ECE1050/60 Exam 3 given: Fall 04 (The space between problems has been removed.)

1. (18 pts) Analysis of a circuit (not pictured) yields the characteristic equation below.

$$0 = s^2 + 400\cdot s + 130000 \qquad R := 80\cdot\Omega \qquad L := 2.5\cdot mH \qquad C := 2\cdot\mu F$$

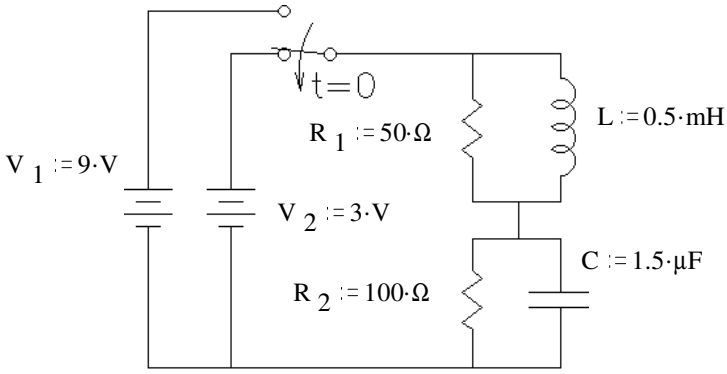
Further analysis yields the followiing initial and final conditions:

$i_L(0) = 2\cdot mA$ $\quad v_L(0) = 3\cdot V$ $\quad v_C(0) = 6\cdot V$ $\quad i_C(0) = -8\cdot mA$

$i_L(\infty) = 10\cdot mA$ $\quad v_L(\infty) = 0\cdot V$ $\quad v_C(\infty) = 12\cdot V$ $\quad i_C(\infty) = 0\cdot mA$

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

2. (18 pts) Consider the circuit at right. The switch has been in the top position for a long time and is switched down at time t = 0.

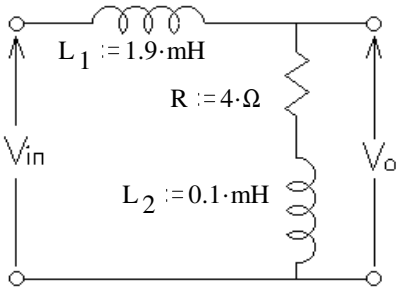


a) What are the final conditions of i_L and the v_C?

b) Find the initial condition and intial slope of i_L 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.

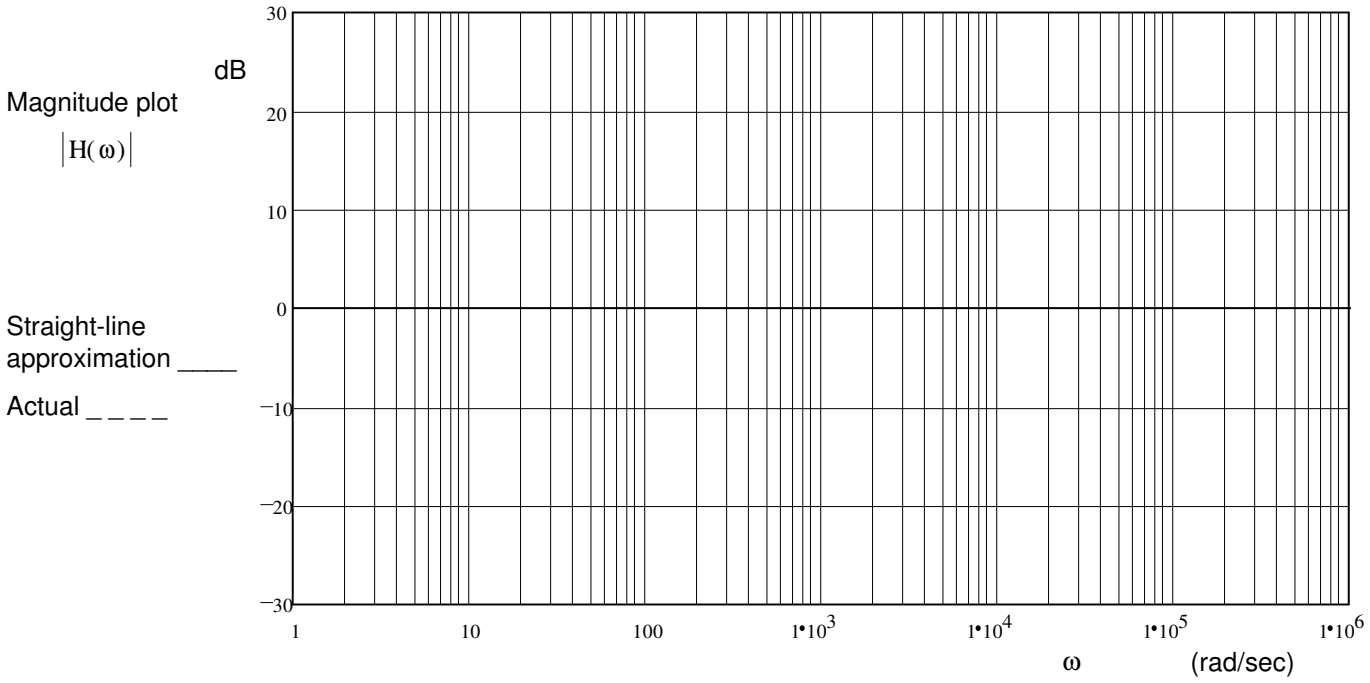
c) Find the initial condition and intial slope of v_C that you would need to have in order to find all the constants in $v_C(t)$. Don't find $v_C(t)$ or it's constants, just the initial conditions.

3. (26 pts) a) Draw the asymptotic Bode plot (the straight-line approximation) of the filter circuit at right. Accurately draw it on the graph provided on the next page. V_{in} is the input and V_O 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..

Notice that this graph is in rad/sec

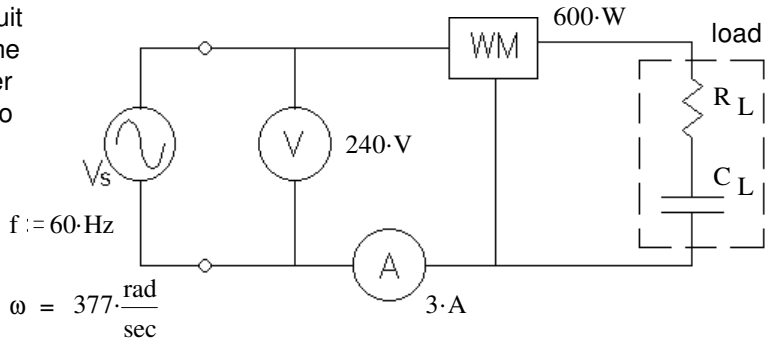


3. b) The asymptotic Bode plot is not exact. Using a dotted line, sketch the actual magnitude of the transfer function $|H(\omega)|$ on the plot above. Draw arrow(s) to the point(s) where the difference between the two lines is the biggest and write down the value(s) of that/those difference(s).

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

5. (24 pts) R, & C together are the load in the circuit shown. The RMS voltmeter measures 240 V, the RMS ammeter measures 3 A, and the wattmeter measures 600 W. Find the following: Be sure to show the correct units for each value.



   a) The real power. P = ?

   b) The value of the load resistor. R_L = ?

   c) The apparent power. |S| = ?

   d) The reactive power. Q = ?

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

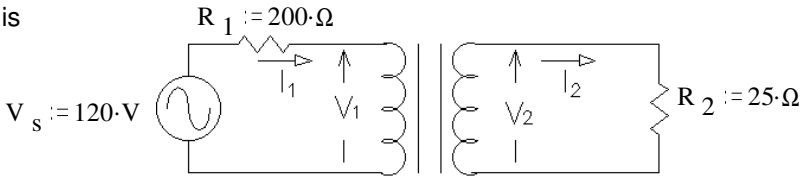
   f) The power factor. pf = ?

   g) The power factor is: i) leading ii) lagging (circle one)

   h) The two 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 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.

6. (14 pts) The transformer shown in the circuit is ideal. It is rated at 120/30 V, 30 VA, 60 Hz Find the following:

   a) I_1 = ? b) V_2 = ?



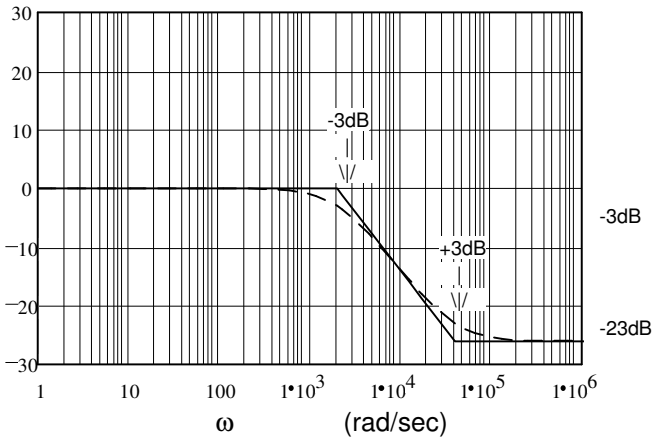
Answers

1. $v_C(t) := 12\cdot V + e^{-200t}\cdot(-6\cdot V\cdot\cos(300\cdot t) - 17.33\cdot V\cdot\sin(300\cdot t))$

2. a) $i_L(\infty) = 30\cdot mA$ $v_C(\infty) = 3\cdot V$

   b) $i_L(0) = 90\cdot mA$ $\frac{d}{dt} i_L(0) = -12000\cdot\frac{A}{sec}$ c) $v_C(0) = 9\cdot V$ $\frac{d}{dt} v_C(0) = -80000\cdot\frac{V}{sec}$

3. a) & b)



   Magnitude plot $|H(\omega)|$

   Straight-line approximation ____

   Actual _ _ _ _

   c) $2000\cdot\frac{rad}{sec}$

   d) $40000\cdot\frac{rad}{sec}$

4. a) $600\cdot W$ b) $66.7\cdot\Omega$ c) $720\cdot VA$ d) $-398\cdot VAR$ e) $(600 - 398\cdot j)\cdot VAR$

   f) 0.833 g) leading h) Add a 384mH inductor in parallel with load

5. a) $0.2\cdot A$ b) $20\cdot V$

ECE 1050 Exam #3
Arn Stolp

Name _____

Scores:

Pgs 1&2 _____ of a possible 36 points

Pgs 3&4 _____ of a possible 26 points

Pgs 5&6 _____ of a possible 38 points

Total _____ of a possible 100 points