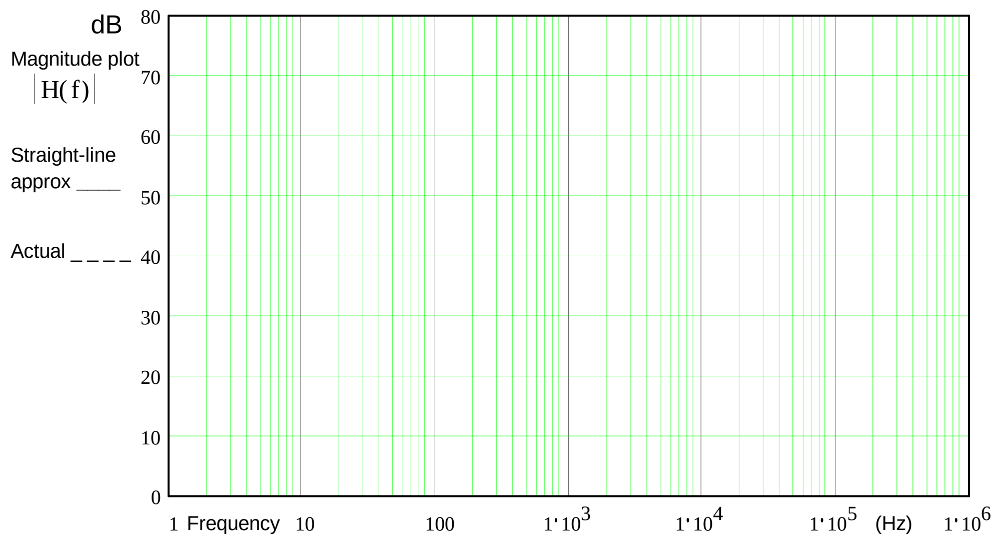
ECE 2210 Exam 3 given: Fall 19

1. (20 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..

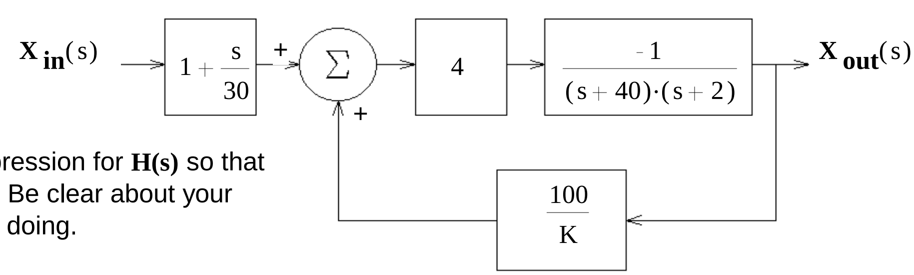
$$H(f) := \frac{(200\cdot \text{kHz} + 10\cdot j\cdot f)\cdot\left(\frac{j\cdot f}{1200\cdot \text{Hz}}\right)}{j\cdot\frac{f}{2} + 30\cdot \text{Hz}}$$



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 arrow(s)) and write down the actual magnitude(s) at that (those) point(s).

2. (20 pts) a) A feedback system is shown in the figure. What is the transfer function of the whole system, with feedback.

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

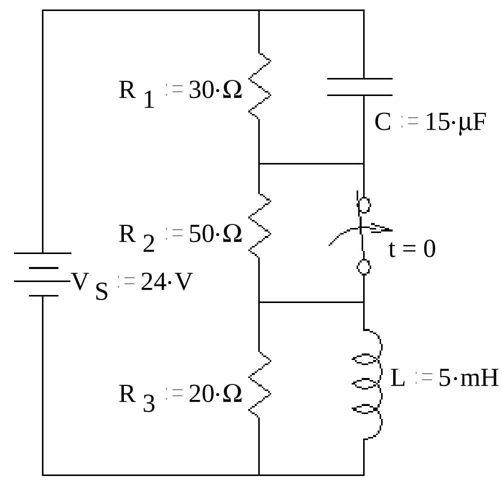


SHOW YOUR WORK. Simplify your expression for $\mathbf{H(s)}$ so that the denominator is a simple polynomial. Be clear about your signs, so I can tell you know what you're doing.

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

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

d) If $K := 4$, find the pole(s) of the transfer function:



3. (30 pts) The switch has been open for a long time and is closed (as shown) at time $t = 0$. SHOW YOUR WORK, no credit for guesses!

   a) What are the final conditions of i_L and the v_C?
   $i_L(\infty) = ?$ $v_C(\infty) = ?$

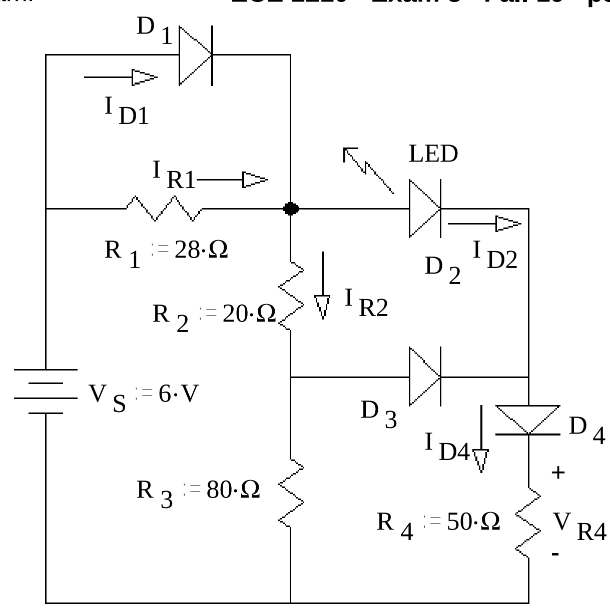
   b) Find the initial condition and initial slope of i_L that you would need to have in order to find all the constants in $i_L(t)$. Don't find $i_L(t)$ or it's constants, just the initial conditions.

   c) Find the initial condition and initial 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.

Use constant-voltage-drop models for the diodes and LEDs on this exam.

4. (30 pts) Assume that diodes D_1, D_2 and D_4 **DO conduct.**

Assume that diode D_3 does **NOT** conduct.



a) Stick with these assumptions even if your answers come out absurd. Find the following and anything else you need in order to check the assumptions:
I_{R1} = ? V_{R4} = ? I_{D4} = ? I_{R2} = ? I_{D1} = ?

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

c) Was the assumption about D_2 correct? yes no (circle one)
How do you know? (Show a value & range.)

d) Was the assumption about D_3 correct? yes no
How do you know? (Show a value & range.)

d) Was the assumption about D_3 correct? yes no
How do you know? (Show a value & range.)

e) Was the assumption about D_4 correct? yes no
How do you know? (Show a value & range.)

f) Based on your answers to parts b), c), d) & e), Circle one:

i) The ***real*** $I_{D4} < I_{D4}$ calculated in part a.

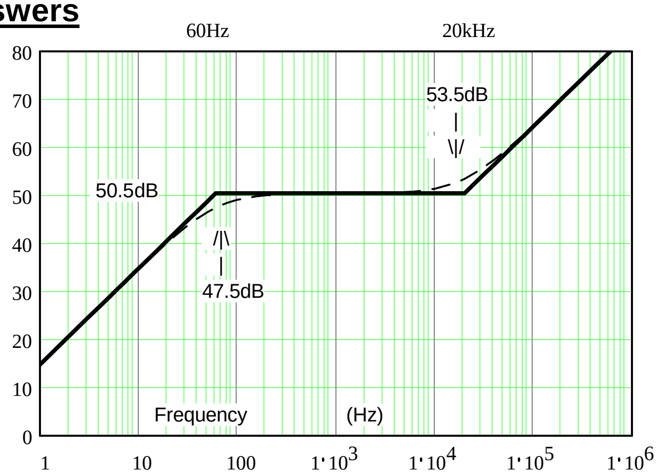
ii) The ***real*** $I_{D4} = I_{D4}$ calculated in part a.

iii) The ***real*** $I_{D4} > I_{D4}$ calculated in part a.

Justify your answer.

Answers

1.



2. a) $\dfrac{-\frac{4}{30}\cdot(s+30)}{s^2+42\cdot s+80+\frac{400}{K}}$ b) 1.11 c) -30 d) -4.85 -37.16

3. a) $800\cdot mA$ $24\cdot V$ b) $300\cdot mA$ $3000\cdot\frac{A}{sec}$ c) $9\cdot V$ $50000\cdot\frac{V}{sec}$

4. a) $25\cdot mA$ $2.6\cdot V$ $52\cdot mA$ $53\cdot mA$ $80\cdot mA$

b) yes $I_{D1} := 80\cdot mA > 0$ c) yes $I_{D2} := 52\cdot mA > 0$

d) no $V_{D3} := 0.94\cdot V > 0.7V$ e) yes $I_{D4} := 52\cdot mA > 0$

f) ii) $V_{D4} = V_{R4}$, which doesn't depend on the current through D_3