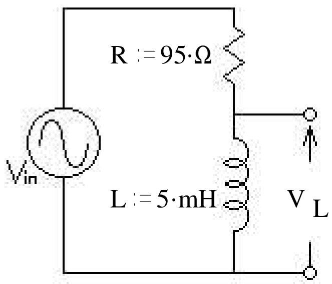
ECE1050 Exam 3 given: Fall 02

(The space between problems has been removed.)

1. (19 pts) a) Draw the asymptotic Bode plot (the straight-line approximation) of the filter circuit below. Accurately draw it on the graph provided. V_{in} is the input and V_L is the output of this circuit.

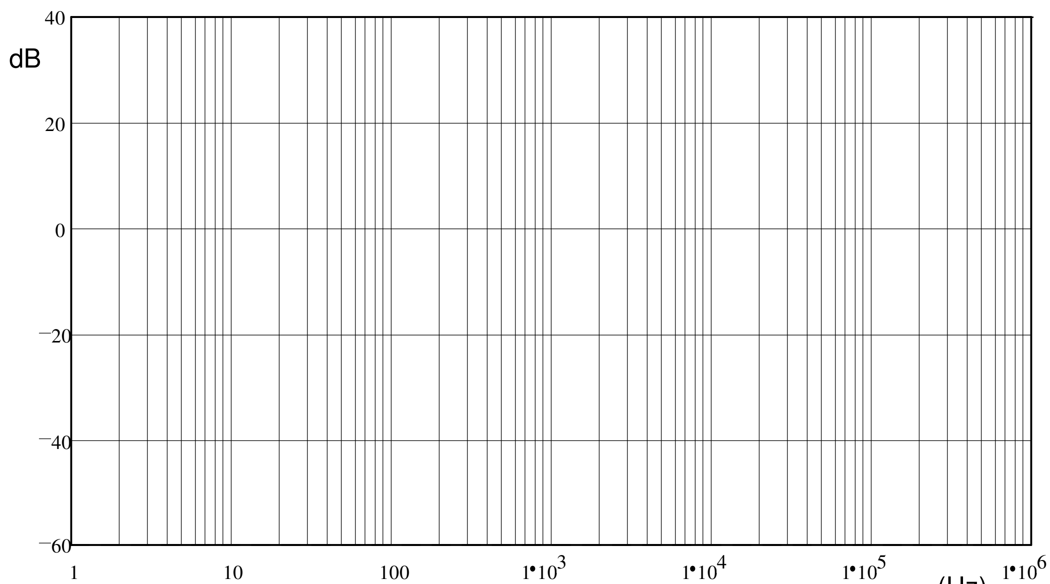
   To be eligible for partial credit, show the steps you use to get the Bode plot. That is, show things like the transfer function, the corner frequency(ies) , the approximations of the transfer function in each frequency region, etc..



Notice that this graph is in Hz, not rad/sec

Magnitude plot

$|H(f)|$



Frequency

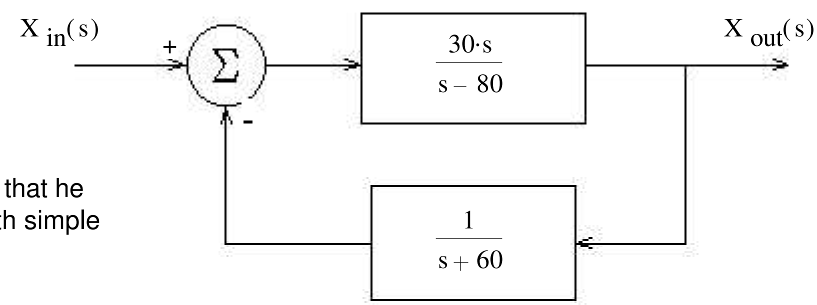
b) The asymptotic Bode plot is not exact. The actual magnitude of the transfer function can be a little different than the straight-line approximation. For the frequency where this difference is largest, fill in the blanks in the line below.

The actual magnitude is ________ dB __higher__ __lower__ than the Bode plot at __________ Hz.

(Circle one)

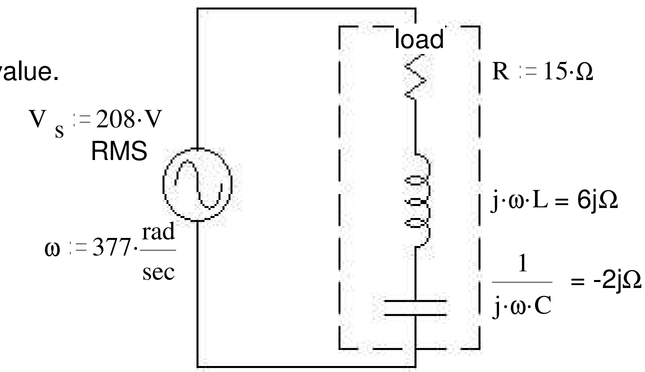
2. (15 pts) A feedback system is shown in the figure. What is the transfer function of the whole system, with feedback.

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



Simplify your expression for H(s) so that he numerator and denominator are both simple polynomials

3. (26 pts) R, L, & C together are the load in the circuit shown.
Find the following: Be sure to show the correct units for each value.



a) The real power. P = ?

b) The reactive power. Q = ?

c) The complex power. **S** = ?

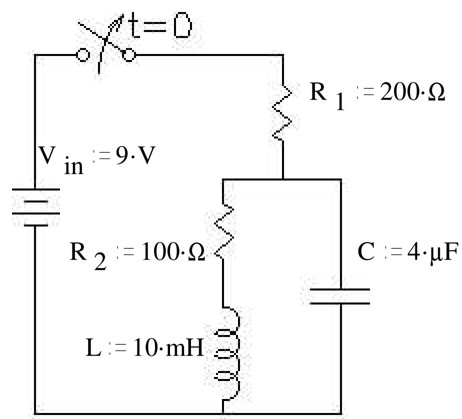
d) The apparent power. |S| = ?

e) The power factor. pf = ?

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

g) The three components of the load are in a box which 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.

4. (26 pts) Analysis of the circuit shown yields the characteristic equation and s values below.



The switch has been in the closed position for a long time and is opened (as shown) at time t = 0. Find the initial and final conditions and write the full expression for $v_C(t)$, including all the constants that you find

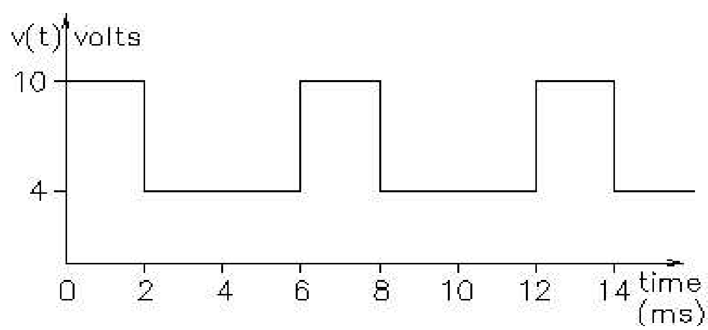
Clearly show important numbers (like initial and final conditions) to get partial credit. If you can't find some of these, guess so that you can move on and demonstrate what you do know.

$$0 = s^2 + \frac{R_2}{L}\cdot s + \frac{1}{L\cdot C} \qquad s_1 := -5000\cdot\frac{1}{sec} \quad \text{and} \quad s_2 := -5000\cdot\frac{1}{sec}$$

5. (14 pts) For waveform shown, find:

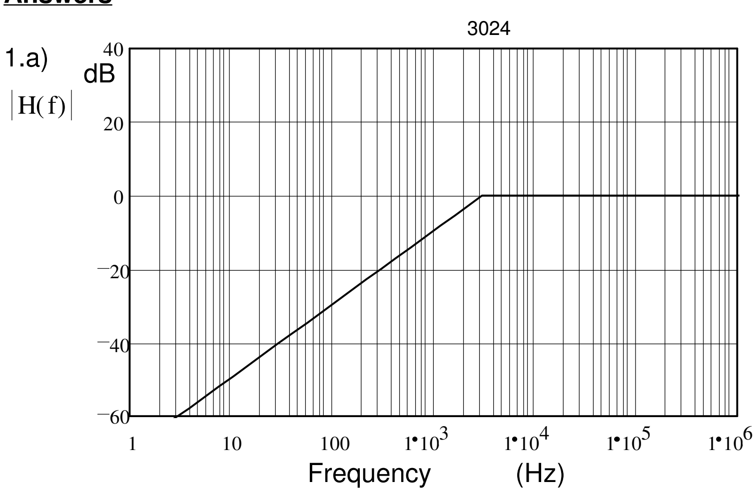
a) Average DC (V_{DC}) value

b) RMS (effective) value



<u>Answers</u>

1.a)



1.b) 3, lower, 3024

2. $\frac{30\cdot s^2 + 1800\cdot s}{s^2 + 10\cdot s - 4800}$

3.a) 2.69kW b) 718VAR c) 2.69 + .718j kVA
d) 2.79kVA e) 0.966 f) lagging
g) Add a 44µF capacitor in parallel with load

4. $v_C(t) := 3\cdot V\cdot e^{\left(-5000\frac{1}{sec}\right)\cdot t} + 7500\cdot\frac{V}{sec}\cdot t\cdot e^{\left(-5000\frac{1}{sec}\right)\cdot t}$

5.a) 6V b) 6.63V