ECE2280 Review For EXAM 1

The material we have covered so far this semester is summarized (but NOT limited to) below:

1. Understand the difference between AC & DC signals.
2. Understand how to analyze circuit (with or without cap in it) to obtain transfer function.
3. Understand how to plot the Bode plots from an equation or circuit.
4. Amplifiers:
   a) Understand how to apply Amplifier models (voltage, current, etc.) to multistage amplifiers
   b) Analyze single input Amplifier (with model) for transfer function.
   c) Analyze amplifier's gain in different configurations (inverting, noninverting, voltage follower)
   d) Understand frequency response of amplifiers for single amplifiers
   e) Compensation of real op-amp imperfections (Slew Rate, Clipping, Input bias currents, Voltage offset, frequency limitations, finite gain)
5. Diodes:
   a) Analyze diode circuit using ideal model
   b) Analyze diode circuit using constant voltage drop model
   c) Analyze diode circuit with both DC and AC signals

Problem (1 of 4)

a) Sketch the Bode (both magnitude & phase) plot for: {label as many y values as possible for both magnitude and phase and/or each slope along with showing all your work}

$$H(s) = \frac{s^2 \cdot 100M}{(s+10k)(s+1k)}$$

b) What is the estimated or actual magnitude value at ω=10k rad/sec (in dB):

160dB

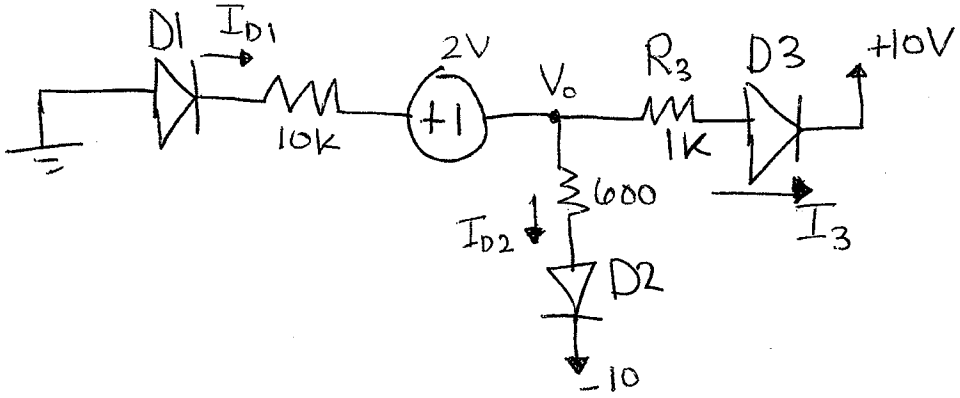
c) What range of frequency will this circuit operate correctly:

above $10k \frac{rad}{sec}$

Problem (2 of 4)

Assume all diodes are identical and have V_{DO}=0.7V, n=1, and V_T=25mV. Use the constant voltage drop method. Verify that your assumption for the diode operation(i.e. on or off) are correct. Find the following making sure you find the correct operation of the diodes.

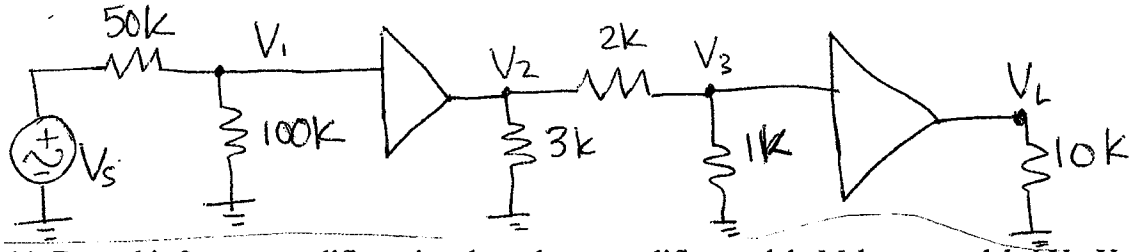
a) State your assumptions (diode is on/off).
b) The current I_{D1} $I_{D1} = I_{D2} = 1mA$
c) The current I_{D2}
d) The voltage Vo $V_o = -8.7$
e) Verification to prove your assumptions for the diodes are correct. $I_{D1} = I_{D2} > 0$
f) If there is noise on the +2V supply of Vac what is the total value for V_o. $V_{o\,total} = -8.7 + 58.7mVac$
{Hint: remember to use the AC model for the diode}



Problem (3 of 4)

V_s is an AC signal. Assume linear operation for both amplifiers with only the following nonideal effects:

$A_{vo}=30$, $R_{in}=100k\Omega$, $R_o=20k\Omega$ power supplies = ± 12 V



(a) Draw this 2 stage amplifier using the voltage amplifier model. Make sure to label V_S, V_1, V_2,V_3, and V_L on the schematic.

(b) Find the voltage gain V_L/V_s without frequency dependence or amplifier imperfections.

(c) Find the voltage gain V_L/V_s WITH frequency dependence considering both amplifiers are internally compensated with f_T=5MHz. *(Hint: Find V_2/Vs and V_L/V_2)*

(d) What is the maximum amplitude for Vs considering the limits of a nonideal amplifier?*(Hint: Consider first the maximum output voltage possible)*

ANSWER: (b) $+9.4\ V/V$

(c) $$\frac{94}{\left(\frac{s}{444KHz}+1\right)\left(\frac{s}{600KHz}+1\right)}$$

(d) $V_{smax}=1.3V$

Problem

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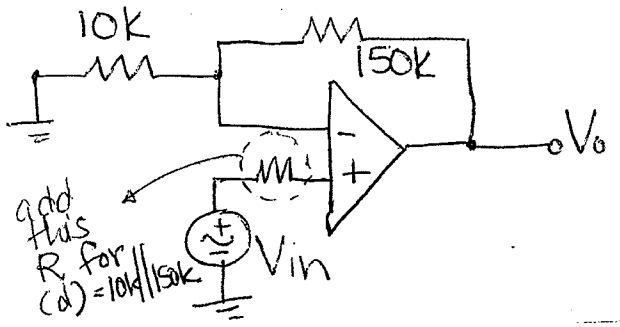
You are given the following characteristics for a real amplifier:

Input offset voltage,	V_{ios}=2mV
Input Resistance,	R_i=1MΩ
Unity-gain bandwidth,	f_T=100MHz
Output swing limits,	within 2Volts of power supply
Slew Rate,	SR=4 $\frac{V}{\mu sec}$

The following circuit is powered at ±12V:



a) State the gain. +16 V/V

b) What is the bandwidth of the circuit. Consider both the effect due to slew rate (use the maximum output value possible) compared to the effect due to the unity gain bandwidth. up to 64kHz

c) For V_{in}=0.01sin(ωt), what is the PEAK(not peak to peak) value at the output considering the input offset voltage? 192mV [Solutions shows answer when V_{in}= 2m sin(ωt)]

d) How should the circuit above be modified to minimize the effect of the input bias current? Draw the schematic of the modified circuit and state values of added component(s).