1. Shown below is the frequency response for the voltage gain of a non-feedback amplifier. Determine the approximate value of the feedback network’s $\beta$ that will yield a phase margin of 60 degrees.

![Amplifier Gain Graph](image)

**Answer:** $\beta \simeq \frac{1}{10}$

2. In the amplifier shown below, voltage-sampling, voltage-mixing feedback is employed. The active element is an opamp, for which the open-loop gain is $10^5$, the output resistance is $r_O = 1k\Omega$, and the input resistance is $r_d = 100k\Omega$.

   a) Find the feedback network’s $\beta$, $R_{11}$ and $R_{22}$.

   **Answer:** $\beta \simeq \frac{1}{20}$, $R_{11} \simeq 50k\Omega$, $R_{22} \simeq 1k\Omega$.

   b) Use feedback theory to find the feedback amplifier’s voltage gain $A_{ef}$, input resistance $R_{if}$ and output resistance $R_{of}$.

   **Answer:** $A_{ef} = 19.98V/V$, $R_{if} = 250M\Omega$, $R_{of} = 0.4\Omega$.

![Amplifier Circuit](image)

3. Determine the voltage gain $A_v = v_{out}/v_s$, $R_i = v_s/i_s$, and $R_o$ (as shown). Assume all $C_s = \infty$ and the following parameters: MOSFETs - $g_m = 2mA/v$, $r_{ds} = \infty$; BJTs - $\beta = h_{fe} = 200$, $r_\pi = 4.5k\Omega$ and $r_o = \infty$. 

![Circuit Diagram](image)
4. In the following amplifier, voltage-sampling, current-mixing feedback is used. Find the feedback amplifier transresistance, \( R_{mf} \). Assume that the capacitor is a short circuit at the operating frequency. Use \( h_{fe} = 100 \) and \( r_{\pi} = 2k\Omega \).

\[
R_{mf} = \frac{v_O}{i_s} = -75k\Omega
\]

5. In the following amplifier, the opamp has an open-loop d.c. gain of \( 10^4 \) and 4 poles at 1MHz, 10MHz, 10MHz and 200MHz. Find the smallest ratio \( R_2/R_1 \) for which the amplifier is stable.

\[
R_2/R_1 \geq 497V/V
\]
6. For a current-mixing feedback amplifier, $R_{if} = 110\Omega$, $R_{of} = 26k\Omega$, $A_f = 20$, and $\omega_{L,f} = 10rad/s$. For the associated non-feedback amplifier, $R_o = 2k\Omega$ and $\omega_H = 10^4rad/s$.

   a) Find the non-feedback amplifier $R_i$, $A$ and $\omega_L$.
   
   ANSWER: $R_i = 1430\Omega$, $A_i = 260A/A$, $\omega_L = 130rad/s$.

   b) What’s the feedback’s network $\beta$?
   
   ANSWER: $\beta = 6/130$

7. A feedback amplifier displays a transresistance gain $R_{Mf} = 10^5\Omega$, $R_{if} = 10\Omega$ and $R_{of} = 10\Omega$. The feedback type is voltage-sampling, current-mixing with $\beta = 0.9 \times 10^{-5}$. The source’s Thevenin resistance is $R_s = v_s/i_s = 1k\Omega$ and $R_L = v_o/i_o = 2k\Omega$.

   a) Determine the current and voltage gains, $A_{vf} = v_o/v_s$ and $A_{if} = i_o/i_s$ respectively, of the feedback amplifier.
   
   ANSWER: $A_{vf} = 100V/V$, $A_{if} = 50A/A$.

   b) Find the transresistance gain $R_M = v_o/i_s$, input resistance $R_i$ and output resistance $R_o$ of the non-feedback amplifier.
   
   ANSWER: $R_M = 190k\Omega$, $R_i = 19\Omega$, $R_o = 19\Omega$.

   c) Determine the current and voltage gains of the non-feedback amplifier.
   
   ANSWER: $A_v = 190V/V$, $A_i = 85A/A$. 