ECE1050 Exam 3 given: Spring 05 (The space between problems has been removed.)

1. (16 pts) Analysis of a circuit (not pictured) yields the characteristic equation below.

$$0 = s^2 + 400\cdot s + 400000 \qquad R := 80\cdot\Omega \qquad L := 20\cdot mH \qquad C := 2\cdot\mu F$$

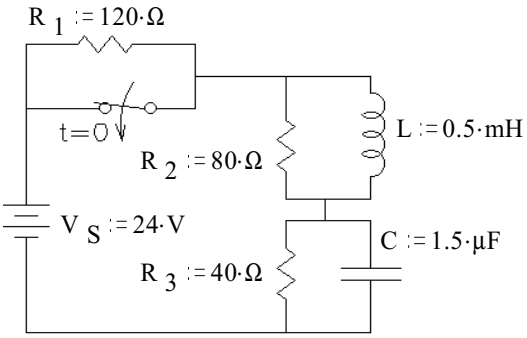
Further analysis yields the followiing initial and final conditions:

$i_L(0) = 120\cdot mA$ $\quad v_L(0) = -3\cdot V$ $\quad v_C(0) = 7\cdot V$ $\quad i_C(0) = -80\cdot mA$

$i_L(\infty) = 800\cdot mA$ $\quad v_L(\infty) = 0\cdot V$ $\quad v_C(\infty) = 12\cdot V$ $\quad i_C(\infty) = 0\cdot mA$

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

2. (20 pts) Consider the circuit at right. The switch has been in the open position for a long time and is closed (as shown) 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 so that you could 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 so that you could find all the constants in $v_C(t)$. Don't find $v_C(t)$ or it's constants, just the initial conditions.

3. (22 pts) a) Draw the asymptotic Bode plot (the straight-line approximation) of the transfer function below. Accurately draw it on the graph provided. I've done the first section, you do the remainder.

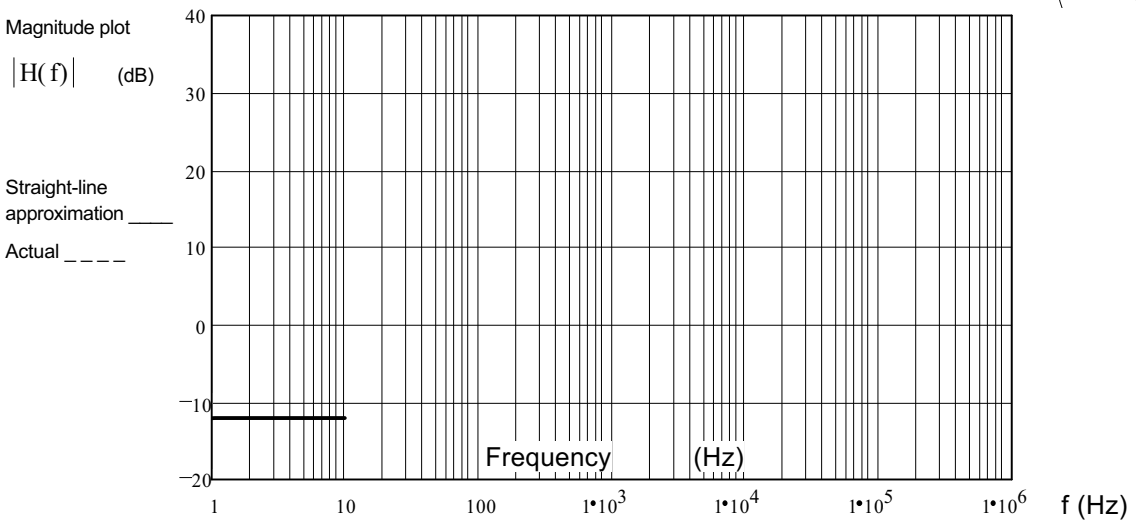
To be eligible for partial credit, show the steps you use to get the Bode plot. That is, show things like the corner frequency(ies) , the approximations of the transfer function in each frequency region, etc..

$$H(f) := \frac{10\cdot(10\cdot Hz + j\cdot f)}{(400\cdot Hz + j\cdot f)\cdot\left(1 + \frac{0.00002}{Hz}\cdot j\cdot f\right)} \qquad 10\cdot Hz = |j\cdot f_{C1}| \qquad f_{C1} := 10\cdot Hz$$

$f < f_{C1}$ $\qquad |H(f)| \simeq \left|\frac{10\cdot(10\cdot Hz)}{(400\cdot Hz)\cdot(1)}\right| = 0.25$ $\qquad 20\cdot\log(0.25) = -12\cdot dB$

I've drawn the first part of the Bode plot, you draw the rest.

From here on the transfer function can be approximated as: $|H(f)| \simeq \frac{10\cdot(j\cdot f)}{(400\cdot Hz + j\cdot f)\cdot\left(1 + \frac{0.00002}{Hz}\cdot j\cdot f\right)}$

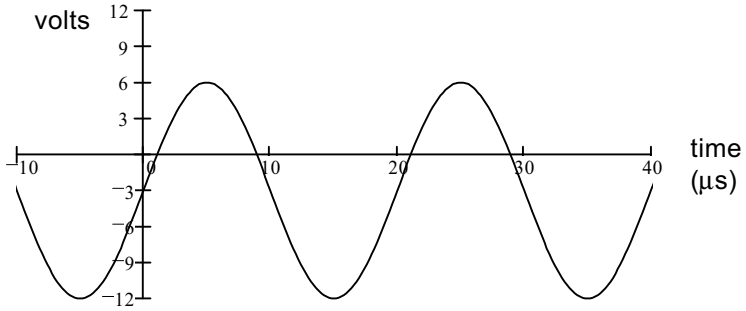


b) If there are any corners in the Bode plot associated with **poles** in the transfer function, list that/those corner frequency(ies) below (f_p).

c) 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).

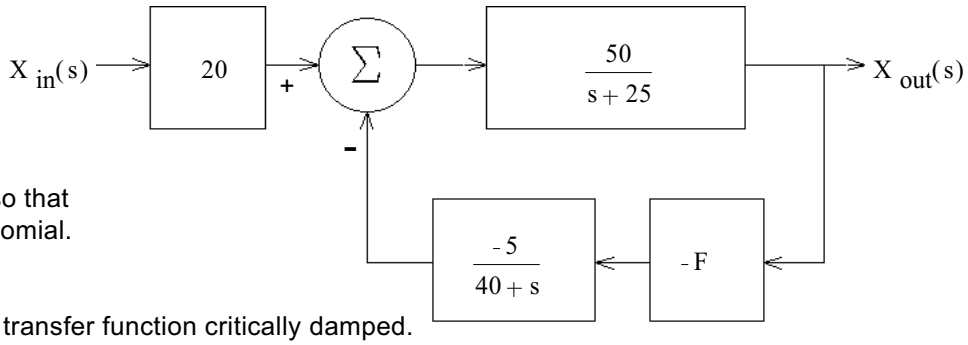
d) The asymptotic Bode plot is not exact. Using a dotted line, sketch the actual magnitude of the transfer function |H(f)| on the plot above. Indicate the point(s) where the difference between the two lines is the biggest (draw arrow(s)) and write down the actual magnitude(s) at that (those) point(s).

4. (8 pts) Find:
   a) The average, DC (V_{DC}) voltage.
   b) The RMS (effective) voltage



5. (20 pts) a) A feedback system is shown in the figure. What is the transfer function of the whole system, with feedback.

$$H(s) = \frac{X_{out}(s)}{X_{in}(s)} = ?$$



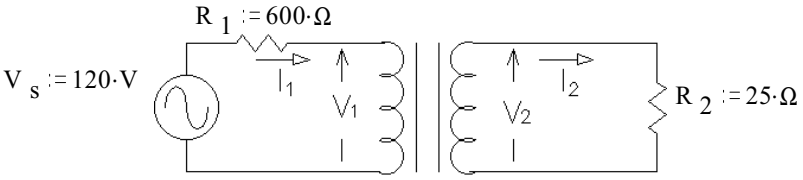
Simplify your expression for H(s) so that the denominator is a simple polynomial.

b) Find the value of F to make the transfer function critically damped.

c) If F is **Greater** 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 of that zero.

6. (14 pts) The transformer shown in the circuit below is ideal. It is rated at 120/20 V, 200 VA, 60 Hz
   Find the following:
   a) V_1 = ?
   b) I_2 = ?

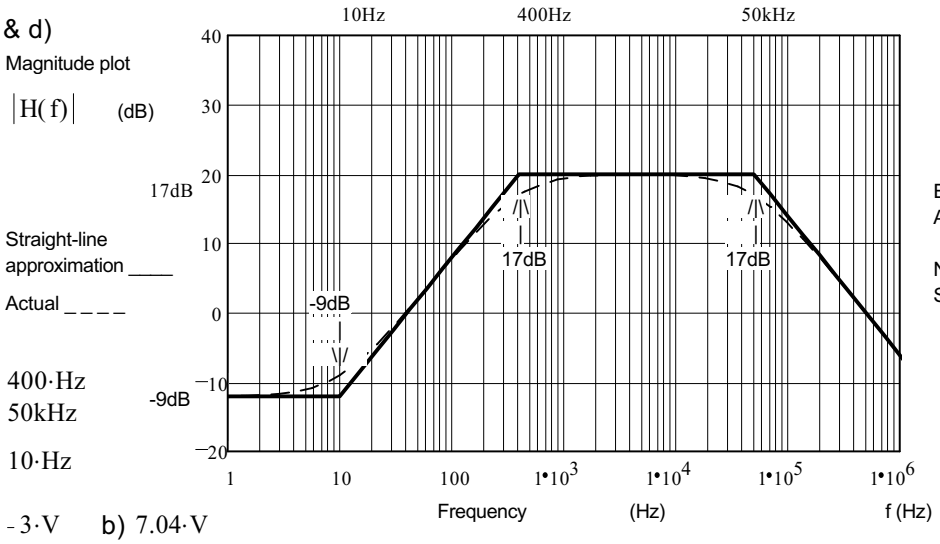


Answers

1. $i_L(t) := 800\cdot mA + e^{-200\cdot t}\cdot(-680\cdot mA\cdot\cos(600\cdot t) - 477\cdot mA\cdot\sin(600\cdot t))$

2. a) $600\cdot mA$ $24\cdot V$ b) $150\cdot mA$ $36000\cdot\frac{A}{sec}$ c) $6\cdot V$ $15\cdot 10^5\cdot\frac{V}{sec}$

3. a) & d)



b) $400\cdot Hz$
$50kHz$

c) $10\cdot Hz$

ECE 1050 Exam #3
Arn Stolp

Name _____

Scores:
Pgs 1&2 _____ of a possible 36 points
Pgs 3&4 _____ of a possible 30 points
Pgs 5&6 _____ of a possible 34 points
Total _____ of a possible 100 points

4. a) $-3\cdot V$ b) $7.04\cdot V$

5.a) $H(s) = 20\cdot\frac{50\cdot s + 2000}{s^2 + 65\cdot s + 1000 + 250\cdot F}$ b) 0.225 c) underdamped d) -40 6. a) $72\cdot V$ b) $0.48\cdot A$