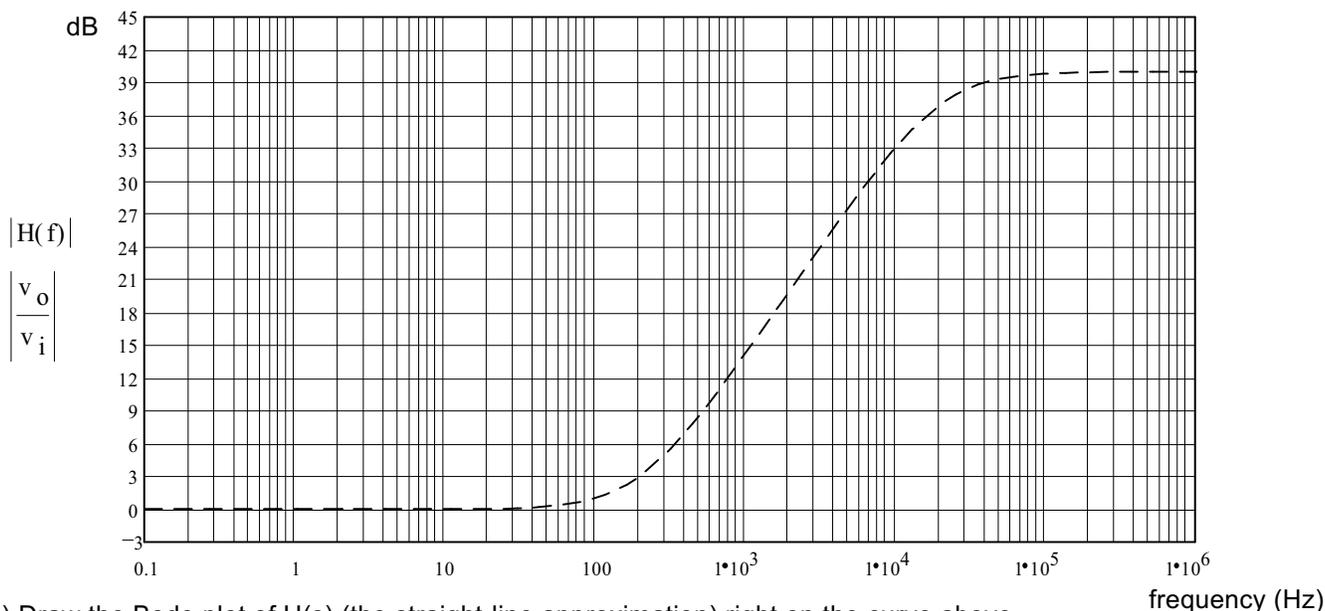


ECE1050 Exam 3 given: Spring 04 (The space between problems has been removed.)

1. (21 pts) A frequency response curve is shown below (dashed line).

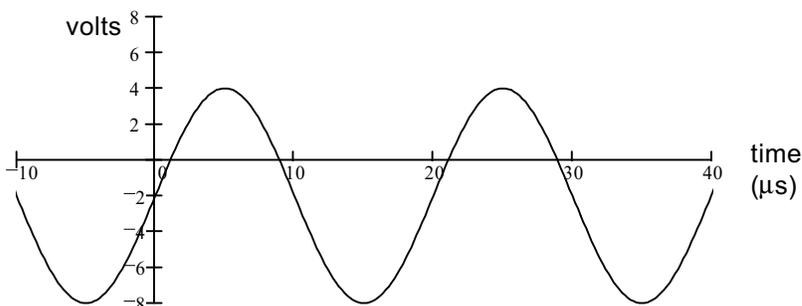


- a) Draw the Bode plot of H(s) (the straight-line approximation) right on the curve above.
- b) List any and all corner frequencies that you can find from the graph above.
- c) If there are any corners in the Bode plot associated with **poles** in the transfer function, list that/those corner frequency(ies) below (f_p).
- d) If there are any corners in the Bode plot associated with **zeros** in the transfer function, list that/those corner frequency(ies) below (f_z).
- e) This Bode plot is for what type of filter? Circle the best answer.
 - i) low pass
 - ii) high pass
 - iii) band pass
 - iv) band reject
 - v) sludge
 - vi) can't tell
- f) Which of the following expressions for the transfer function is of the correct form. (Circle one)

The variable is f , k is a constant, f_z , and f_p are just constants representing zero and pole frequencies respectively.

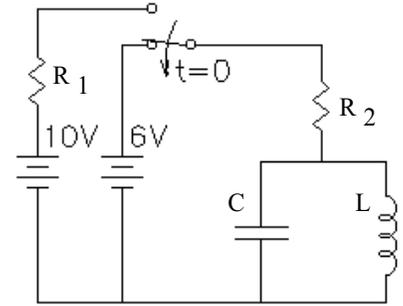
i) $H(jf) = k \cdot \frac{\frac{j \cdot f}{f_z} + 1}{\frac{j \cdot f}{f_p} + 1}$	ii) $H(jf) = k \cdot \frac{\frac{f_z}{j \cdot f} + 1}{\frac{f_p}{j \cdot f} + 1}$	iii) $H(jf) = k \cdot \frac{\frac{j \cdot f}{f_p} + 1}{\frac{j \cdot f}{f_z} + 1}$
iv) $H(jf) = k \cdot \left(\frac{j \cdot f}{f_z} + 1 \right) \cdot \left(\frac{j \cdot f}{f_p} + 1 \right)$	v) $H(jf) = \frac{k}{\left(\frac{j \cdot f}{f_{p1}} + 1 \right) \cdot \left(\frac{j \cdot f}{f_{p2}} + 1 \right)}$	vi) $H(jf) = \frac{k}{\left(\frac{j \cdot f}{f_z} + 1 \right) \cdot \left(\frac{j \cdot f}{f_p} + 1 \right)}$
vii) $H(jf) = k \cdot \left(\frac{j \cdot f}{f_{z1}} + 1 \right) \cdot \left(\frac{j \cdot f}{f_{z2}} + 1 \right)$		

- 2. (10 pts) Find:
 - a) The average, DC (V_{DC}) voltage.
 - b) The RMS (effective) voltage



ECE1050 Exam 3 Spring 04 p2

3. (21 pts) a) Find the characteristic equation of the circuit shown (after the switch moves to the lower position at $t = 0$). You **MUST** show work (including transfer function, if you use that method) to get credit.



b) Find the solutions of the characteristic equation given these component values.

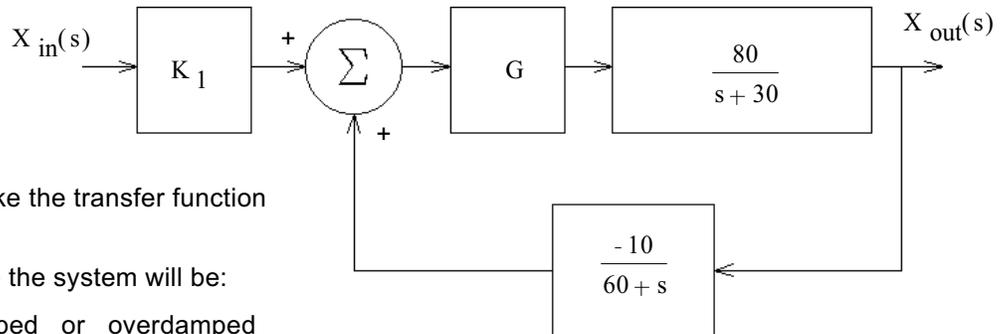
$R_1 := 25\text{-}\Omega$ $R_2 := 125\text{-}\Omega$ $L := 5\text{-mH}$ $C := 0.08\text{-}\mu\text{F}$

c) This circuit is: (circle one)

- i) underdamped ii) critically damped iii) overdamped iv) can't tell

4. (20 pts) a) A feedback system is shown in the figure. What is the transfer function of the whole system, with feedback.

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



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:

Circle one: underdamped or overdamped

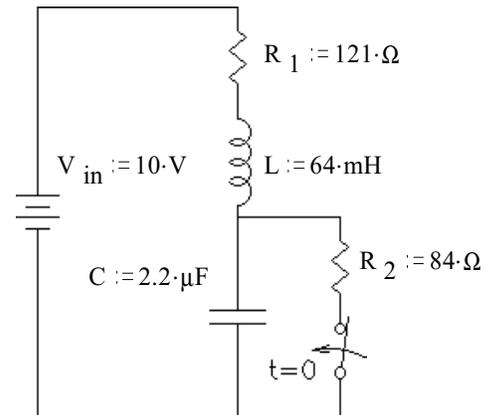
5. (28 pts) Analysis of the circuit shown yields the characteristic equation and s values below.

The switch has been in the open position for a long time and is closed (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.

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

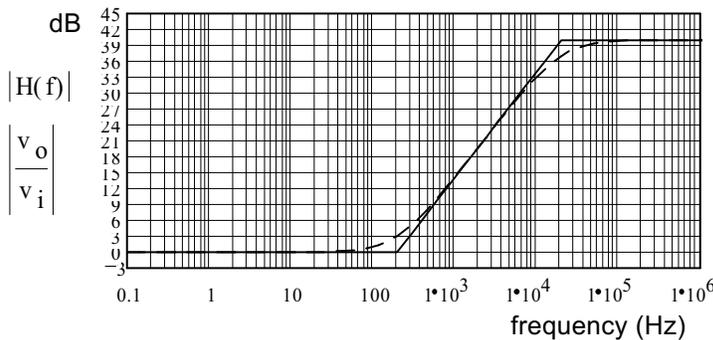
$s_1 := (-3650 + 2000 \cdot j) \cdot \frac{1}{\text{sec}}$ and $s_2 := (-3650 - 2000 \cdot j) \cdot \frac{1}{\text{sec}}$



$v_C(t) = ?$

Answers

1. a)



- b) 200·Hz 20·kHz d) 200·Hz
c) 20·kHz e) ii f) i

2. a) -2·V b) 4.69·V

3. a) $0 = s^2 + \frac{1}{R_2 \cdot C} \cdot s + \frac{1}{L \cdot C}$

b) $-50000 \cdot \frac{1}{\text{sec}}$ $-50000 \cdot \frac{1}{\text{sec}}$

c) ii critically damped

4. a) $H(s) = K_1 \cdot \frac{G \cdot 80 \cdot s + G \cdot 4800}{s^2 + 90 \cdot s + 800 \cdot G + 1800}$

b) 0.28125

c) overdamped

5. $v_C(t) := e^{-3650t} \cdot (5.902 \cdot V \cdot \cos(2000 \cdot t) - 16.285 \cdot V \cdot \sin(2000 \cdot t)) + 4.098 \cdot V$