Let

\[ v_s = \sum_{k=-1}^{3} V_k \cos(10^k \omega_o t + \phi_k) \]

Find \( v_o(t) \) for the circuits on 23-4 through 23-7 of the lecture notes.
Homework #9, due 6/1/06 (due date MIGHT be delayed one lecture)
12-1, 12-2, 12-3, 12-4, 12-9, 12-10 and the following:

Problem 1:
Suppose we have a noisy signal, where the raw signal is
\[ v_i = V_i \cos 500t \]
and the noise can be modeled as
\[ v_n = V_N \cos 50 \cdot 10^6 t. \]
Use the circuit in 23-3 (repeated below) and input \( v_s = v_i + v_n \) to "filter" the high frequency noise. Select R and C so as not attenuate \( v_i \) below 70% of its original strength, while the noise should be dampened below 1%. What is the resulting output signal in the time domain?

Problem 2:
Using the circuit in 23-7 (repeated below), choose R, L and C to design a bandpass filter that selects 90.5 MHz. The band should be as tight as possible, subject to \( R \leq 1k\Omega \).
\[
\frac{V_o}{V_s} = \frac{1}{\sqrt{1 + (\omega/\omega_o)^2}} e^{j\left(-\arctan\left(\frac{\omega}{\omega_o}\right)\right)}; \quad \omega_o = \frac{1}{CR}
\]
\[
\frac{V_o}{V_s} = \frac{Q \omega_o}{\sqrt{\left(1 - \left(\frac{\omega}{\omega_o}\right)^2\right)^2 + \left(Q \frac{\omega}{\omega_o}\right)^2}} \begin{pmatrix}
\frac{1}{2} \left(90 - \arctan\left(\frac{Q \omega}{\omega_o^2} \frac{\omega}{1 - \left(\frac{\omega}{\omega_o}\right)^2}\right)\right) \end{pmatrix}
\]

\[
\omega_o = \frac{1}{\sqrt{LC}}; \quad Q = \omega_o CR = \frac{R}{\omega_o L}; \quad \text{Bandwidth} = \frac{\omega_o}{Q}
\]