IV Praktikum 2022

Vorbereitungsteil:

Aufgabe 1

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

1. Bestimmen Sie Pmax.

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

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

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

```
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).

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

$U_2 = I * R_2$

$I = \frac{E}{R_{ges}} \quad \Rightarrow U_2 = \frac{E}{R_{ges}} R_2 \rightarrow S_{21} = 2 \frac{R_2}{R_{ges}}$

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

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

$$S_{21} = 2\frac{R}{R+\frac{R}{j\omega CR+1}} = \frac{2}{1+\frac{1}{j\omega CR+1}} = \frac{2}{\frac{j\omega CR+1}{j\omega CR+1}+\frac{1}{j\omega CR+1}} = \frac{2}{\frac{j\omega CR+2}{j\omega CR+1}} = 2\frac{j\omega CR+1}{j\omega CR+2} = \frac{2\omega CR-2j}{\omega CR-2j}$$

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

S_21 =

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

```
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",3)
```

ans =

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

```
S21_abs_quad = (4*C^2*R^2*omega^2)/(C^2*R^2*omega^2 + 4) + 4/(C^2*R^2*omega^2 + 4)
```

S21_abs_quad =

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

```
simpS21_abs_quad = simplify(S21_abs_quad,"Steps",10)
```

simpS21_abs_quad =

$$4-\frac{12}{C^2\,R^2\,\omega^2+4}$$

```
A_db = -10*log10(1/simpS21_abs_quad)
```

A_db =

$$-\frac{10\log\left(-\frac{1}{\frac{12}{C^2\,R^2\,\omega^2+4}-4}\right)}{\log(10)}$$

```
simA_db = simplify(A_db,"Steps",10)
```

```
simA_db =
```

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

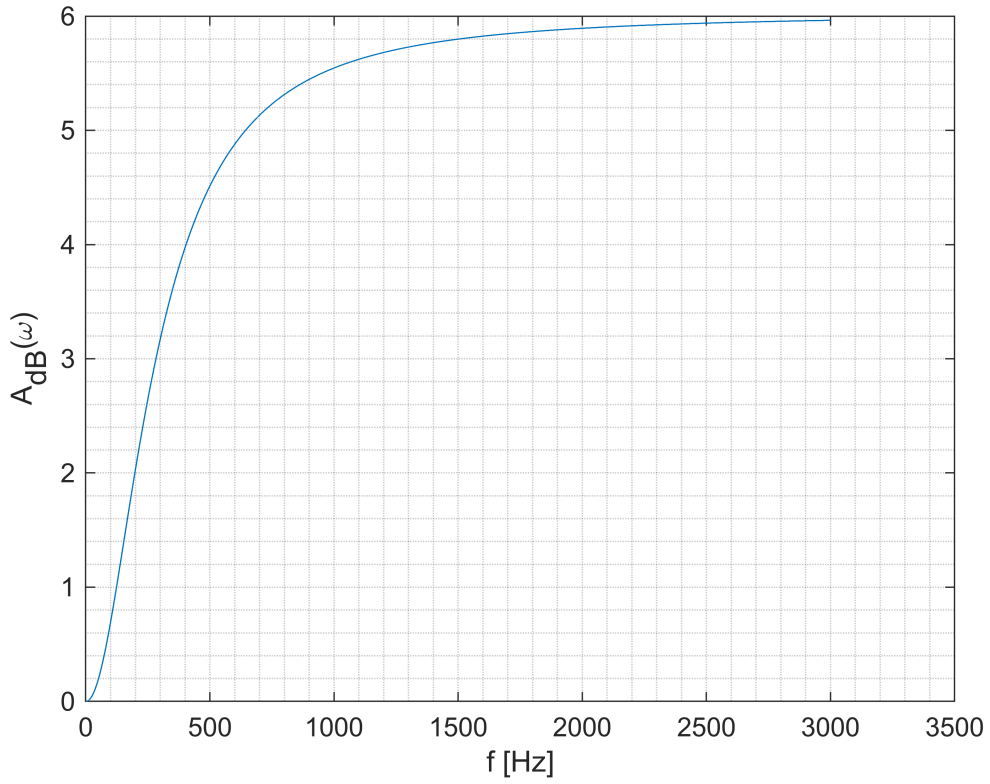
4. Zeichnen Sie AdB(ω) qualitativ.

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

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

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

```
plot((A_dB(0.1,50,0:1/1000:3))) %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.

Anhand des Plot ist die Dämpfung für hohe Freq. groß und für kleine Freq. klein. Das Verhalten spiegelt einen Tiefpass wieder

```
double(solve(subs(simA_db,[C,R],[0.1,50])==3))
```

```
ans = 2×1
   -0.2818
    0.2818
```

```
%xline(ans(2)*1000,LineStyle="-",LineWidth=4,DisplayName="\omega_g")

xline(ans(2)*1000,"LineStyle","--")
xlim("auto")
ylim("auto")
legend(["A_{dB}","\omega_g"])
title("Plot")
```