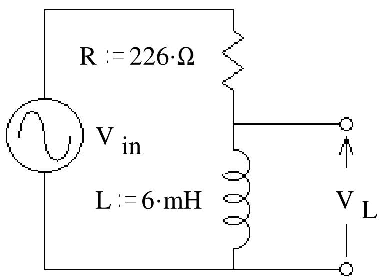
ECE2210 Exam 3 given: Fall 05

(The space between problems has been removed.)

1. (18 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.

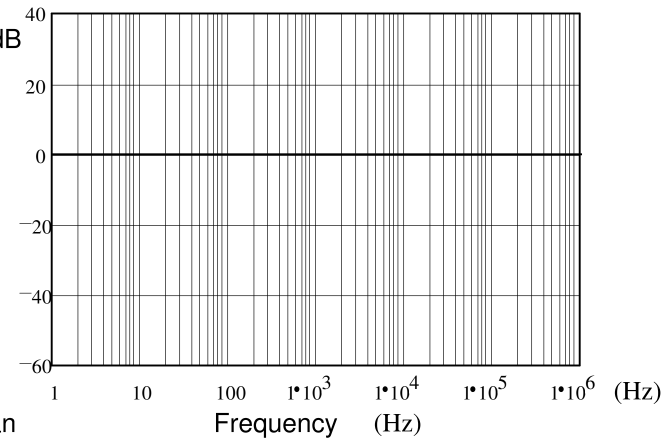
   To be eligible for partial credit, show the steps you use to get the Bode plot. That is, show things like the transfer function, the corner frequency(ies) , the approximations of the transfer function in each frequency region, etc..



Magnitude plot dB

$|H(f)|$

Straight-line approximation ____



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

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

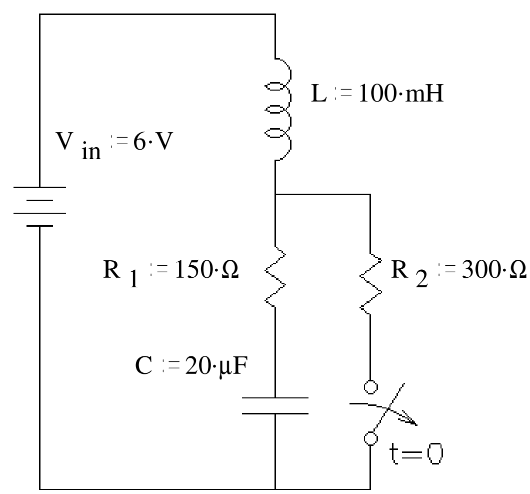
$$0 = s^2 + 400 \cdot s + 290000 \qquad R := 80 \cdot \Omega \qquad L := 20 \cdot mH \qquad C := 200 \cdot \mu F$$

Further analysis yields the followiing initial and final conditions:

$i_L(0) = 120 \cdot mA$	$v_L(0) = -4 \cdot V$	$v_C(0) = 7 \cdot V$	$i_C(0) = -800 \cdot mA$
$i_L(\infty) = 500 \cdot mA$	$v_L(\infty) = 0 \cdot V$	$v_C(\infty) = 12 \cdot V$	$i_C(\infty) = 0 \cdot mA$

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

3. (18 pts) Consider the circuit at right. The switch has been in the closed position for a long time and is open (as shown) at time $t = 0$.

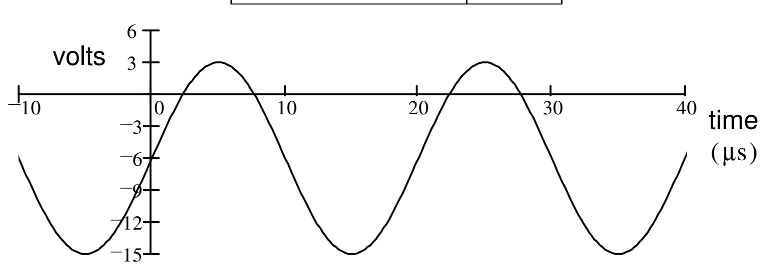


   a) What are the final conditions of i_L and the v_C?

   b) Find the initial condition and intial slope of i_L so that you could 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 so that you could find all the constants in $v_C(t)$.
   Don't find $v_C(t)$ or it's constants, just the initial conditions.

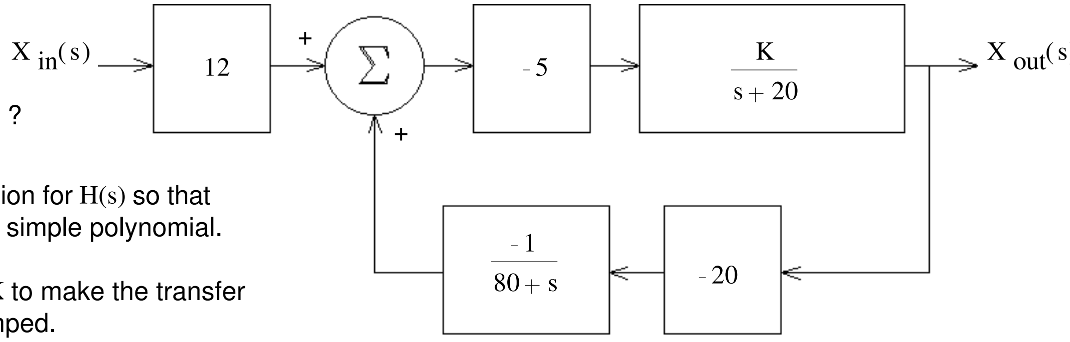
NOTE: The problems are not presented here in the same order as the original exam.



6. (8 pts) Find:
   a) The average, DC (V_{DC}) voltage.
   b) The RMS (effective) voltage

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

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



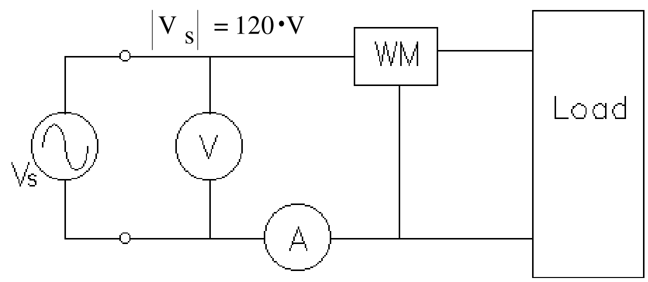
Simplify your expression for $H(s)$ so that the denominator is a simple polynomial.

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

c) If K is **Greater** 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. (19 pts) For the $60\ \text{Hz}$ load shown in the figure, the RMS voltmeter measures $120\ \text{V}$. The phasor diagram for the power is also shown. Find the following:



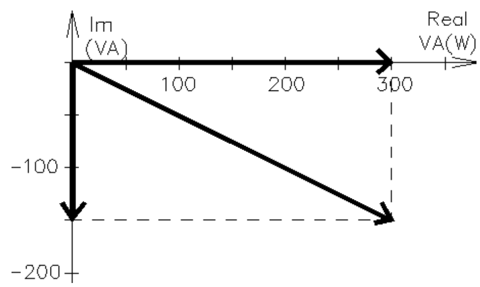
a) The complex power. **S** = ?

b) The apparent power. |S| = ?

c) The power factor. $\text{pf} = ?$

d) The item marked "WM" in the figure is a wattmeter, what does it read? (give a number)

e) The item marked "A" in the figure is an RMS ammeter, what does it read? (give a number)



f) The power factor is: i) leading ii) lagging

(circle one)

g) The 3 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 $\text{pf} = 1$). Show the correct component in the correct place and find its value. This component should not affect the real power consumption of the load.

Answers

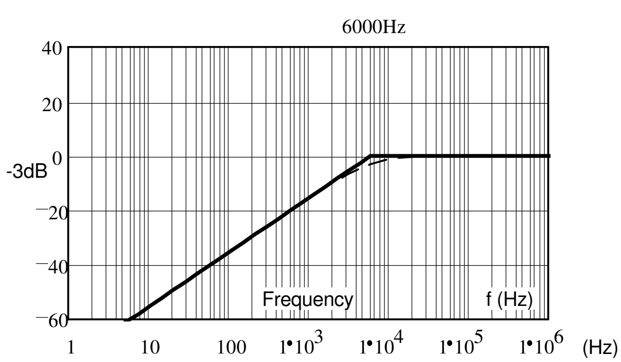
1. a)

Magnitude plot

$|H(f)|$ (dB)

Straight-line approximation ____

Actual _ _ _ _



b) The actual magnitude is ___3___ dB ___lower___ than the Bode plot at ___6000___ Hz.

ECE 2210 Exam #3
Arn Stolp

Name ______________________________

Scores:

Pgs 1&2 _________ of a possible 35 points

Pgs 3&4 _________ of a possible 38 points

Pgs 5&6 _________ of a possible 27 points

Total _________ of a possible 100 points

2. $v_C(t) := 12\cdot V + e^{-200t}\cdot(-5\cdot V\cdot\cos(500\cdot t) - 10\cdot V\cdot\sin(500\cdot t))$

3. a) $0\cdot mA$ $6\cdot V$ b) $20\cdot mA$ $-30\cdot\frac{A}{sec}$ c) $6\cdot V$ $1000\cdot\frac{V}{sec}$

4. a) $H(s) = \dfrac{-60\cdot K\cdot(s+80)}{s^2 + 100\cdot s + 1600 + 100\cdot K}$ b) 9 c) underdamped d) -80

5. a) $(300 - 150\cdot j)\cdot VA$ b) $333.5\cdot VA$ c) 0.894 d) $300\cdot W$ e) $2.8\cdot A$ f) leading g) $255\cdot mH$

6. a) $-6\cdot V$ b) $8.75\cdot V$