Electronics II Problem sheet 5

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• For the (positive) feedback system of Figure 1, determine the relation between V_i and V_o.

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

• Fill out the table below with gain values $A_f \equiv V_o/V_i$ for combinations A- β .

$\beta \setminus A$	∞	10 ⁵	104	1000	100	10	1
-1	1	1	1	1	0.99	0.91	0.05
-0.1	10	10	9.99	9.9	9.09	5	0.91
-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	104	9090.91	5000	909.09	99.01	9.99	1
0	∞	10 ⁵	10 ⁴	1000	100	10	1
+0.1	-10	-10	-10.01	-10.1	-11.11	∞	1.11
+1	-1	-1	-1	-1	-1.01	-1.11	x

• 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 A ($A = 10^5$) 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 $A_v \ge \Delta f = 10^5 \ge 10$ Hz = 1 MHz. With feedback of $\beta = -10^{-3}$, the gain becomes (see the table above) 990.1. The bandwidth therefore is $\Delta f = 1$ MHz/ 990.1 = 1.01 kHz. Another way of calculating is: $\Delta f = \Delta f_0 (1 - A\beta) = 10$ Hz $\ge (1 + 10^5 \ge 10^3) = 1010$ Hz.