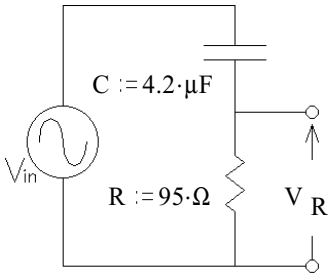
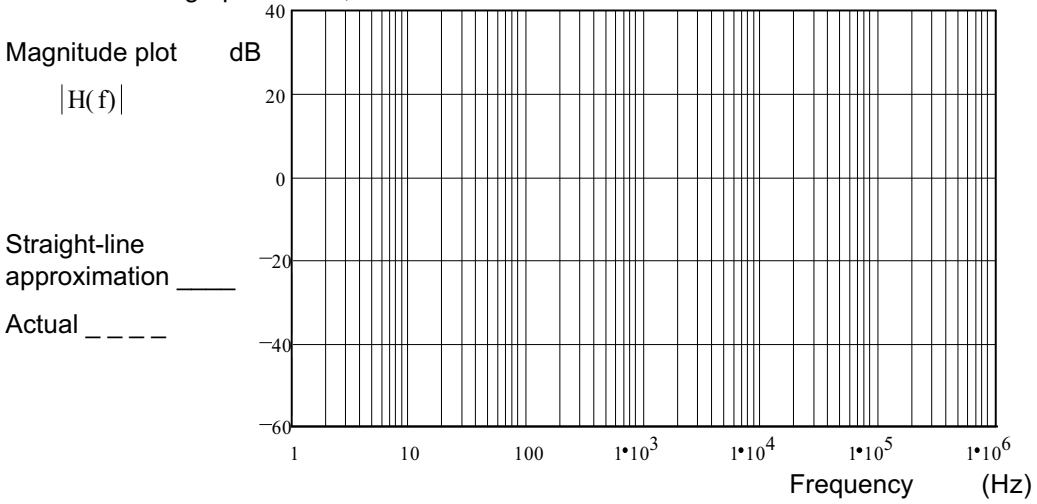
ECE1050 Exam 3 given: Spring 03 (The space between problems has been removed.)

1. (24 pts) a) Draw the asymptotic Bode plot (the straight-line approximation) of the filter circuit shown. Accurately draw it on the graph provided. V_{in} is the input and V_R 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..

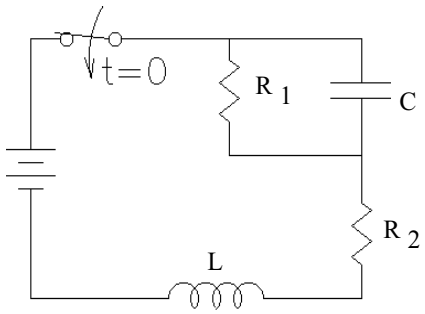


Notice that this graph is in Hz, not rad/sec



   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. Draw an arrow to the point where the difference between the two lines is the biggest write down the value of that difference.

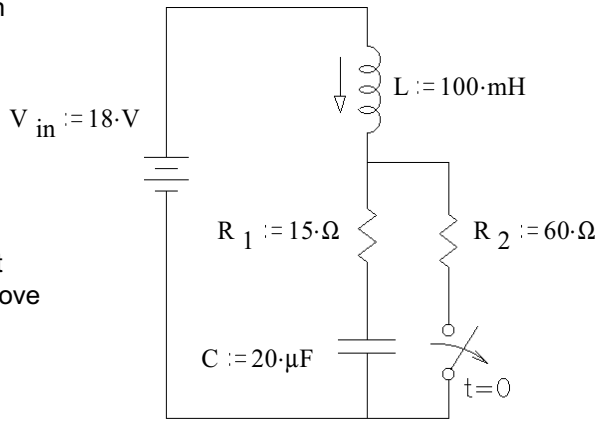
2. (15 pts) Find the characteristic equation of the circuit shown. (after the switch closes at t = 0). Write your equation in the form of a simple polynomial.
   You MUST show work to get credit.



3. (26 pts) Analysis of the circuit shown yields the characteristic equation and s values below.

   The switch has been in the closed position for a long time and is opened (as shown) at time t = 0. Find the initial and final conditions and write the full expression for $v_C(t)$, including all the constants that you find. Don't let the odd position of the switch throw you, just use it to find your initial conditions.

   Clearly show important numbers (like initial and final conditions) to get partial credit. If you can't find some of these, guess so that you can move on and demonstrate what you do know.



$$0 = s^2 + \frac{R_1}{L}\cdot s + \frac{1}{L\cdot C} \qquad v_C(t) = ?$$

$$s_1 := (-75 + 703\cdot j)\cdot\frac{1}{sec} \quad \text{and} \quad s_2 := (-75 - 703\cdot j)\cdot\frac{1}{sec}$$

4. (15 pts)

a) Find the solutions (numbers) of the following characteristic equation: $0 = s^2 + \frac{1}{C \cdot R} \cdot s + \frac{1}{L \cdot C}$

Where: $R := 50 \cdot \Omega$ $L := 8 \cdot mH$ $C := 0.2 \cdot \mu F$

b) This system represented by this characteristic equation is: (circle one)

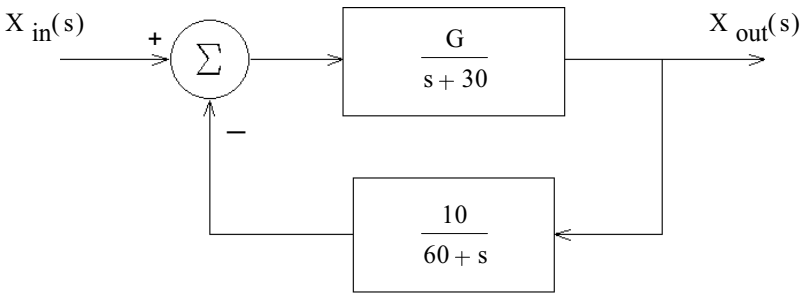
i) underdamped ii) critically damped iii) overdamped iv) impossible to tell

c) What value of R would make this system critically damped?

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 G to make the transfer function critically damped.

c) If G is less than this value the system will be: underdamped or overdamped Circle one

Answers

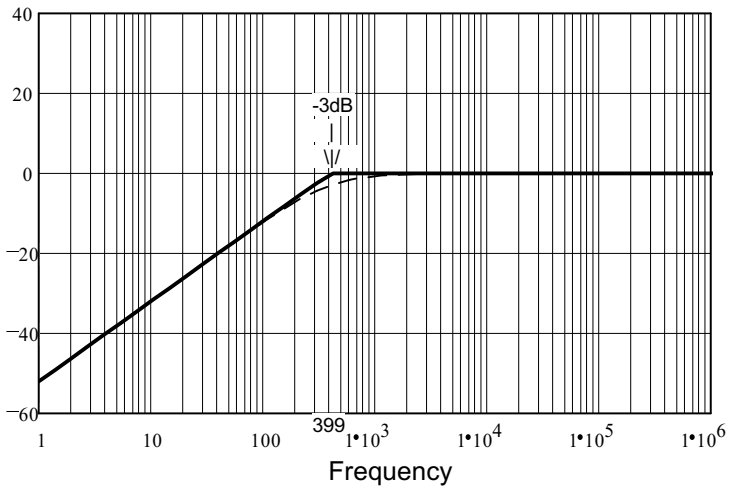
1.

Magnitude plot dB

$|H(f)|$

Straight-line approximation ____

Actual _ _ _ _



2. $0 = s^2 + \left(\frac{1}{C \cdot R_1} + \frac{R_2}{L}\right) \cdot s + \left(1 + \frac{R_2}{R_1}\right) \cdot \frac{1}{L \cdot C}$

3. $v_C(t) = e^{-75 \cdot t} \cdot 21.334 \cdot V \cdot \sin(703 \cdot t) + 18 \cdot V$

4. a) $-6700 \cdot \frac{1}{sec}$ $-93300 \cdot \frac{1}{sec}$ b) iii) overdamped c) $100 \cdot \Omega$

5. a) $\frac{G \cdot (s + 60)}{s^2 + 90 \cdot s + 1800 + G \cdot 10}$ b) 22.5 c) overdamped

ECE 1050 Midterm #3
Arn Stolp

Name _____
Scores:

P 1&2 _____ of a possible 39 points

P 3&4 _____ of a possible 41 points

P 5 _____ of a possible 20 points

Total _____ of a possible 100 points