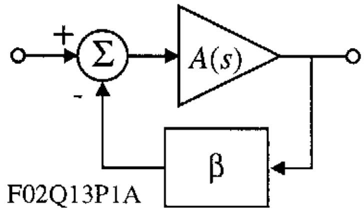
QUIZ NO. 13 - SOLUTION

(Average score = 7.1/10 of those who took the quiz)

1.) The amplifier in the feedback circuit shown has a transfer function of

$$A(s) = \frac{100}{\frac{s}{10^5}+1}$$



F02Q13P1A

What value of β will increase the upper –3db frequency by a factor of 10 for the closed loop gain? What is the closed loop, low frequency gain?

Solution

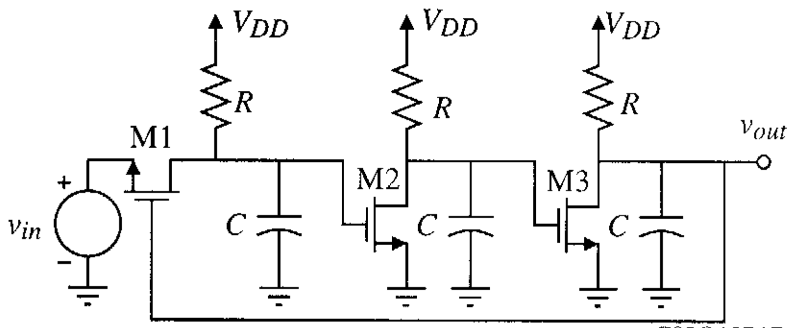
$$A_F = \frac{A}{1+A\beta} = \frac{1}{\frac{1}{A}+\beta} = \frac{1}{\frac{s/10^5+1}{100}+\beta} = \frac{100}{\frac{s}{10^5}+1+100\beta} = \left(\frac{100}{1+100\beta}\right)\frac{1}{\frac{s}{10^5(1+100\beta)}+1}$$

$$\therefore\ 10^5(1+100\beta) = 10^6 \quad \rightarrow \quad 1+100\beta = 10 \quad \rightarrow \quad \underline{\beta = 9/100 = 0.09}$$

The closed-loop, low frequency gain is,

$$A_F(0) = \frac{100}{1+100\beta} = \frac{100}{1+9} = 10 \quad \rightarrow \quad \underline{A_F(0) = 10}$$

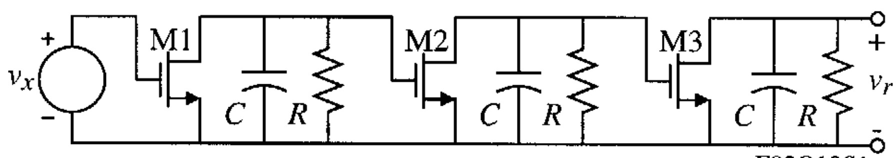
2.) Find the loop gain of the amplifier shown. Assume that g_m = 1mS and $r_{ds} = \infty$ for all MOSFETs and that R = 10kΩ and C = 100nF.



F02Q13P1B

Solution

Use the model shown to find the loop gain.



F02Q13S1

This circuit consists of three identical stages with each transfer function given as

$$A(s) = \frac{-g_mR}{sRC+1}$$

Therefore,

$$T(s) = -\frac{v_r}{v_x} = -\left(\frac{-g_mR}{sRC+1}\right)^3 = -\left(\frac{-10}{\frac{s}{10^3}+1}\right)^3 = \frac{1000}{\left(\frac{s}{10^3}+1\right)^3} \rightarrow \boxed{T(s) = \frac{1000}{\left(\frac{s}{10^3}+1\right)^3}}$$