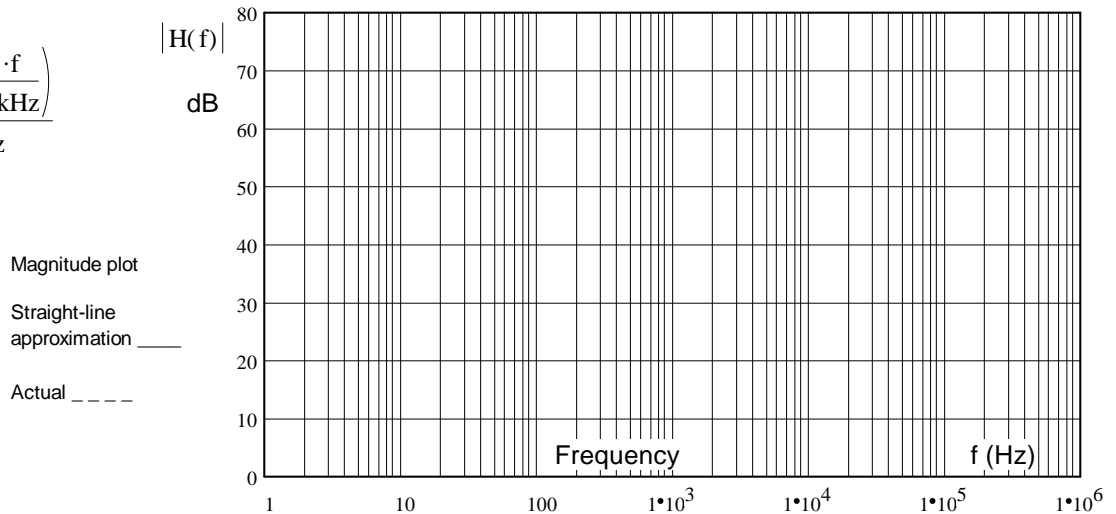# ECE 2210 Exam 3 given: Spring 12 (The space between problems has been removed.)

1. (23 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..

$$H(f) := \frac{j \cdot 10 \cdot f \cdot \left(10 + \dfrac{j \cdot f}{2 \cdot kHz}\right)}{j \cdot f + 30 \cdot Hz}$$

Magnitude plot

Straight-line approximation _____

Actual _ _ _ _

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).

2. (23 pts) a) A feedback system is shown in the figure. What is the transfer function of the whole system, with feedback.

$$H(s) = \frac{X_{out}(s)}{X_{in}(s)} = ?$$
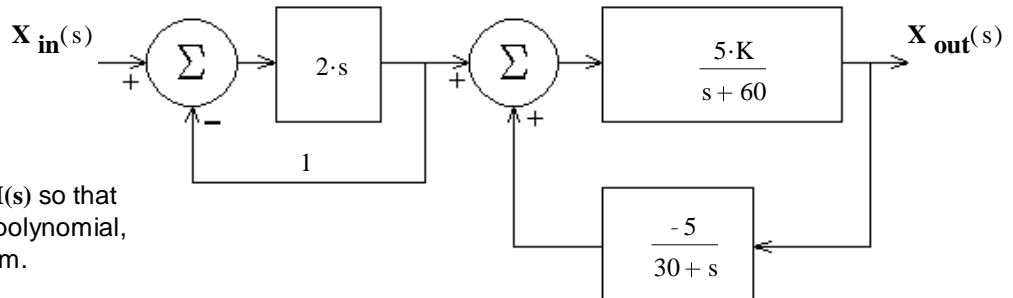
SHOW YOUR WORK
Simplify your expression for **H(s)** so that the denominator is a simple polynomial, or better still, in a factored form.
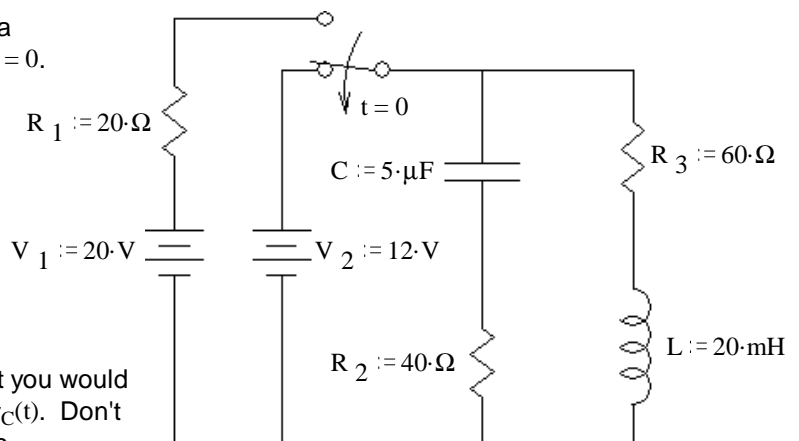

b) Find the value of K to make the transfer function of the major loop critically damped.

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

d) Does the transfer function have a pole that doesn't depend on K? Answer no or find the s value of that pole.

3. (27 pts) The switch has been the upper position for a long time and is switched down (as shown) 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 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.
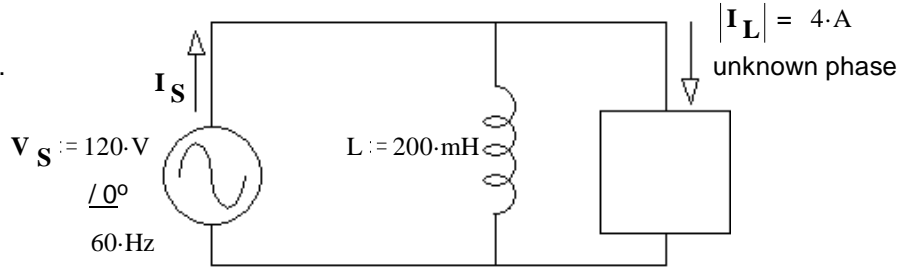

$R_1 := 20 \cdot \Omega$

$C := 5 \cdot \mu F$

$R_3 := 60 \cdot \Omega$

$V_1 := 20 \cdot V$

$V_2 := 12 \cdot V$

$R_2 := 40 \cdot \Omega$

$L := 20 \cdot mH$

4. (27 pts) An inductor is used to completely correct the power factor of a load.

Find the following:

$|I_L| = 4 \cdot A$
unknown phase

a) The power consumed by the load.
   $P_L = ?$

I_S

$V_S := 120 \cdot V$

$L := 200 \cdot mH$

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.

$\underline{/0^o}$

$60 \cdot Hz$

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 $P_L = 450W$ for the rest of the problem.

b) The power supplied by the source.

c) The source current (magnitude and phase).

d) The load can be modeled as 2 parts in parallel. Draw the model and find the values of the parts.

e) The inductor, L, is replaced with a 50 mH inductor.

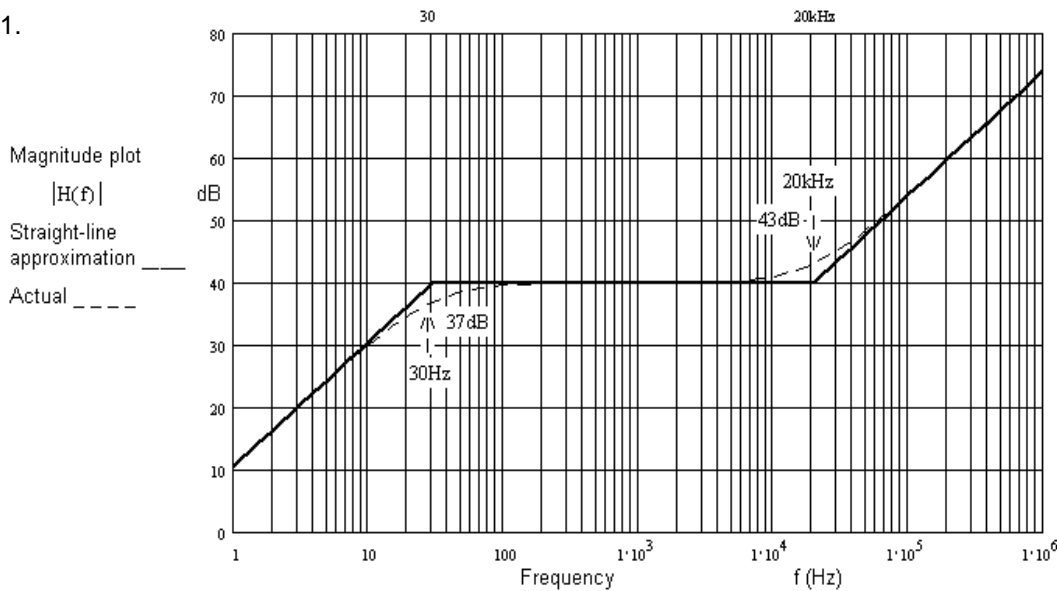   i) The **new** source current $|I_S|$ is **greater** than that calculated in part c).

circle one
   ii) The **new** source current $|I_S|$ is **the same** as that calculated in part c).

   iii) The **new** source current $|I_S|$ is **less** than that calculated in part c).

Answers

1.

2. a) $\dfrac{10 \cdot K \cdot s \cdot (s + 30)}{(1 + 2 \cdot s) \cdot (s^2 + 90 \cdot s + 1800 + 25 \cdot K)}$
   b) 9
   c) 0 , -30
   d) $-\dfrac{1}{2}$

3. a) $12 \cdot V$, $200 \cdot mA$
   b) $250 \cdot mA$, $-150 \cdot \dfrac{A}{sec}$
   c) $15 \cdot V$, $-15000 \cdot \dfrac{V}{sec}$

4. a) $440 \cdot W$ b) $440 \cdot W$ c) $3.67A \underline{/0^o}$ d) $32.7 \cdot \Omega$, $35.2 \cdot \mu F$ e) i)   **ECE 2210   Exam 3   Spring 12   p2**