ECE2210 Exam 3 given: Fall 08

(The space between problems has been removed.)

1. (20 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 the steps you use 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..

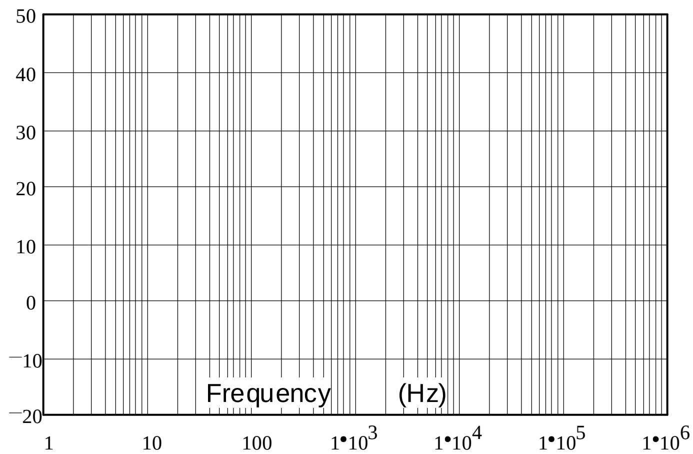
$$H(f) := \frac{200\cdot(100\cdot Hz + j\cdot f)}{(30\cdot kHz + j\cdot f)}$$

Magnitude plot

$|H(f)|$

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).

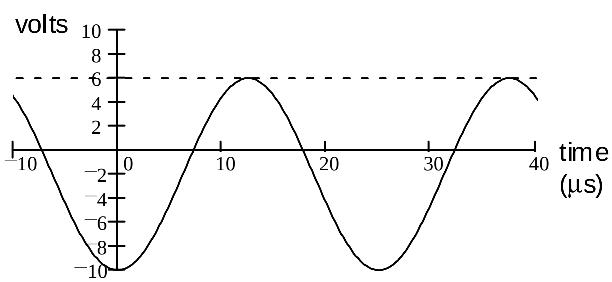
   c) If there are any corners in the Bode plot associated with **poles** in the transfer function, list that/those corner frequency(ies) below (f_p).

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

2. (12 pts) Find:

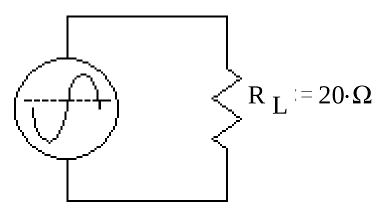
   a) The average, DC (V_{DC}) voltage.

   b) The RMS (effective) voltage (show work)



   c) The voltage is hooked to a resistor, as shown, for 5 seconds.

   How much energy is transfered to the resistor during that 5 seconds?



   d) What happened to that energy?

3. (22 pts) Analysis of a circuit (not pictured) yields the characteristic equation below.

$$0 = s^2 + 50\cdot s + 400$$

$R := 10\cdot\Omega$ $\quad L := 80\cdot mH$ $\quad C := 60\cdot\mu F$

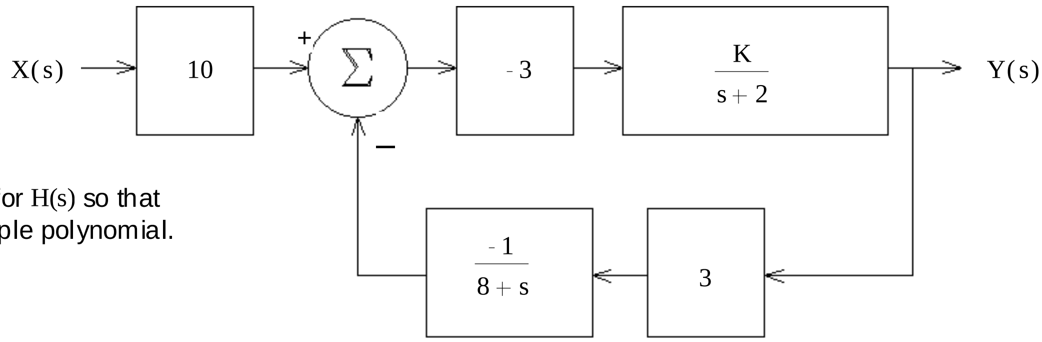
Further analysis yields the followiing initial and final conditions:

$i_L(0) = 18\cdot mA$	$v_L(0) = -6\cdot V$	$v_C(0) = 12\cdot V$	$i_C(0) = -9\cdot mA$
$i_L(\infty) = 10\cdot mA$	$v_L(\infty) = 0\cdot V$	$v_C(\infty) = 3\cdot V$	$i_C(\infty) = 0\cdot mA$

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

Include **units** in your answer

4. (22 pts) a) A feedback system is shown in the figure. What is the transfer function of the whole system, with feedback.



$H(s) = \frac{Y(s)}{X(s)} = ?$

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

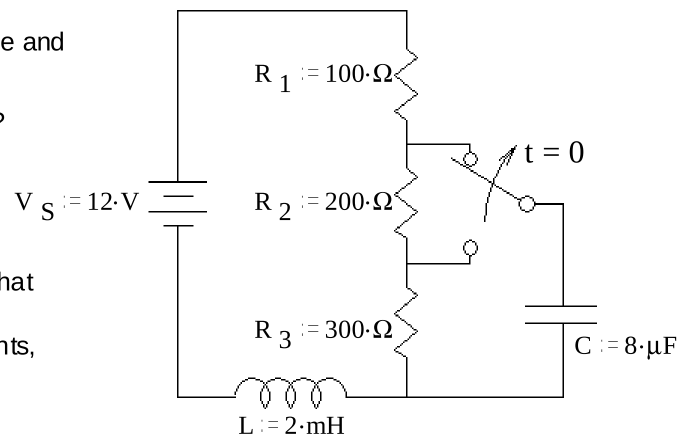
b) Find the value of K to make the transfer function critically damped. Answer may be left as a fraction.

c) If $K := 5$, find the pole(s) of the transfer function:

d) If $K := 5$, find the zero(s) of the transfer function:

5. (24 pts) The switch has been down for a long time and is switched up (as shown) at time $t = 0$.

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.

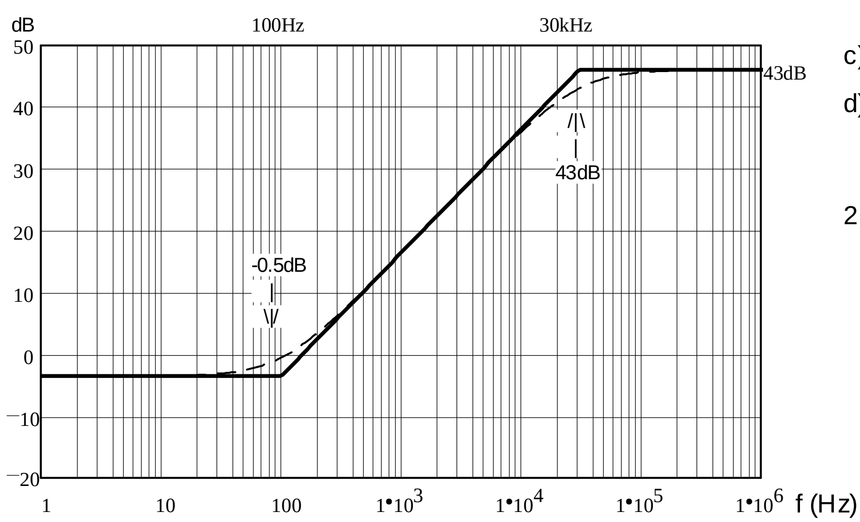
c) Find the initial condition and initial slope of v_C that you would need to have in order to find all the constants in $v_C(t)$. Don't find $v_C(t)$ or it's constants, just the initial conditions.

Answers

1. a) & b)
Magnitude plot
$|H(f)|$

Straight-line approximation __

Actual _ _ _ _



c) $f_{C2} = 30\cdot kHz$

d) $f_{C1} = 100\cdot Hz$

2. a) $-2\cdot V$

b) $6\cdot V$

c) $9\cdot J$

d) It was converted to heat

3. $v_C(t) := 3\cdot V + 7\cdot V\cdot e^{-\frac{10}{sec}\cdot t} + 2\cdot V\cdot e^{-\frac{40}{sec}\cdot t}$

4. a) $\dfrac{-30\cdot K\cdot(s+8)}{s^2 + 10\cdot s + 16 + 9\cdot K}$ b) 1 c) $-5+6\cdot j$, $-5-6\cdot j$ d) -8

5. a) $20\cdot mA$ $\quad 10\cdot V$ b) $20\cdot mA$ $\quad 2000\cdot\frac{A}{sec}$ c) $6\cdot V$ $\quad 1000\cdot\frac{V}{sec}$