IV Praktikum 2022

Vorbereitungsteil:

Aufgabe 1

$$|E| = \frac{1}{\sqrt{2}} 1V, \; R_1 = R_2 = R = 50\Omega$$

1. Bestimmen Sie Pmax.

$$P_{max} = \frac{|E|^2}{4R}$$

$$|E|^2 = \left(\frac{1V}{\sqrt{2}}\right)^2 \;\Rightarrow\; |E|^2 = \frac{1}{2}V^2$$

$$P_{max} = \frac{\frac{1V^2}{2}}{4R} = \frac{1V^2}{8R} = \frac{1}{400}\frac{V^2}{\Omega} = 2,5\,\text{mW}$$

```
syms R E
P_max = abs(E)^2/(4*R)
```

P_max =

$$\frac{|E|^2}{4\,R}$$

```
P_max = double(subs(P_max,[E,R],[1/sqrt(2),50]))*1000  %W --> mW
```

P_max = 2.5000

2. Bestimmen Sie S21(jω).

$$S_{21} = k\frac{U_2}{E} = 2\sqrt{\frac{R_1}{R_2}}\frac{U_2}{U_1}\frac{U_1}{E} \;\Rightarrow\; S_{21} = 2\frac{U_2}{E}$$

$$U_2 = I * \left(R_2 + \frac{1}{j\omega C}\right)^{-1}$$

$$I = \frac{E}{R_{ges}}$$

$$\Rightarrow U_2 = \frac{E}{R_{ges}} * \left(R_2 + \frac{1}{j\omega C}\right)^{-1} \rightarrow S_{21} = 2\frac{\left(R_2 + \frac{1}{j\omega C}\right)^{-1}}{R_{ges}}$$

$$R_{ges} = R + C||R$$

$$C||R = \frac{1}{j\omega C + \frac{1}{R}} \qquad \Rightarrow \qquad R_{ges} = R + \frac{1}{j\omega C + \frac{1}{R}}$$

$$S_{21} = 2\frac{\left(\frac{1}{R} + j\omega C\right)^{-1}}{R + \frac{R}{j\omega CR + 1}}$$

```
syms R omega C real
R_ges = R + 1/(1i*omega*C+1/R);
S_21 = 2*((1/R+1i*omega*C)^-1)/(R+R/(1+1i*omega*C*R)) %2*R/R_ges
```

S_21 =

$$\frac{2}{\left(\frac{1}{R} + C\,\omega\,\mathrm{i}\right)\left(R + \frac{R}{1 + C\,R\,\omega\,\mathrm{i}}\right)}$$

```
simplify(S_21,"Steps",640)
```

ans =

$$\frac{2}{2 + C\,R\,\omega\,\mathrm{i}}$$

3. Bestimmen Sie |S21(jω)|² und AdB(ω).

```
simplify(abs(S_21)^2,"Steps",100)
```

ans =

$$\frac{4\,R^2\,|C\,R\,\omega - \mathrm{i}|^2}{|C\,R\,\omega - 2\,\mathrm{i}|^2\,|1 + C\,R\,\omega\,\mathrm{i}|^2\,|R|^2}$$

```
S21 = 4/(C^2*R^2*omega^2 + 4) - (2i*C*R*omega)/(C^2*R^2*omega^2 + 4)
```

S21 =

$$\frac{4}{C^2\,R^2\,\omega^2 + 4} - \frac{2\,C\,R\,\omega\,\mathrm{i}}{C^2\,R^2\,\omega^2 + 4}$$

```
simpS21_abs_quad = (4*C^2*R^2*omega^2)/(C^2*R^2*omega^2 + 4)^2 + 16/(C^2*R^2*omega^2 + 4)^2
```

simpS21_abs_quad =

$$\frac{16}{(C^2\,R^2\,\omega^2 + 4)^2} + \frac{4\,C^2\,R^2\,\omega^2}{(C^2\,R^2\,\omega^2 + 4)^2}$$

```
A_db = 10*log10((C^2*R^2*omega^2 + 4)^2/(4*C^2*R^2*omega^2+16))
```

A_db =

$$\frac{10\log\left(\frac{(C^2\,R^2\,\omega^2 + 4)^2}{4\,C^2\,R^2\,\omega^2 + 16}\right)}{\log(10)}$$

```
simA_db = simplify(A_db,"Steps",100)
```

simA_db =

$$\frac{10\log\left(\frac{C^2\,R^2\,\omega^2}{4}+1\right)}{\log(10)}$$

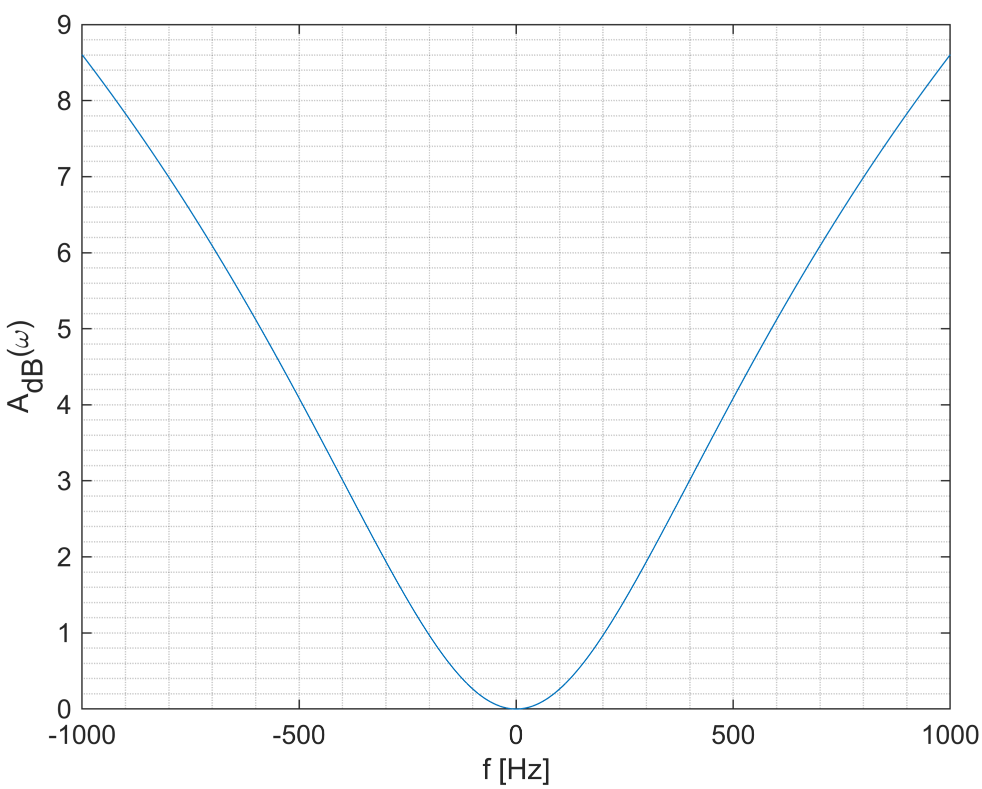
4. Zeichnen Sie AdB(ω) qualitativ.

```
syms A_dB(omega)
A_dB = symfun(simA_db,[C,R,omega])
```

A_dB(C, R, omega) =

$$\frac{10\log\left(\frac{C^2\,R^2\,\omega^2}{4}+1\right)}{\log(10)}$$

```
plot(-1000:1:1000,A_dB(0.1,50,-1:1/1000:1)) %Welche Werte für C?
xlabel ("f [Hz]")
ylabel("A_{dB}(\omega)")
grid("minor")
```



5. Handelt es sich um ein Hochpass- oder ein Tiefpassfilter? Begründen Sie Ihre Antwort.

Hochpass, da tiefe Frequ. blockiert werden

```
wg = solve(A_db==3)
```

wg =

$$\begin{pmatrix} -\frac{2\sqrt{10^{3/10}-1}}{C\,R} \\ \frac{2\sqrt{10^{3/10}-1}}{C\,R} \end{pmatrix}$$

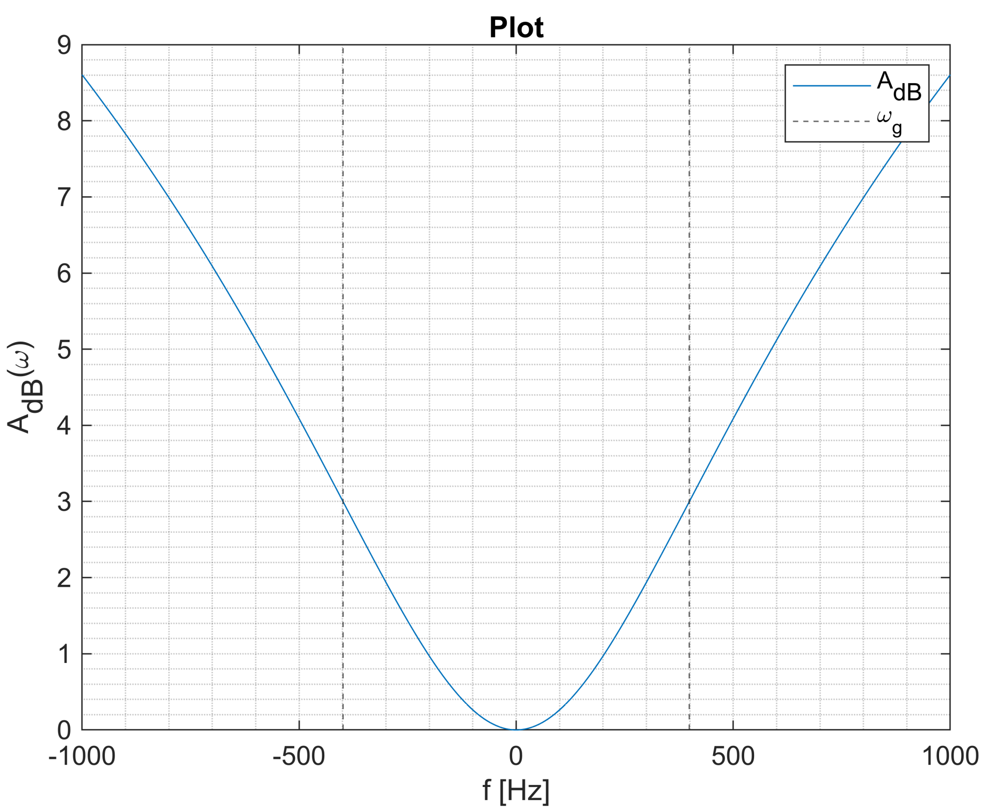
```
double(subs(wg,[C,R],[0.1,50]))
```

```
ans = 2×1
   -0.3991
    0.3991
```

```
double(vpasolve(subs(A_dB,[C,R],[0.1,50])==3))
```

```
ans = -0.3991
```

```
xline(ans*1000,"LineStyle","--")
xline(-ans*1000,"LineStyle","--")
xlim("auto")
ylim("auto")
legend(["A_{dB}","\omega_g"])
title("Plot")
```



Kondensator: $X_c = \frac{1}{j\omega C}$ mit $\omega = 2\pi f$

$f_g = \frac{1}{2\pi RC}$

```
fg = 1/(1i*2*pi*R*C)
```

```
fg =
```

$-\frac{\mathrm{i}}{2\,C\,R\,\pi}$

```
A_dB
```

```
A_dB(C, R, omega) =
```

$\frac{10\log\left(\frac{C^2\,R^2\,\omega^2}{4}+1\right)}{\log(10)}$

```
double(subs(A_dB,omega,2*pi*fg))
```

```
ans = -1.2494
```

Aufgabe 2

1. $\Omega_s < 2$ --> n=3
2. $\Theta = 30$ $r_1 = r_2 = 1$
3.
4.