ECE 2210 Exam 3 given: Fall 10

(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..

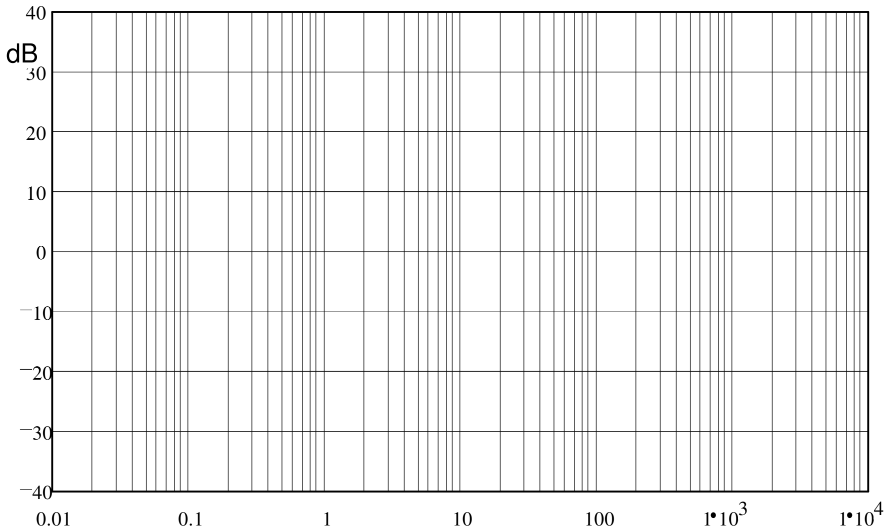
$$H(f) := \frac{1\cdot Hz + 0.1\cdot j\cdot f}{20\cdot Hz + \frac{j\cdot f}{100}}$$

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) List any corners in the Bode plot associated with **<u>zeroes</u>** in the transfer function.

   d) List any corners in the Bode plot associated with **<u>poles</u>** in the transfer function.

2. (20 pts) Analysis of a circuit (not pictured) yields the characteristic equation below.

$$0 = s^2 + 100\cdot s + 1600 \qquad R := 10\cdot\Omega \qquad L := 800\cdot mH \qquad C := 60\cdot\mu F$$

   Further analysis yields the following initial and final conditions:

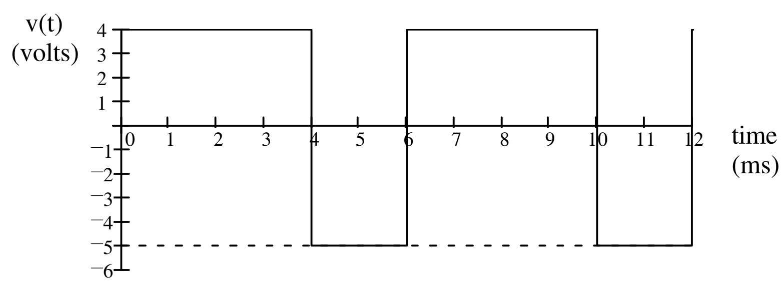
$i_L(0) = 180\cdot mA$	$v_L(0) = -8\cdot V$	$v_C(0) = 12\cdot V$	$i_C(0) = -9\cdot mA$
$i_L(\infty) = 100\cdot mA$	$v_L(\infty) = 0\cdot V$	$v_C(\infty) = 3\cdot V$	$i_C(\infty) = 0\cdot mA$

   Write the full expression for $i_L(t)$, including all the constants that you find. $i_L(t) = ?$ Include **units** in your answer

3. (14 pts) For waveform shown, find:

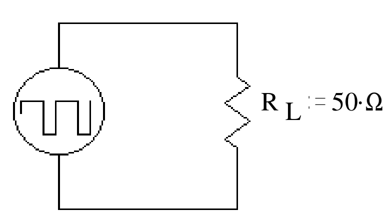
   a) Average DC (V_{DC}) value

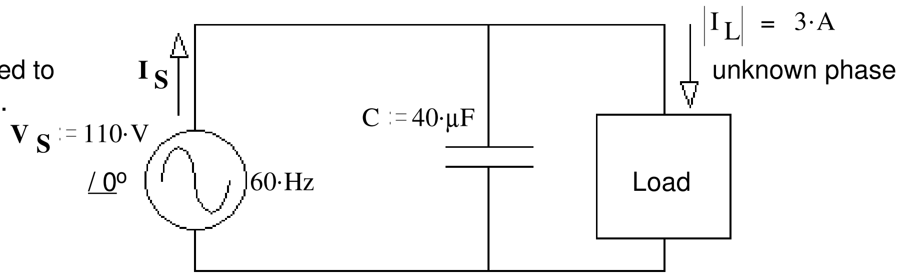
b) RMS (effective) value



c) The voltage is hooked to a resistor, as shown, for 6 seconds.

   How much energy is transferred to the resistor during that 6 seconds?





4. (21 pts) An capacitor (C, shown below) is used to completely correct the power factor of a load.

   All values are RMS. Find the following:

   a) The power consumed by the load.

      $P_L = ?$

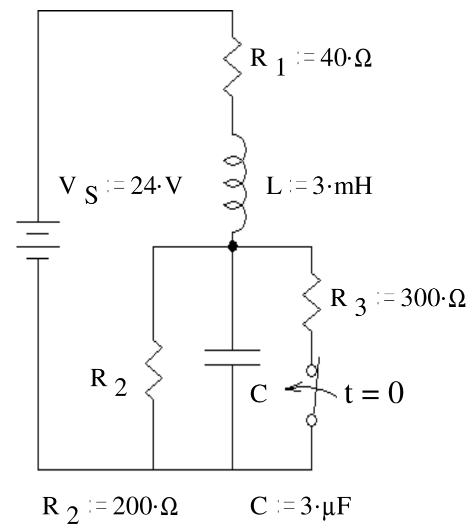
   Hint 1: Since C corrects the power factor, its Q must exactly cancel the load's Q and the source provides only P and no Q.

   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).

   b) The power supplied by the source. Note: If you skipped part a), assume $P_L = 300W$ for the rest of the problem.

   c) The source current (magnitude and phase).

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



5. (25 pts) The switch has been open for a long time and is closed (as shown) at time $t = 0$.

   SHOW YOUR WORK, no credit for guesses!

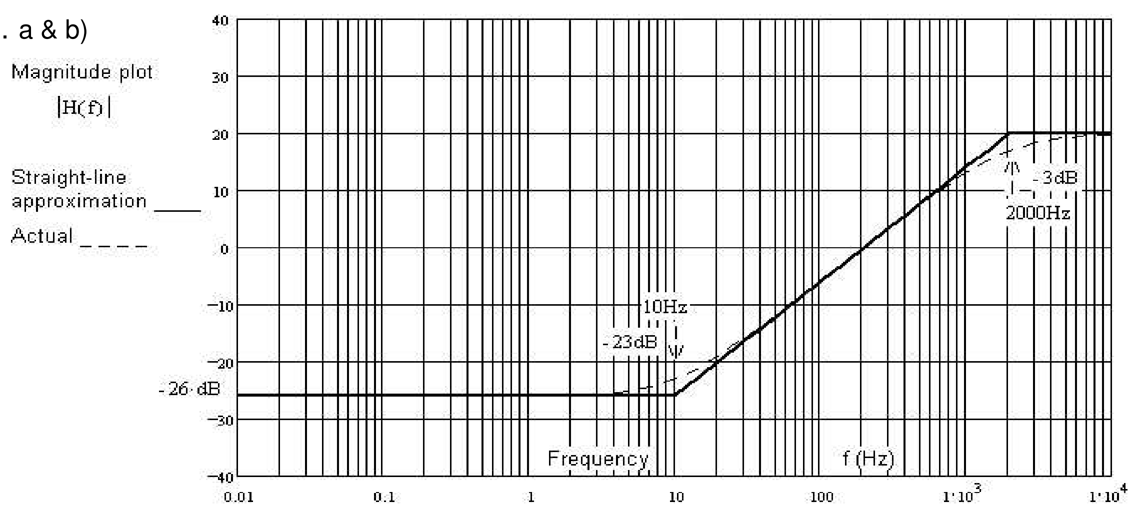
   a) What are the final conditions of i_L and the v_C?
      $i_L(\infty) = ?$ $v_C(\infty) = ?$

   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.

Answers

1. a & b)



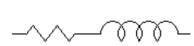
c) $10\cdot Hz$

d) $2\cdot kHz$

2. $i_L(t) := 100\cdot mA - 60\cdot mA\cdot e^{-\frac{20}{sec}\cdot t} + 140\cdot mA\cdot e^{-\frac{80}{sec}\cdot t}$

3. a) $1\cdot V$ b) $4.36\cdot V$ c) $2.28\cdot J$

4. a) $275\cdot W$ b) $275\cdot W$ c) $2.5\cdot A$ $/0^o$



d) $30.6\cdot\Omega$ $53.8\cdot mH$

5. a) $150\cdot mA$ $18\cdot V$ b) $100\cdot mA$ $0\cdot\frac{A}{sec}$ c) $20\cdot V$ $-22222\cdot\frac{V}{sec}$