(ECE3455, Q2) In the given model of amplifier

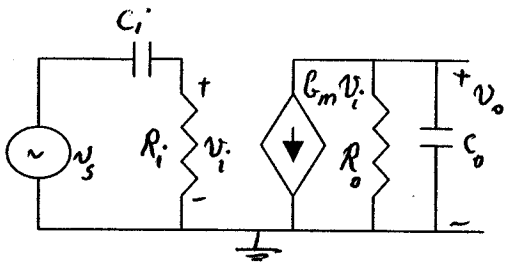
a) Find R_i so that the input resistance is 10K ,R_o so that the output resistance is 1 K ,and the G_m so that the voltage gain V_o/V_i is −100.

b) Find C_i and C_o so that the f_L =100 Hz and f_H =100 KHz.

c) Obtain the transfer function $T(\omega)= V_o / V_s$

d) Draw the magnitude and the phase of the transfer function using bode plot method.

(A)



Solution:

a) $R_i = 10k\Omega$, $R_o = 1k\Omega$

$V_o = -G_m V_i \cdot R_o \Rightarrow \frac{V_o}{V_i} = -G_m R_o$

$-G_m R_o = -100 \qquad G_m = \frac{100}{R_o} = \frac{100}{1} = 100\ m\mho$

b) $f_L = \frac{1}{2\pi R_i C_i} \qquad f_H = \frac{1}{2\pi R_o C_o}$

$C_i = \frac{1}{2\pi R_i f_L} = \frac{1}{2\pi \times 10^4 \times 100} = 0.159\ \mu F$

$C_o = \frac{1}{2\pi R_o f_H} = \frac{1}{2\pi \times 10^3 \times 10^5} = 1.59\ nF$

c) $T(\omega) = \frac{V_o}{V_s} = \qquad Z_o = R_o \| C_o = \frac{R_o \times \frac{1}{jC_o\omega}}{R_o + \frac{1}{jC_o\omega}} = \frac{R_o}{1+jR_oC_o\omega}$

$V_o = -G_m V_i Z_o = -G_m V_i \frac{R_o}{1+jR_oC_o\omega}$

$\frac{V_o}{V_i} = -G_m \frac{R_o}{1+jR_oC_o\omega}$

$\frac{V_i}{V_s} = \frac{R_i}{R_i + \frac{1}{jC_i\omega}} = \frac{jR_iC_i\omega}{1+jR_iC_i\omega} \Rightarrow \frac{V_o}{V_s} = \frac{V_o}{V_i} \cdot \frac{V_i}{V_s}$

$\frac{V_o}{V_s} = -G_m R_o R_i C_i \frac{j\omega}{(1+jR_oC_o\omega)(1+jR_iC_i\omega)}$