ECE 2210 Exam 3 given: Fall 20

1. (24 pts) a) Draw the asymptotic Bode plot (the straight-line approximation) of the transfer function below. Accurately draw it on the graph provided.

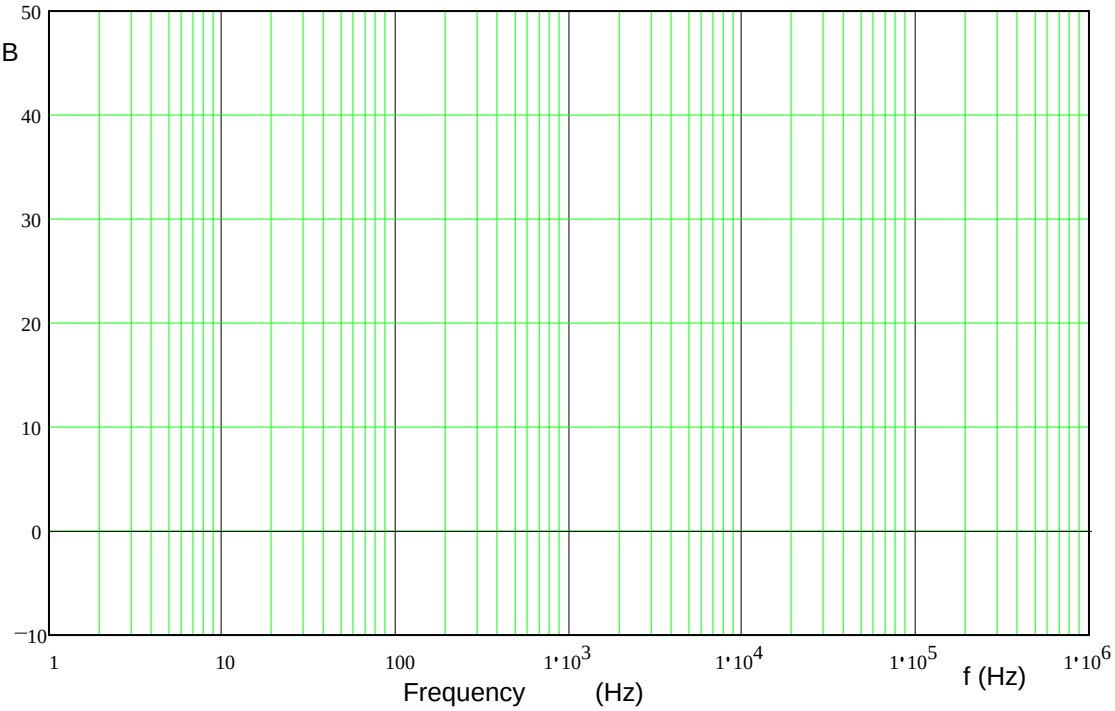
   You **must** show and use the method from the class notes to get the Bode plot. That is, show things like the corner frequency(ies) , the approximations of the transfer function in each frequency region, calculations of dB, etc..

$$\mathbf{H}(f) := \frac{300\cdot\text{Hz}\cdot\left(20 + \frac{0.005}{\text{Hz}}\cdot j\cdot f\right)}{(30\cdot\text{Hz} + j\cdot f)}$$

Magnitude plot $|\mathbf{H}(f)|$

Straight-line approximation ____

Actual _ _ _ _



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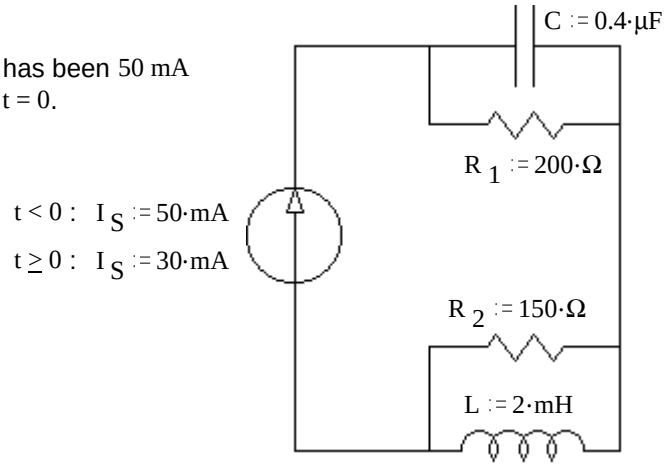
b) The asymptotic Bode plot is not exact. Using a dotted line, sketch the actual magnitude of the transfer function $|\mathbf{H}(f)|$ on the plot above. Indicate the point(s) where the difference between the two lines is the biggest (draw an arrow) and write down the actual magnitude(s) at that (those)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

2. (26 pts) Consider the circuit at right. The current source has been $50\ \text{mA}$ for a long time and changes from $50\ \text{mA}$ to $30\ \text{mA}$ at time $t = 0$.



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

$i_L(\infty) = ?$ $\quad v_C(\infty) = ?$

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.

Answers

2. a) $6\cdot V \quad 30\cdot mA$

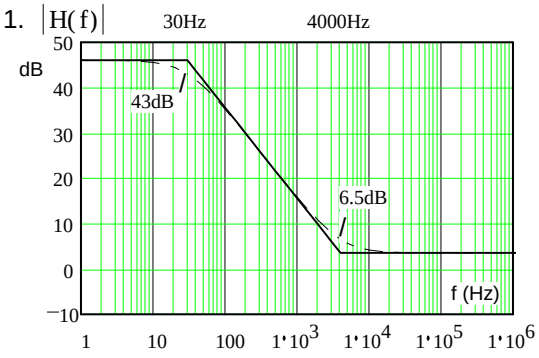
b) $50\cdot mA \quad -1500\cdot\frac{A}{sec}$

c) $10\cdot V \quad -50000\cdot\frac{V}{sec}$

3. a) $\dfrac{\frac{-24\cdot s}{K}\cdot(s+60)}{\left(s^2+90\cdot s+1800+\frac{18}{K}\right)\cdot(1+4\cdot s)}$ b) 900 c) 0 $\quad -60$ d) $-\frac{1}{4}$

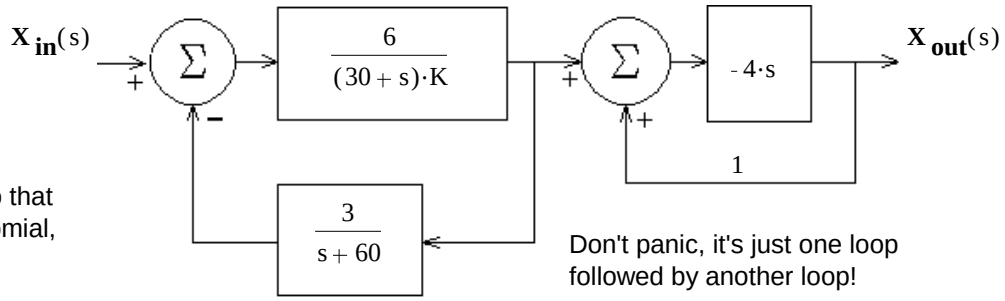
4. a) $35\cdot mA \quad 50\cdot mA \quad 50\cdot mA \quad -5\cdot mA$ b) no $\quad -5\cdot mA < 0$ c) yes $\quad 0.6\cdot V < 0.7V$ d) yes $\quad 50\cdot mA > 0$

1.



3. (26 pts) a) A feedback system is shown in the figure. What is the transfer function of the whole system, with feedback.

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



Don't panic, it's just one loop followed by another loop!

SHOW YOUR WORK
Simplify your expression for **H(s)** so that the denominator is a simple polynomial, or better still, in a factored form.

$$\frac{6\cdot(s+60)}{(30+s)\cdot K\cdot(s+60)+10}$$

b) Find the value of K to make the transfer function of the first loop critically damped.

c) Does the transfer function have a zero? Answer no or find the s value of that zero.

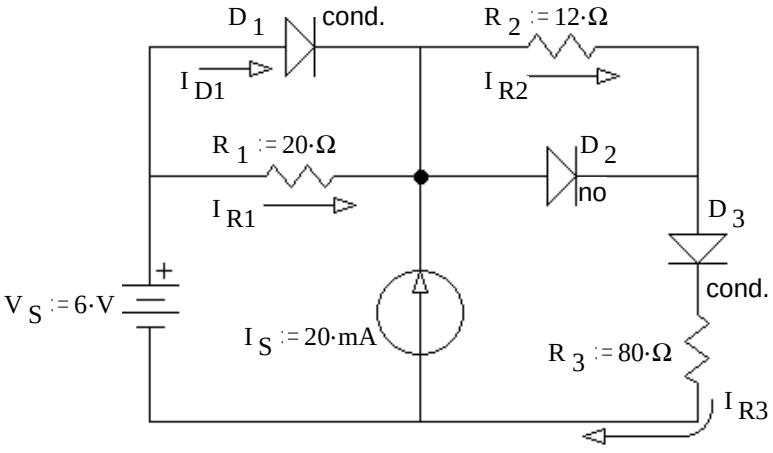
d) Does the transfer function have a pole that doesn't depend on K? Answer no or find the s value of that pole.

4. (24 pts)

a) Assume that diode D_1 & D_3 DO conduct.
Assume that diode D_2 does NOT conduct.

Find I_{R1}, I_{R2}, I_{R3}, I_{D1}, & based on these assumptions. Stick with these assumptions even if your answers come out absurd. Hint: think in nodal voltages.

I_{R1} = ? I_{R2} = ? I_{R3} = ? I_{D1} = ?



b) Based on your numbers above, does it look like the assumption about D_1 was correct? yes no
How do you know? (Specifically show a value which is or is not within a correct range.) (circle one)

c) Based on your numbers, does it look like the assumption about D_2 was correct? yes no
How do you know? (Specifically show a value which is or is not within a correct range.)

d) Based on your numbers above, does it look like the assumption about D_3 was correct? yes no
How do you know?

Answers Are on the Bottom of page 3