NAME:

STUDENT NO.:

University of Puerto Rico
Electrical and Computer Engineering Department
INEL 4202 - Electronics II - Spring 2001 - Exam 2b - Prof. M. Toledo
THERE ARE THREE PROBLEMS - BE CLEAR OR LOOSE POINTS

1. An ideal voltage amplifier with $A_V = 4000$, $R_i = 100\Omega$ and $R_o = 100k\Omega$ is connected in a negative feedback loop. The feedback network is ideal and has a $\beta = 0.01$. Find A_{vf}, R_{if} and R_{of}. Assume ideal source and load. (30 points)

$D = 1 + (.01)(4000) = 41$

$A_{vf} = \frac{4000}{41} = 97.6$

$R_{if} = D\,R_i = 41(100) = 4.1k\Omega$

$R_{of} = \frac{R_o}{D} = \frac{100K}{41} = 2.44K\Omega$

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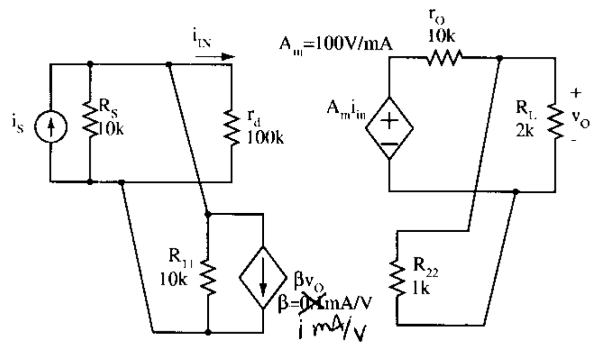
2. The sketch below shows a model of a negative feedback amplifier. Find A_f, R_{if} and R_{of}. Specify the appropriate units for A_f, if any. All resistors are expressed in ohms, with k denoting kilo. (40 points)



voltage-shunt

$R_o = 2k \| 1k \| 10k = 625\,\Omega$

$R_i = 10k \| 10k \| 100k = 4.76k$

$R_M = \left(100 \frac{V}{mA}\right)\left(\frac{1}{10k}\right) 625 \frac{5k}{105k} = .297 \frac{V}{mA} = 297\,\Omega$

$D = 1 + \beta R_M = 1 + (1)(.297) = 1.297$

$R_{of} = \frac{R_o}{D} = \frac{625\,\Omega}{1.297} = \ldots \rightarrow$ $R_{of} = 482\,\Omega$

$R_{if} = \frac{R_i}{D} = \frac{4760}{1.3} = \ldots$ $3.66\,k\Omega = R_{if}$

$R_{Mf} = \frac{R_M}{D} = \ldots$

$= \frac{.297}{1.297} = 0.23 \frac{V}{mA} = R_{Mf}$

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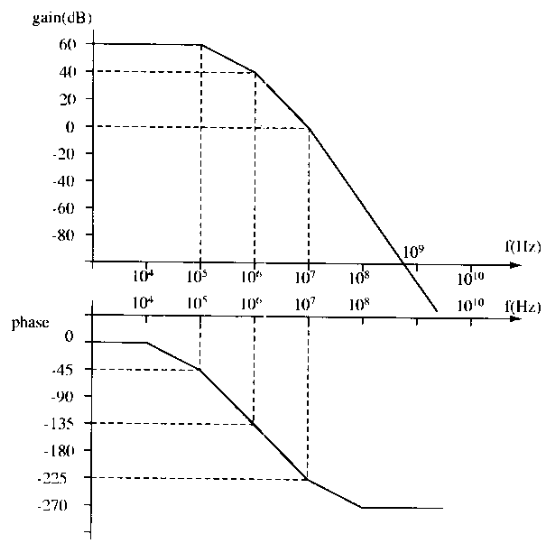
3. The following diagram shows the bode plot of the gain A of a non-feedback amplifier, which will be used in a negative feedback amplifier. The non-feedback amplifier dc-gain is 60 dB and has poles at 10^5, 10^6 and 10^7 Hz. Find
   (a) the phase and gain margins if the negative feedback's $\beta = 0.01$. (15 points)
   (b) the new first pole's frequency if the pole-shifting technique is used to compensate the amplifier for a 45° phase margin with the feedback network's $\beta = 1$. (15 points)



(a) $20\log\frac{1}{\beta} = 40\,\text{dB} \Rightarrow \phi_M = 45^\circ$; $G_M \cong +20\,\text{dB}$

(b) $20\log\frac{1}{\beta} = 0\,\text{dB}$ → gain at 2nd pole must be reduced by 40 dB → 1st pole must be moved 2 decades down

$f_p = 10^3$ Hz