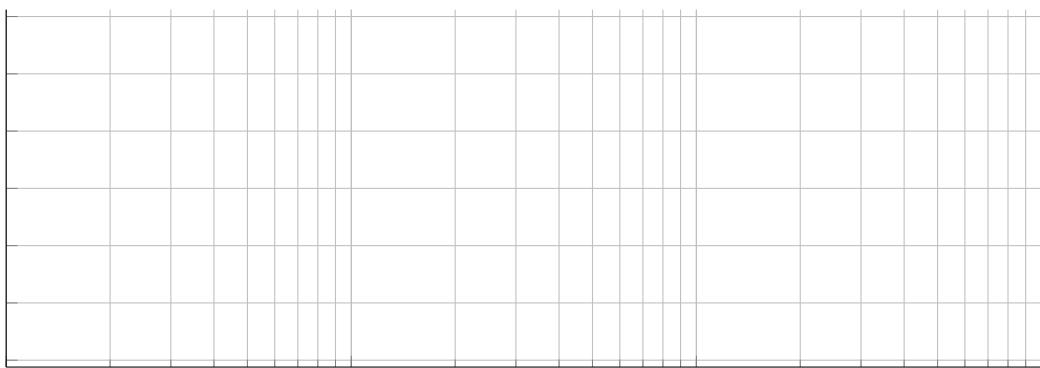
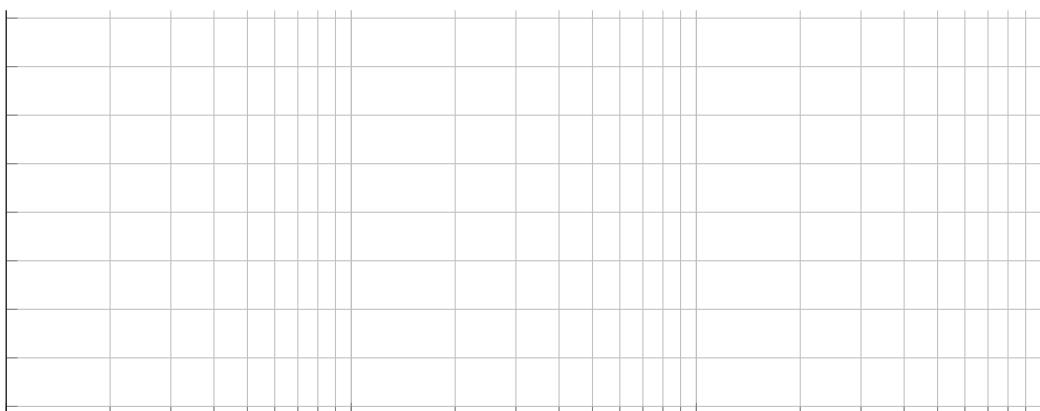
(7)

*Übungen Bode-Diagramm*

4.(b)



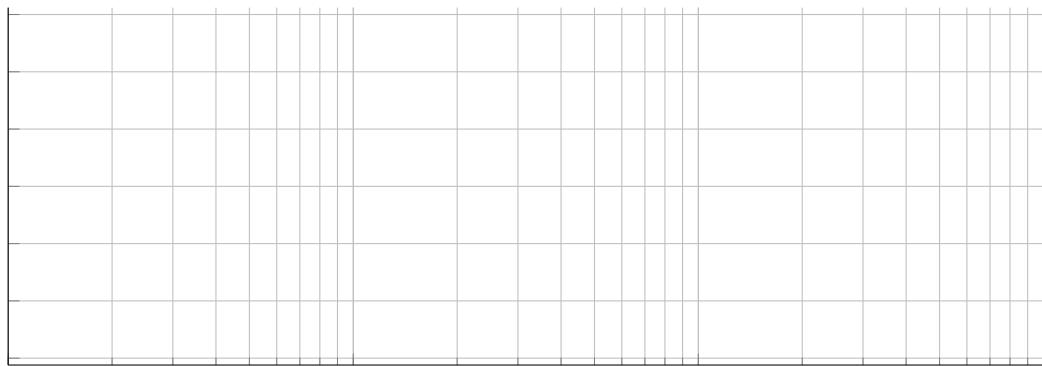
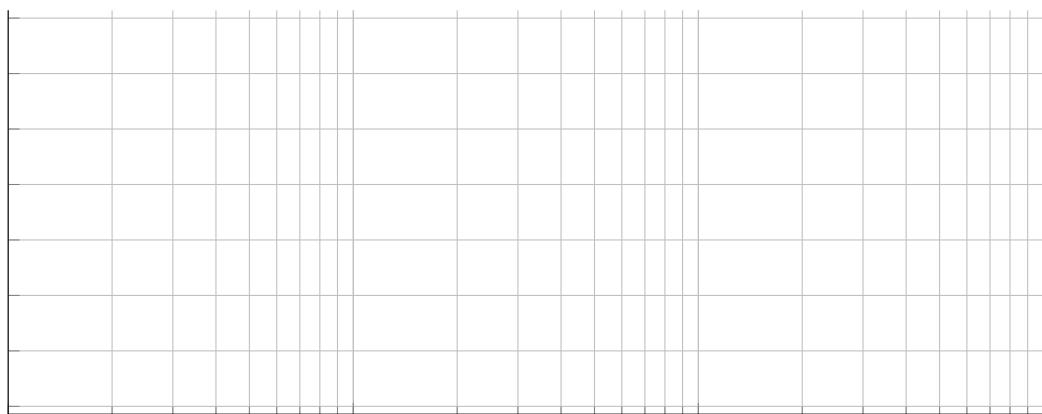
4.(c)



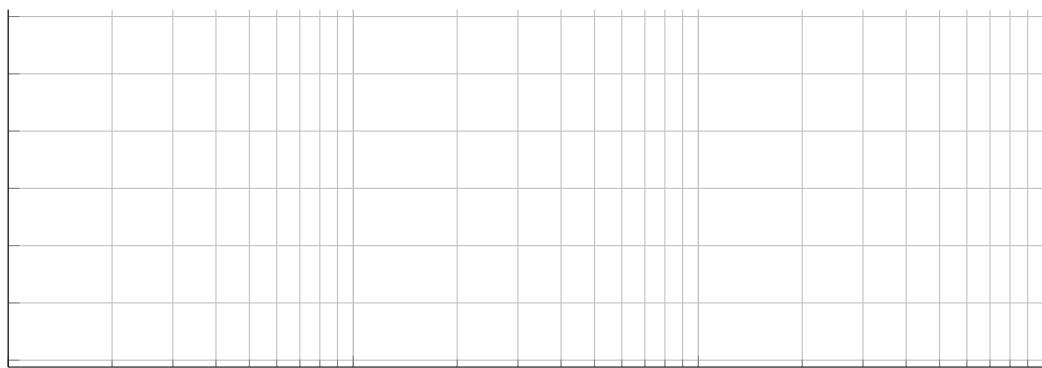
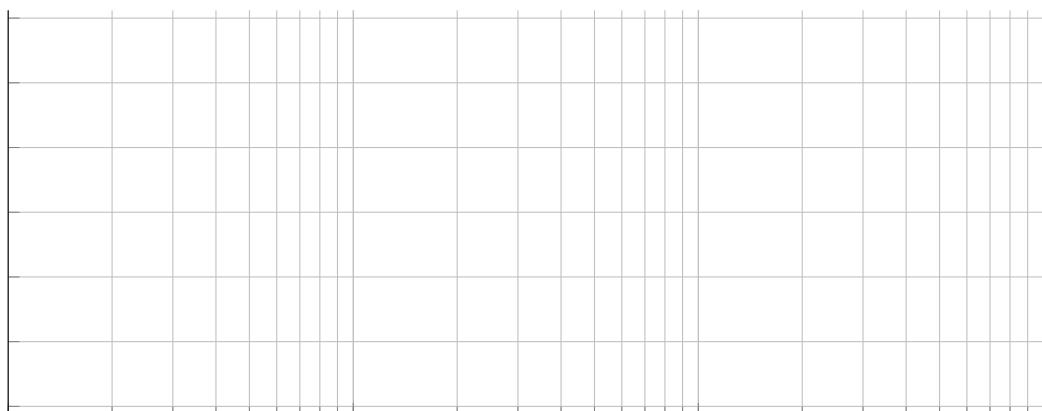
(7)

*Übungen Bode-Diagramm*

4.(d)



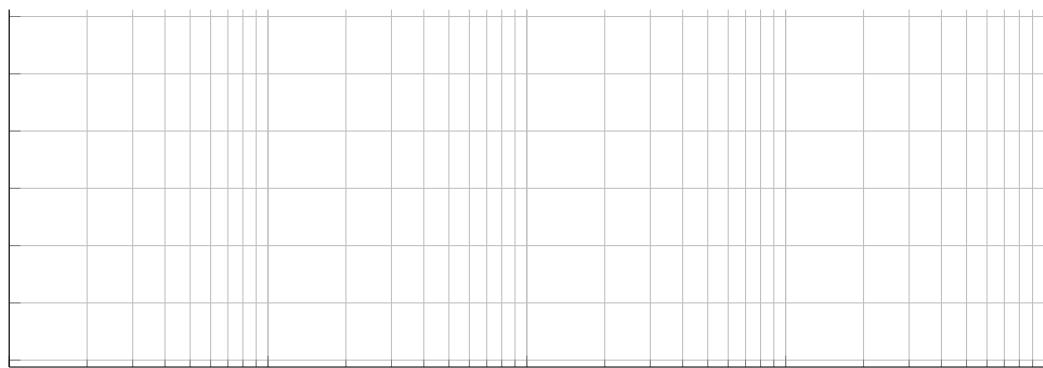
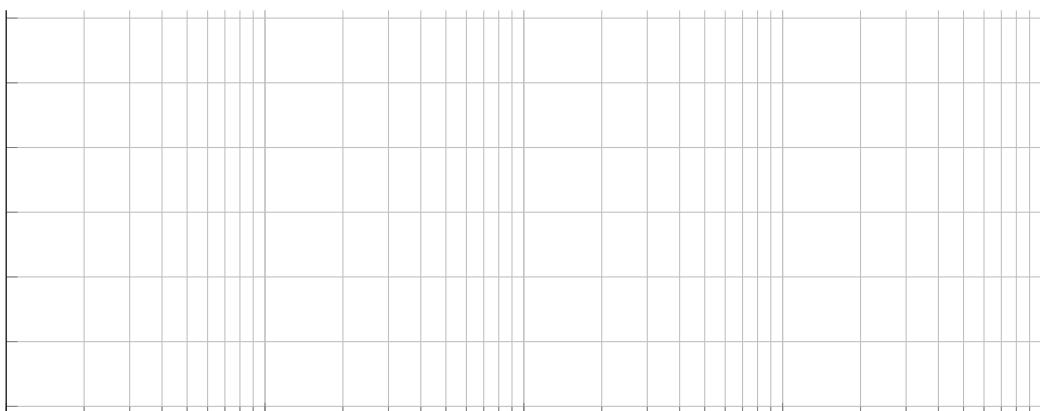
4.(e)



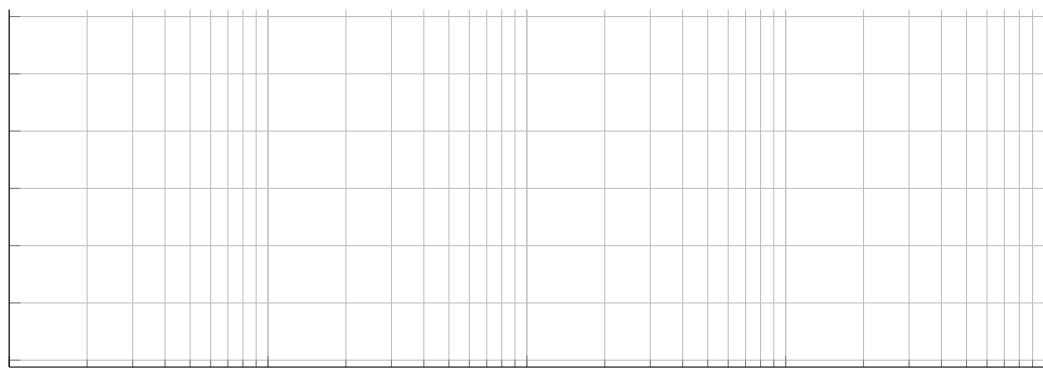
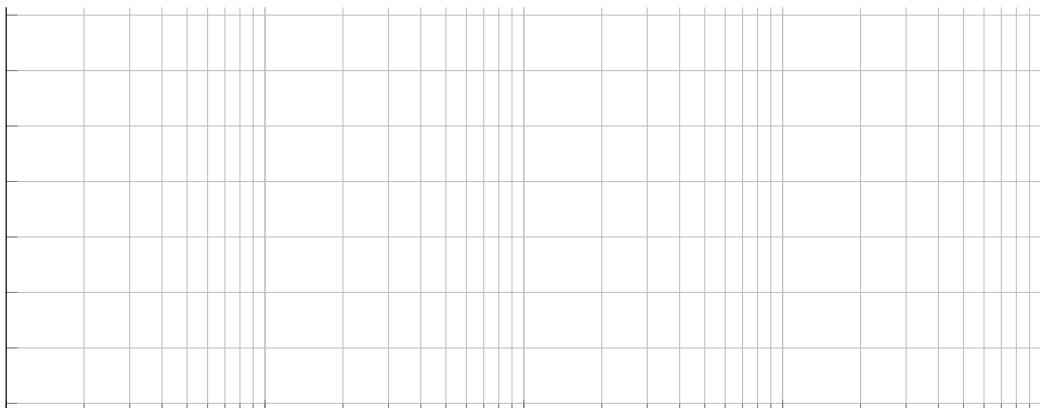
(7)

*Übungen Bode-Diagramm*

4.(f)



4.(g)



**Literatur**

- [FPE10] Gene F. Franklin, J. David Powel und Abbas Emami-Naeini. *Feedback Control of Dynamic Systems*. 6th international edition. Pearson Prentice Hall, 2010.