Assignment 4

Problem 1:

A sinusoidal input with phase shift $\phi = 0$ is fed to a Miller integrator that uses an ideal opamp and an *RC* pair with *R* = 100 kΩ and *C* =.001 μF.

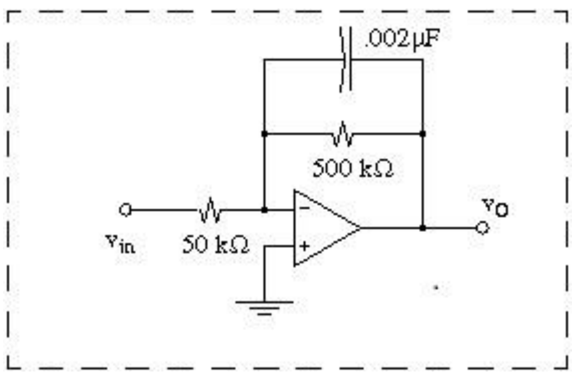
(a) At what frequency are the input and output signals equal in magnitude?

(b) What is the phase of V_O relative to V_{in}?

(c) If the frequency is decreased by a factor of 10 from that of part (a), by how many dB does the output change?

Problem 2:

A lossy Miller integrator, as shown, uses an ideal opamp.



(a) Plot the Bode magnitude plot of this circuit a sinusoidal signal is applied to the input.

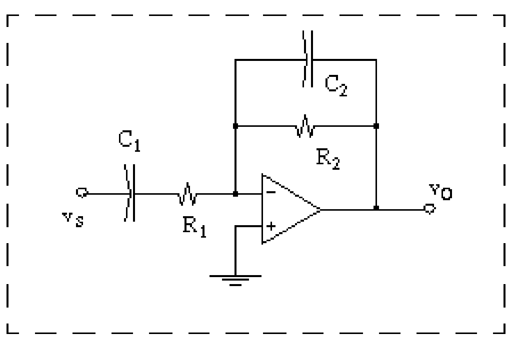
(b) At what frequency are the input and output signals equal in magnitude?

(c) What is the phase of v_o relative to v_{in} for part (a)?

(d) If the frequency is decreased by a factor of 10 from that of part (b), by how many dB does the output change?

Problem 3:

(a) Show that the transfer function for the configuration shown is



$$T = \frac{-R_2/R_1}{(1+p_1/s)(1+s/p_2)}$$

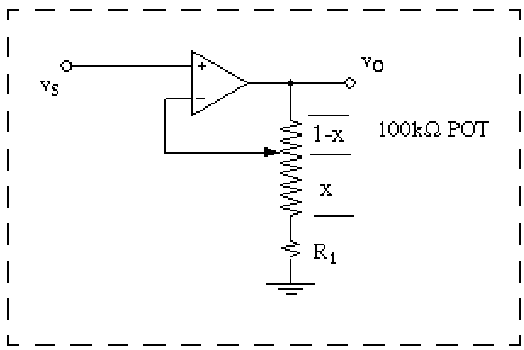
where $p_1 = 1/R_1C_1$ and $p_2 = 1/R_2C_2$, $s = j\omega$

The circuit has the frequency response of a bandpass, for which the low-frequency 3dB rolloff is at p_1 and the high-frequency 3dB rolloff is at p_2

(b) By choice of R_1, R_2, C_1, C_2, design a circuit for which R_{in} = 25 kΩ, midband gain = 34 dB, low-frequency rolloff = 200Hz and upper frequency rolloff = 20 kHz.

(c) Draw the Bode plot of the circuit designed in (b)

Problem 4:

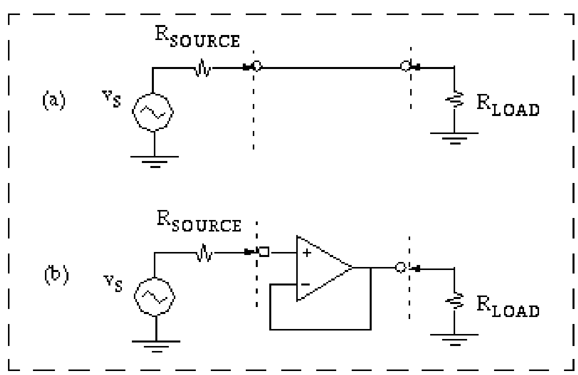


The circuit shown uses a 100kΩ potentiometer to devise an adjustable gain amplifier.

(a) Assuming $R_1 = 0$, derive an expression for the gain as a function of parameter setting x.

(b) What value of R_1 is necessary so the gain will range from $T = 1$ to $T = 10$ V/V?

Problem 5:

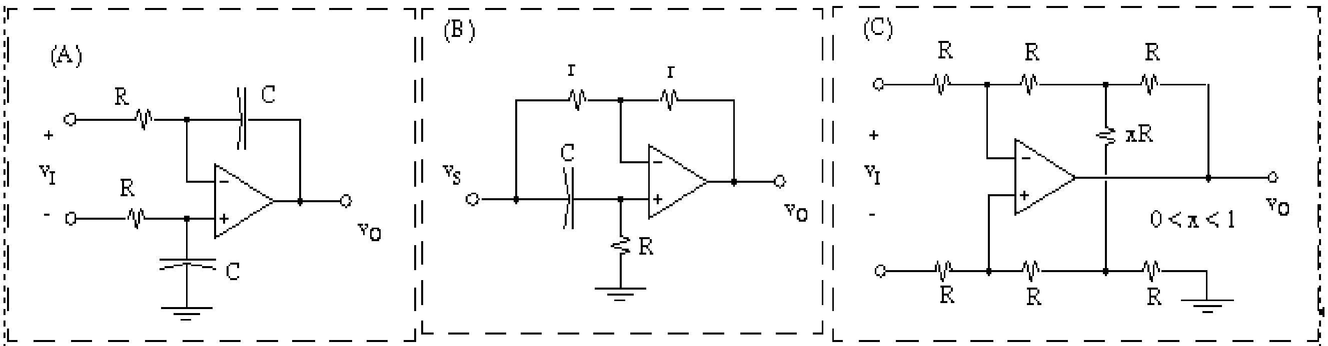


A photodetector with source voltage 100 mV and source resistance 100 kΩ is connected to a 1 kΩ load. Find the voltage that will appear across the load if:

(a) It is connected directly to the load.
(b) An ideal unity-gain buffer is inserted between the source and the load (as shown).

Problem 6:

Find transfer functions for each of the following circuits



Problem 7:

Assuming ideal opamps determine the 3dB rolloff frequency for the following 4-stage circuit in terms of the time constant $\tau = RC$. (*Hint:* Assume each stage loses 3/4 dB)