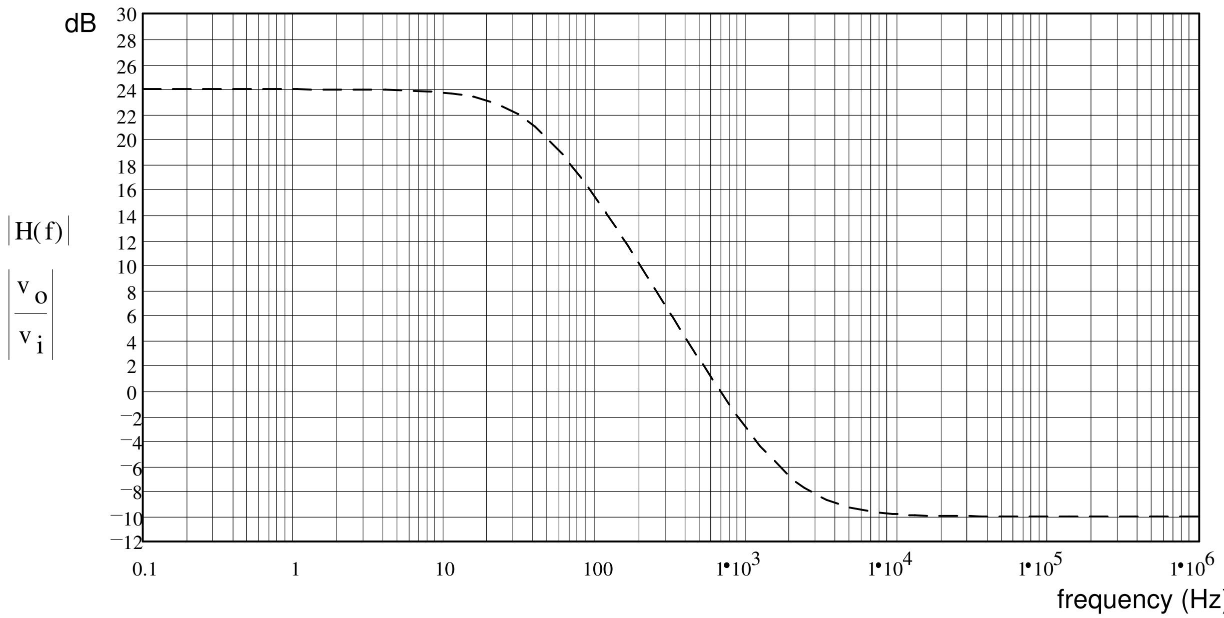
ECE2210/00 Exam 3 given: Spring 06 (The space between problems has been removed.)

1. (14 pts) A frequency response curve is shown below (dashed line).



a) Draw the Bode plot of H(s) (the straight-line approximation) right on the curve above.

b) List any and all corner frequencies that you can find from the graph above.

c) If there are any corners in the Bode plot associated with **poles** in the transfer function, list that/those corner frequency(ies) below (f_p).

d) If there are any corners in the Bode plot associated with **zeroes** in the transfer function, list list that/those corner frequency(ies) below (f_z).

e) This Bode plot is for what type of filter? Circle the best answer.

i) low pass ii) high pass iii) band pass iv) band reject v) sludge vi) coffee vii) can't tell

2. (18 pts) Analysis of a circuit (not pictured) yields the characteristic equation below.

$0 = s^2 + 20\cdot s + 6500$ $R := 6\cdot\Omega$ $L := 80\cdot mH$ $C := 120\cdot\mu F$

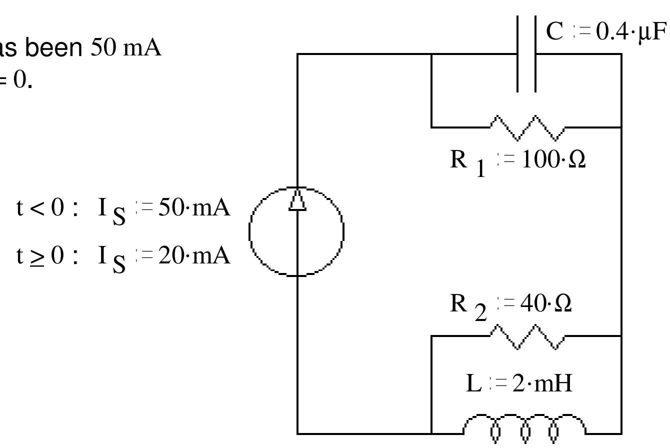
Further analysis yields the followiing initial and final conditions:

$i_L(0) = 220\cdot mA$ $v_L(0) = -6\cdot V$ $v_C(0) = 8\cdot V$ $i_C(0) = 100\cdot mA$

$i_L(\infty) = 80\cdot mA$ $v_L(\infty) = 0\cdot V$ $v_C(\infty) = 2\cdot V$ $i_C(\infty) = 0\cdot mA$

Write the full expression for $i_L(t)$, including all the constants that you find. $i_L(t) = ?$

3. (20 pts) Consider the circuit at right. The current source has been 50 mA for a long time and changes from 50 mA to 20 mA at time $t = 0$.



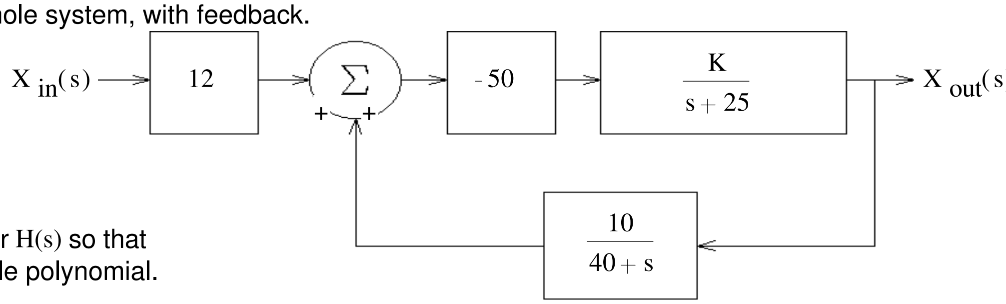
a) What are the final conditions of i_L and the v_C?
$i_L(\infty) = ?$ $v_C(\infty) = ?$

b) Find the initial condition and intial slope of i_L that you would need to have in order to find all the constants in $i_L(t)$. Don't find $i_L(t)$ or it's constants, just the initial conditions.

c) Find the initial condition and intial slope of v_C that you would need to have in order to find all the constants in $v_C(t)$. Don't find $v_C(t)$ or it's constants, just the initial conditions.

4. (20 pts) a) A feedback system is shown in the figure. What is the transfer function of the whole system, with feedback.

$$H(s) = \frac{X_{out}(s)}{X_{in}(s)} = ?$$



Simplify your expression for $H(s)$ so that the denominator is a simple polynomial.

b) Find the value of K to make the transfer function critically damped.

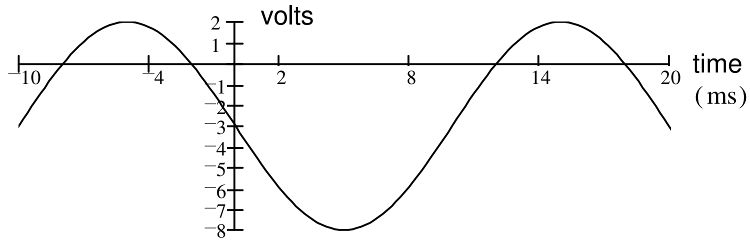
c) If K is **less** than this value the system will be: underdamped or overdamped Circle one

d) Does the transfer function have a zero? Answer no or find the s value(s) of the zero(s).

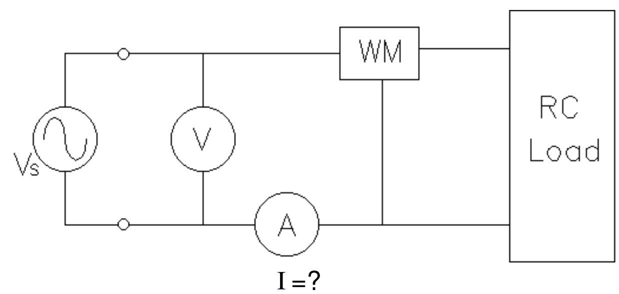
5. (8 pts) Find:

a) The average, DC (V_{DC}) voltage.

b) The RMS (effective) voltage



6. (20 pts) For the $60\ \mathrm{Hz}$ load shown in the figure, the RMS voltmeter measures $220\ \mathrm{V}$, the wattmeter measures $560\ \mathrm{W}$, and the power factor is 82%. Find the following:



a) The reading on the RMS ammeter.

b) The apparent power. $|\mathbf{S}|$ = ?

c) The reactive power. Q = ?

d) The complex power. $\mathbf{S}$ = ?

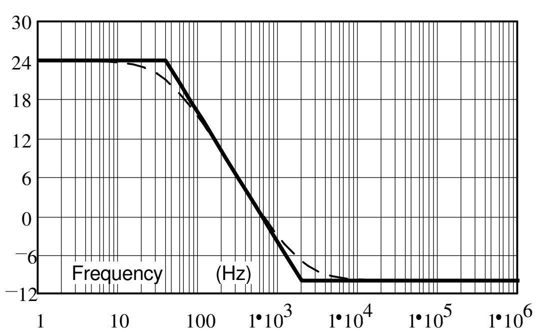
e) The power factor is: i) leading ii) lagging (circle one)

f) The load box cannot be opened. Add (draw it) another component to the circuit above which can correct the power factor (make $pf = 1$). Show the correct component in the correct place and <u>find its value</u>. This component should not affect the real power consumption of the load.

Draw the component on drawing !

<u>Answers</u>

1. a) $|H(f)|$ (dB)



b) $40 \cdot \mathrm{Hz}$ $2 \cdot \mathrm{kHz}$ c) $40 \cdot \mathrm{Hz}$ d) $2 \cdot \mathrm{kHz}$

e) i) low pass

2. $i_L(t) := 80 \cdot \mathrm{mA} + e^{-10 \cdot t} \cdot (140 \cdot \mathrm{mA} \cdot \cos(80 \cdot t) - 920 \cdot \mathrm{mA} \cdot \sin(80 \cdot t))$

3. a) $2 \cdot \mathrm{V}$ $20 \cdot \mathrm{mA}$ b) $50 \cdot \mathrm{mA}$ $-600 \cdot \frac{\mathrm{A}}{\mathrm{sec}}$ c) $5 \cdot \mathrm{V}$ $-75000 \cdot \frac{\mathrm{V}}{\mathrm{sec}}$

4. a) $\dfrac{-600 \cdot K \cdot (s + 40)}{s^2 + 65 \cdot s + 500 \cdot K + 1000}$ b) 0.113 c) overdamped d) -40

5. a) $-3 \cdot \mathrm{V}$ b) $4.64 \cdot \mathrm{V}$

6. a) $3.1 \cdot \mathrm{A}$ b) $683 \cdot \mathrm{VA}$ c) $-391 \cdot \mathrm{VAR}$ d) $(560 - 391 \cdot j) \cdot \mathrm{VA}$

e) leading g) $328 \cdot \mathrm{mH}$ inductor in parallel with load

ECE 2210 Exam #3
Arn Stolp

Name ______________________________
Scores:

Pgs 1&2	_________	of a possible 32 points
Pgs 3&4	_________	of a possible 40 points
Pgs 5&6	_________	of a possible 28 points
Total	_________	of a possible 100 points