

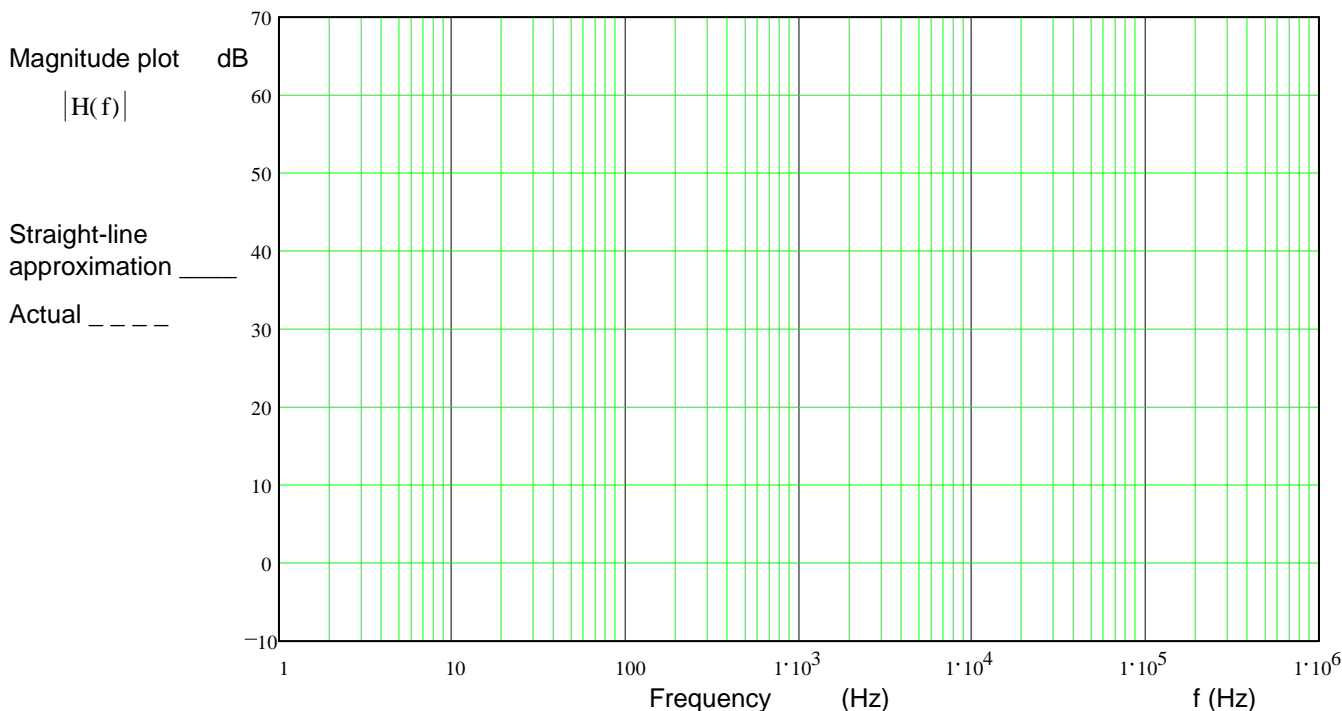
# ECE 2210 Exam 3 given: Spring 14

(The space between problems has been removed.)

1. (24 pts) a) Draw the asymptotic Bode plot (the straight-line approximation) of the transfer function below. Accurately draw it on the graph provided.

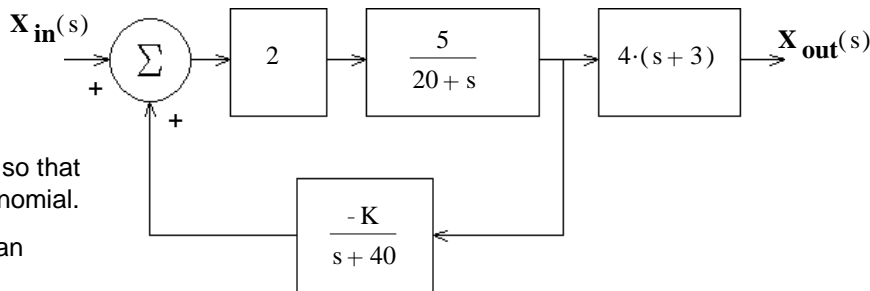
You must show and use the method from the class notes to get the Bode plot. That is, show things like the corner frequency(ies), the approximations of the transfer function in each frequency region, calculations of dB, etc..

$$H(f) := \frac{5 \cdot j \cdot f \left( 4 + \frac{j \cdot f}{10 \cdot \text{kHz}} \right)}{(100 \cdot \text{Hz} + 0.5 \cdot j \cdot f)}$$



- b) The asymptotic Bode plot is not exact. Using a dotted line, sketch the actual magnitude of the transfer function  $|H(f)|$  on the plot above. Indicate the point(s) where the difference between the two lines is the biggest (draw arrow(s)) and write down the actual magnitude(s) at that (those) point(s).
- c) If there are any corners in the Bode plot associated with **poles** in the transfer function, list that/those corner frequency(ies) here ( $f_p$ ).
- d) If there are any corners in the Bode plot associated with **zeroes** in the transfer function, list that/those corner frequency(ies) here ( $f_z$ ).
2. (23 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.

Be clear about your signs, so I can tell you know what you're doing.

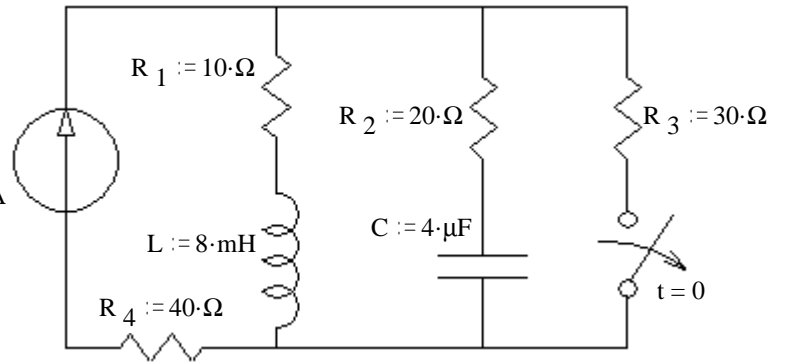
- b) Find the value of  $K$  to make the transfer function critically damped.
- c) If  $K$  is **less** than this value the system will be: underdamped or overdamped Circle one
- d) Does the transfer function have a zero? Answer "no" or find the  $s$  value(s) of the zero(s).

ECE 2210 Exam 3 Spring 14 p2

3. (35 pts) The switch has been closed for a long time and is opened (as shown) at time  $t = 0$ .

SHOW YOUR WORK, no credit for guesses!

$I_S := 240 \cdot \text{mA}$



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

b) Find the initial condition and initial 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 initial 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.

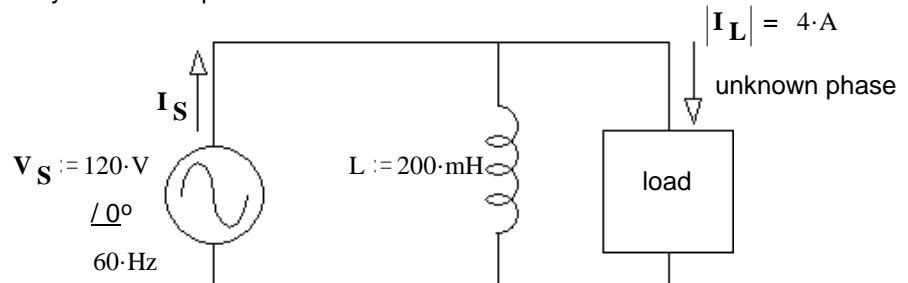
4. (18 pts) An inductor is used to completely correct the power factor of a load.

Find the following:

a) The power consumed by the load.

$P_L = ?$

Hint 1: Since L corrects the power factor, find its Q because it must exactly cancel the load's Q. The source will provide only P and no Q.



Hint 2: If hint 1 doesn't make sense to you, you don't know AC power well enough to do part a) -- so skip to part b).

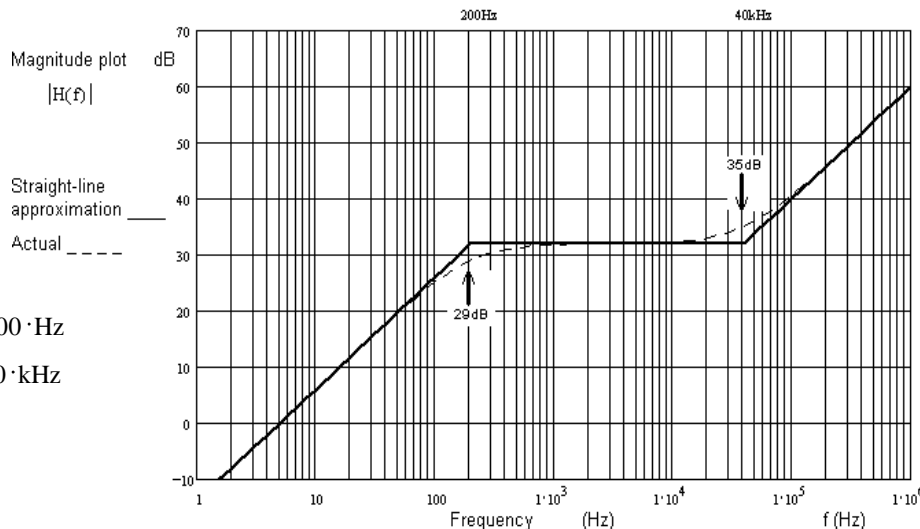
If you can't find this power, mark an x here \_\_\_\_\_ and assume  $P_L = 450\text{W}$  for the rest of the problem.

b) The source current (magnitude and phase).

- c) The inductor, L, is replaced with a 300 mH inductor. circle one:
- i) The **new** source current  $|I_S|$  is **less** than that calculated in part c).
  - ii) The **new** source current  $|I_S|$  is **the same** as that calculated in part c).
  - iii) The **new** source current  $|I_S|$  is **greater** than that calculated in part c).
  - iv) You can't tell from the information given.

Answers

1. a), b)



c)  $f_p = 200 \cdot \text{Hz}$

d)  $f_z = 40 \cdot \text{kHz}$

2. a)  $\frac{40 \cdot (s + 40) \cdot (s + 3)}{s^2 + 60 \cdot s + 800 + 10 \cdot K}$

b) 10 c) overdamped

d) -40 -3

3. a) 240 mA 2.4 V

b) 180 mA  $150 \cdot \frac{\text{A}}{\text{sec}}$

c) 1.8 V  $15000 \cdot \frac{\text{V}}{\text{sec}}$

4. a) 440 W

b) 3.67 A  $\angle 0^\circ$

c) iii)