# Electronics II Problem sheet 5 

P. Stallinga
UAlg
UNIVERSIDADE DO ALGARVE $\underbrace{}_{1979 \mid 2009}$

## MIEET $3^{\circ}$ ano



- For the (positive) feedback system of Figure 1, determine the relation between $V_{\mathrm{i}}$ and $V_{0}$.

$$
A_{f}=\frac{A}{(1-A \beta)}
$$

- Fill out the table below with gain values $A_{\mathrm{f}} \equiv V_{\mathrm{o}} / V_{\mathrm{i}}$ for combinations $A-\beta$.

| $\beta \quad \\ ) & \(A$ | $\infty$ | $10^{5}$ | $10^{4}$ | 1000 | 100 | 10 |  |
| :--- | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| -1 |  | 1 | 1 | 1 | 1 | 0.99 | 0.91 |
| -0.1 | 10 | 10 | 9.99 | 9.9 | 9.09 | 5 | 0.05 |
| -0.01 | 100 | 99.9 | 99.01 | 90.91 | 50 | 9.09 | 0.99 |
| $-10^{-3}$ | $10^{3}$ | 990.1 | 909.09 | 500 | 90.91 | 9.9 | 1 |
| $-10^{-4}$ | $10^{4}$ | 9090.91 | 5000 | 909.09 | 99.01 | 9.99 | 1 |
| 0 | $\infty$ | $10^{5}$ | $10^{4}$ | 1000 | 100 | 10 | 1 |
| +0.1 | -10 | -10 | -10.01 | -10.1 | -11.11 | $\infty$ | 1.11 |
| +1 | -1 | -1 | -1 | -1 | -1.01 | -1.11 | $\infty$ |

- For an open-loop gain, $A=10^{5}$ with a variation (tolerance) of $5 \%$. Calculate the variation of closed-loop gain for the following betas:

| $\beta=0$ | $\beta=-0.001$ | $\beta=-0.01$ | $\beta=-0.1$ | $\beta=-1$ |
| :---: | :---: | :---: | :---: | :---: |
| $5 \%$ | $0.0495 \%$ | $0.005 \%$ | $0.0005 \%$ | $0.00005 \%$ |

- The amplifier $\mathrm{A}\left(A=10^{5}\right)$ has a single pole at 10 Hz . Determine the bandwidth of the circuit with feedback of $\beta=-10^{-3}$.

The gain-bandwidth product is constant. Without feedback $A_{\mathrm{v}} \mathrm{x} \Delta f=10^{5} \mathrm{x} 10 \mathrm{~Hz}=1 \mathrm{MHz}$. With feedback of $\beta=-10^{-3}$, the gain becomes (see the table above) 990.1 . The bandwidth therefore is $\Delta f=$ $1 \mathrm{MHz} / 990.1=1.01 \mathrm{kHz}$. Another way of calculating is: $\Delta f=\Delta f_{0}(1-A \beta)=10 \mathrm{~Hz} \mathrm{x}\left(1+10^{5} \times 10^{3}\right)=$ 1010 Hz .

