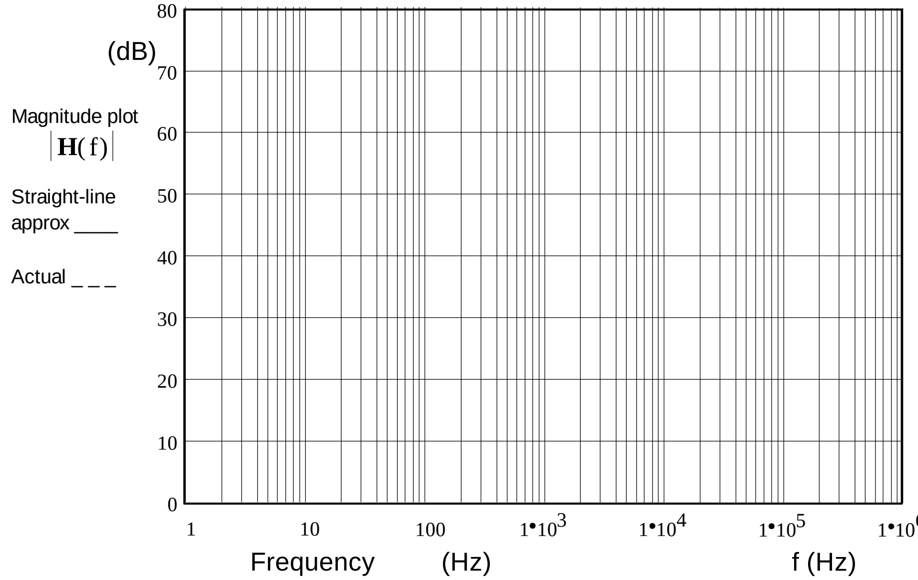
ECE 2210 Exam 3 given: Spring 19

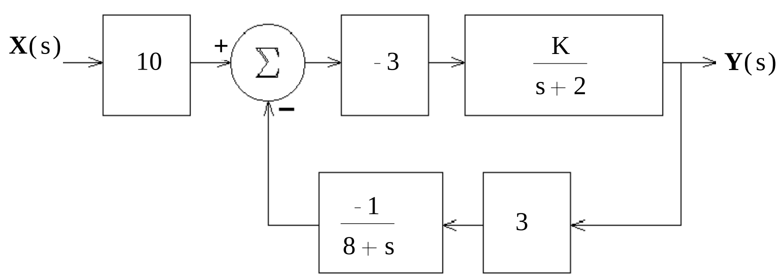
1. (22 pts) a) Draw the asymptotic Bode plot (the straight-line approximation) of the transfer function below. Accurately draw it on the graph provided.
   You must show and use the method from the class notes to get the Bode plot. That is, show things like the corner frequency(ies) , the approximations of the transfer function in each frequency region, calculations of dB, etc..

$$\mathbf{H}(f) := \frac{(j\cdot f + 20\cdot Hz)\cdot\left(30 + \frac{j\cdot f}{1\cdot kHz}\right)}{3\cdot j\cdot f}$$



   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).
   c) If there are any corners in the Bode plot associated with **poles** in the transfer function, list that/those corner frequency(ies) here (f_p).
   d) If there are any corners in the Bode plot associated with **zeroes** in the transfer function, list that/those corner frequency(ies) here (f_z).

2. (22 pts) a) A feedback system is shown in the figure. What is the transfer function of the whole system, with feedback.



$$\mathbf{H}(s) = \frac{\mathbf{Y}(s)}{\mathbf{X}(s)} = ?$$

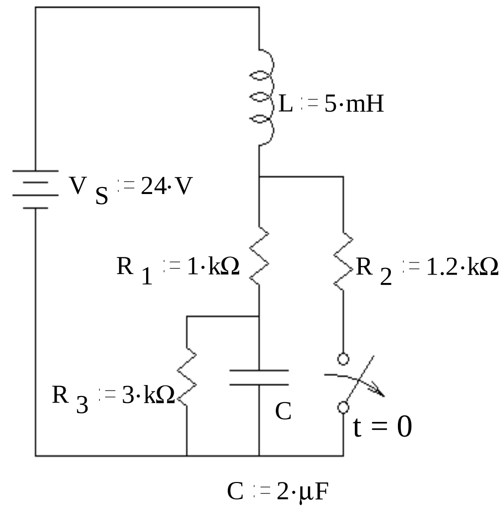
   Simplify your expression for $\mathbf{H}(s)$ so that the denominator is a simple polynomial.

   b) Find the value of K to make the transfer function critically damped. Answer may be left as a fraction.

   c) If $K := 5$, find the pole(s) of the transfer function:

   d) If $K := 5$, find the zero(s) of the transfer function:

3. (30 pts) The switch has been closed for a long time and is opened (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.

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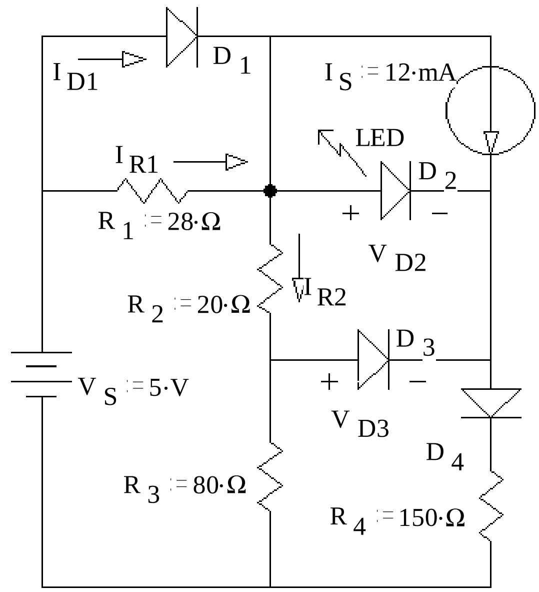
Use constant-voltage-drop models for the diodes and LEDs on this exam.



4. (26 pts) Assume that diodes D_1 and D_4 **DO** conduct.

Assume thatdiodes D_2 and D_3 **DO NOT** conduct.

a) Find I_{R2}, I_{D2}, I_{D1}, & V_{D3} based on these assumptions. Stick with these assumptions even if your answers come out absurd.

I_{R1} = ____________ V_{D2} = ____________

I_{D1} = ____________ V_{D3} = ____________

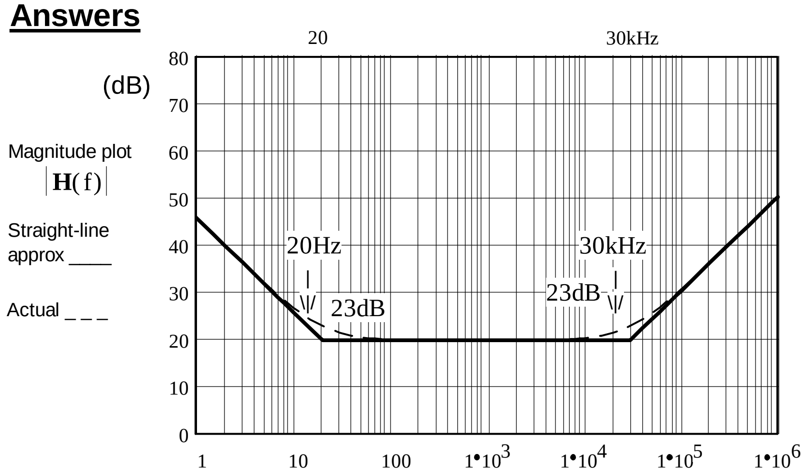
b) Based on the numbers above, was the assumption about D_1 correct? yes no (circle one)
How do you know? (Specifically show a value which is or is not within a correct range.)

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?

e) Was the assumption about D_4 correct? yes no How do you know?

Answers



2. a) $\dfrac{-30 \cdot K \cdot (s+8)}{s^2 + 10 \cdot s + 16 + 9 \cdot K}$ b) 1 c) $-5 \pm 6j$ d) -8

3. a) $18 \cdot V$ $6 \cdot mA$ b) $26 \cdot mA$ $-4000 \cdot \dfrac{A}{sec}$
c) $18 \cdot V$ $10000 \cdot \dfrac{V}{sec}$

4. a) $25 \cdot mA$ $30 \cdot mA$ $1.8 \cdot V$ $0.94 \cdot V$
b) $I_{D1} = 30 \cdot mA > 0$ yes
c) $V_{D2} = 1.8 \cdot V < 2V$ yes
d) $V_{D3} = 0.94 \cdot V > 0.7V$ no
e) $I_{D3} = 12 \cdot mA > 0$ yes