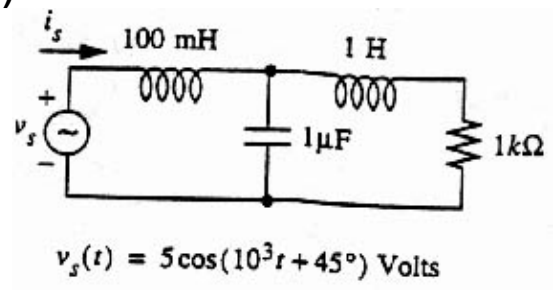
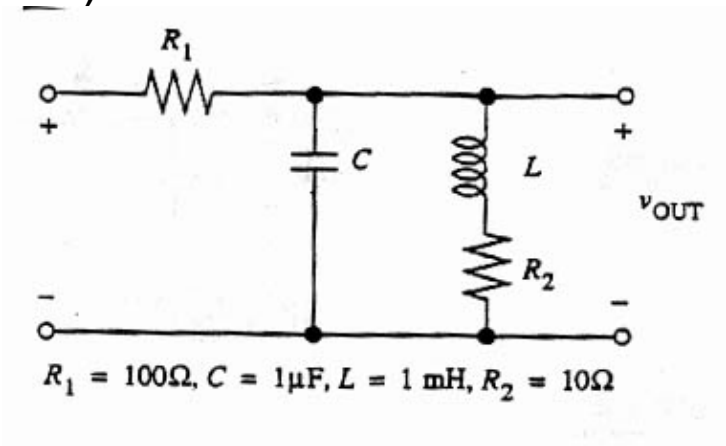
EE 40, Spring/1997
Midterm #2
Professors T.-J. King and R.M White

Problem #1 (18 points)



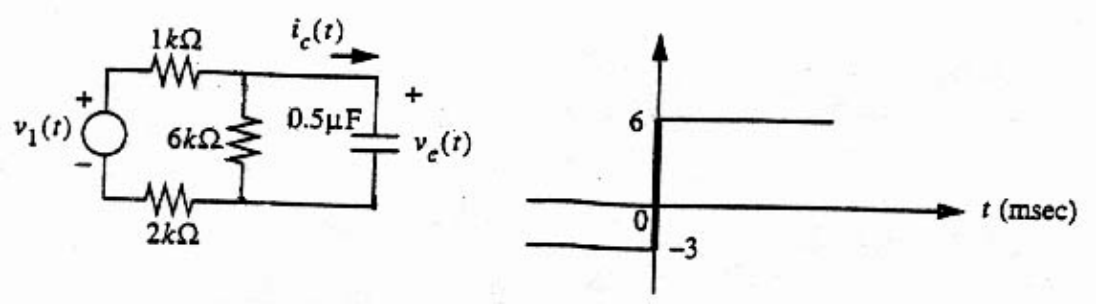
a. What is the phasor corresponding to $v_s(t)$? Express your answer in exponential and rectangular forms. [4 pts.]
b. What is the impedance seen by the voltage source? Express your answer in exponential and rectangular forms. [5 pts.]
c. What is the instantaneous current delivered by the voltage source? [4 pts.]
d. What is the time-averaged power supplied by the voltage source? [5 pts.]

Problem #2 (20 points)



a. What is the transfer function $\mathbf{G} = \mathbf{v}_{OUT}/\mathbf{v}_{IN}$ at very low frequency, w approaching 0? [2 pts.]
b. What is the transfer function $\mathbf{G} = \mathbf{v}_{OUT}/\mathbf{v}_{IN}$ at very high frequency, w approaching infinity? [2 pts.]
c. For what intermediate frequency w_0 is $\mathbf{G}$ real? [6 pts.]
d. What is $\mathbf{G}(w_0)$? [4 pts.]
e. Sketch the general behavior of $|\mathbf{G}(w)|$ vs. w on the axes provided. (y-axis from 0 to 1, x-axis from 0 to 10^9). Note: This is not a Bode plot. Indicate values of $|\mathbf{G}(0.5w_0)|$ and $|\mathbf{G}(2w_0)|$ on your plot. [6 pts.]

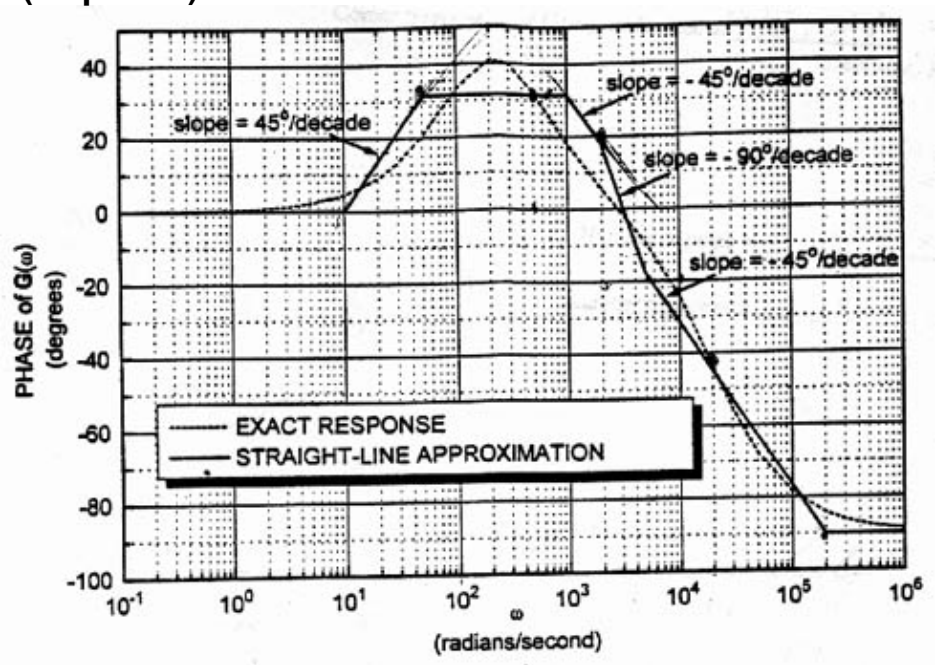
Problem #3 (25 points)



$v_1(t)$ is -3 V for all $t < 0$, and is +6 V for all $t > 0$.

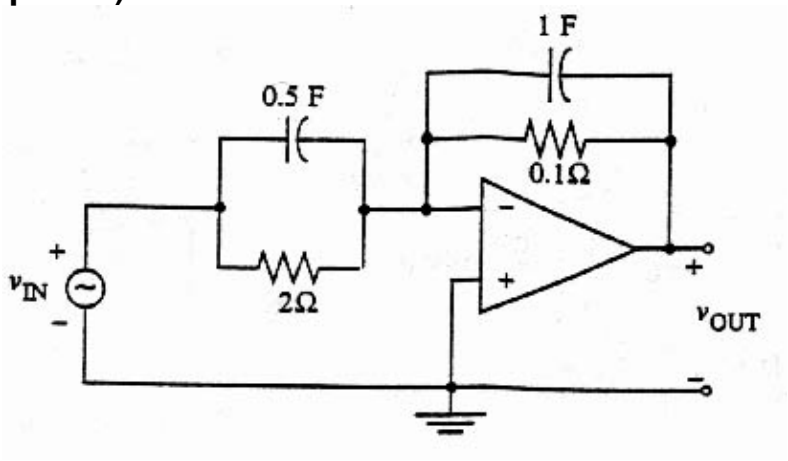
a. What is the value of i_c at $t = 0^-$? [2 pts.]
b. What is the value of v_c at $t = 0^-$? [4 pts.]
c. What is the value of i_c at $t = 0^+$? [4 pts.]
d. Find an expression for v_c, for $t>0$. [5 pts.]
e. Sketch v_c for all t. (Label the axes on the plot.) [4 pts.]
f. Find an expression for i_c, for $t>0$. [3 pts.]
g. Sketch i_c for all t. (Label the axes on the plot.) [3 pts.]

Problem #4 (20 points)



a. Identify all corner frequencies. [6 pts.]
b. How many poles and zeros are in the transfer function? [3 pts.]
c. Write an expression for the transfer function **G**(w), assuming that the magnitude is 20 dB at $w = 0.1$ rad/sec. [4 pts.]
d. Neatly sketch the Bode magnitude plot (magnitude of **G**(w) in decibels vs. frequency on a logarithmic scale). Straight-line approximations are adequate. [7 pts.]

Problem #5 (15 points)



a. Find the transfer function $\mathbf{v}_{OUT}/\mathbf{v}_{IN}$ for the op-amp circuit. You can assume that that the op-amp is ideal. [6 pts.]
b. Sketch the Bode magnitude plot of $\mathbf{v}_{OUT}/\mathbf{v}_{IN}$. Straight-line approximations are adequate. [6 pts.]
c. If the op-amp were slightly "unbalanced" with an input offset voltage of 10 mV, what would be the value of the spurious output voltage? (Hint: The superposition theorem might be helpful here.)

   Note: An op-amp with a voltage offset can be modelled as an offset-free op-amp plus an offset-voltage source: [3 pts.]