1. Determine the expressions for -3dB bandwidth of the circuits shown below. Assume finite value of $r_o$, non-zero device capacitances, $g_m r_o \gg 1$, and $\beta \gg 1$.

2. If the feedback factor $\beta = 0.5$ and the phase margin is equal to 30 degrees, determine the magnitude and phase of the closed loop gain $A(\omega)$ at frequency $\omega_1$ where the magnitude of the loop gain is unity, i.e., $|\beta A_f(\omega_1)| = 1$.

3. If the feedback factor $\beta = 0.5$ and the gain margin is equal to 20 dB, determine the magnitude and phase of the closed loop gain $A(\omega)$ at the frequency $\omega_{180}$ where the phase of the loop gain is -180 degrees.

4. Sketch the Bode plot of the loop gain, determine the gain crossover frequency $\omega_1$ and phase crossover frequency $\omega_{180}$, the phase margin (PM) and the gain margin (GM) for the following cases of the open loop gain $A_f(s)$ and the feedback factor $\beta$:

   a) $A_f(s) = \frac{1000}{1 + \frac{s}{10}}$ and $\beta = 1, 0.5, 0.01$.

   b) $A_f(s) = \frac{4000}{(1 + \frac{s}{10})(1 + \frac{s}{10^2})}$ and $\beta = 1, 0.5, 0.01$.

   c) $A_f(s) = \frac{4000}{(1 + \frac{s}{10})(1 + \frac{s}{10^2})(1 + \frac{s}{10^3})}$ and $\beta = 1, 0.5, 0.01$. 
5. For parts b) and c) of Problem 4, determine the values of $\beta = \beta_{60}$ for which the phase margin is 60 degrees. What is the gain margin at $\beta = \beta_{60}$?