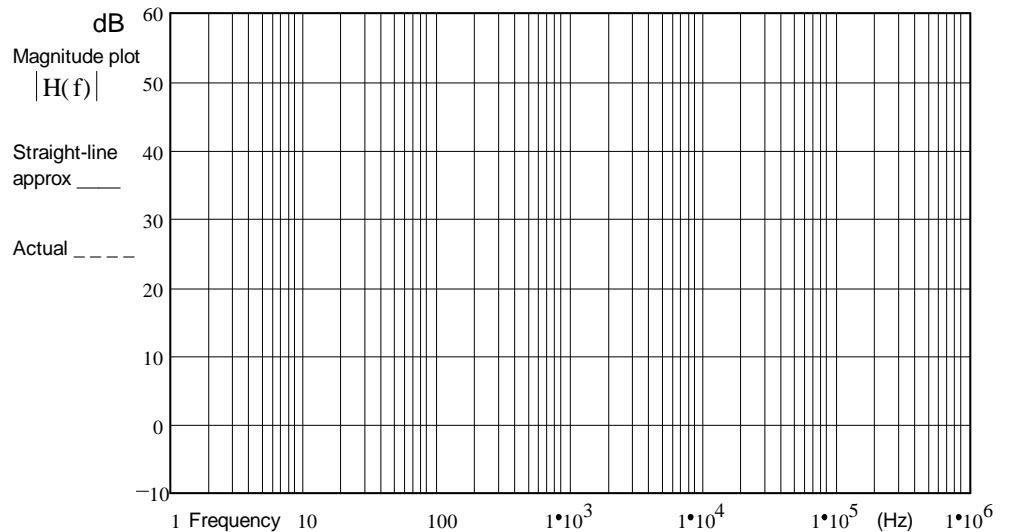


ECE 2210 Exam 3 given: Spring 17

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 the steps you use 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..

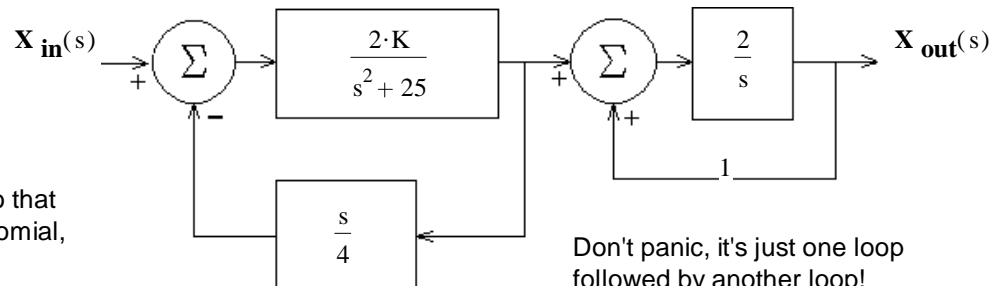
$$H(f) := \frac{4000 \cdot \text{Hz} \cdot j \cdot f}{(1 \cdot \text{Hz} + 0.05 \cdot j \cdot f) \cdot \left(1 \cdot \text{kHz} + \frac{j \cdot f}{30}\right)}$$



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

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



SHOW YOUR WORK

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

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

c) If K is the value you found in part b), find **all** the poles of this system.

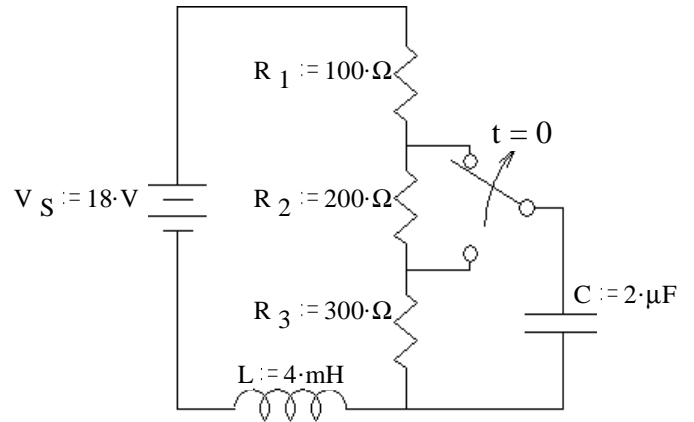
d) Does the transfer function have a pole that doesn't depend on K ?

Answer no or find the s value of that pole.

3. (28 pts) The switch has been down for a long time and is switched up (as shown) at time $t = 0$.

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

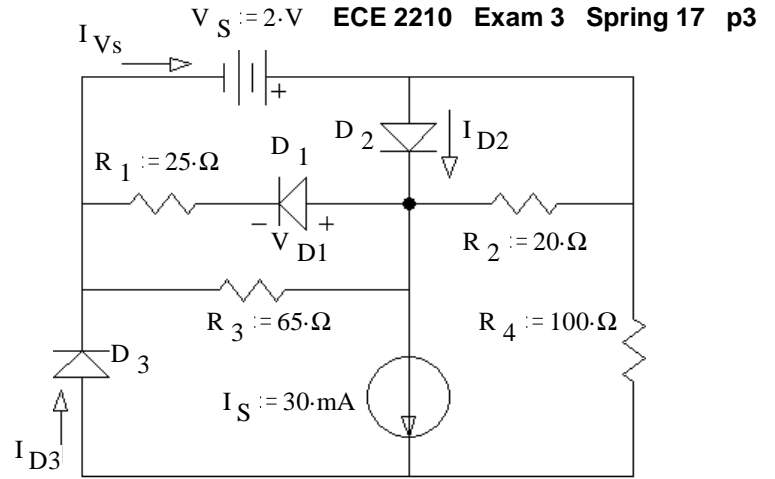
$$i_L(\infty) = ? \quad v_C(\infty) = ?$$



b) Find the initial condition and 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.

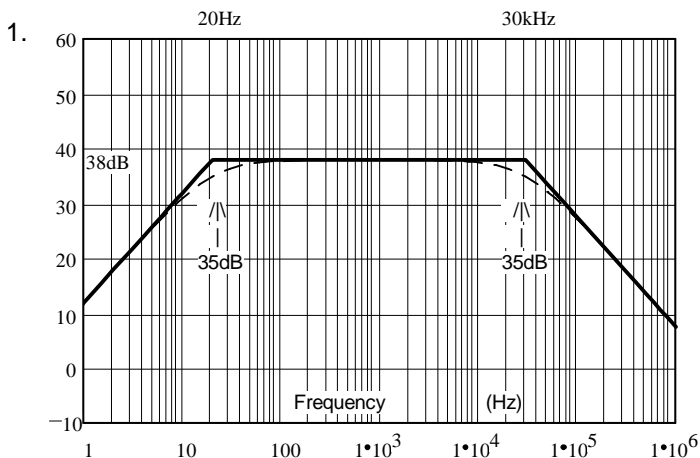
4. (26 pts) Assume that diode D_1 does **NOT** conduct.
 Assume that diodes D_2 and D_3 **DO** conduct.
 a) Stick with these assumptions even if your answers come out absurd. Find the following:
 $V_{D1} = ?$ $I_{D2} = ?$ $I_{D3} = ?$ $I_{V_S} = ?$



Hint: left side of circuit is a good place for ground.

- b) Based on the numbers above, was the assumption about D_1 correct? Circle one: yes no
 How do you know? (Show a value & range.)
- c) Based on the numbers above, was the assumption about D_2 correct? Circle one: yes no
 How do you know? (Show a value & range.)
- d) Based on the numbers above, was the assumption about D_3 correct? Circle one: yes no
 How do you know? (Show a value & range.)

Answers



2. a) $\frac{4 \cdot K}{\left(s^2 + \frac{K}{2} \cdot s + 25\right) \cdot (s - 2)}$ b) 20
- c) -5 , -5 , 2 d) s = 2
3. a) 30·mA 15·V b) 30·mA $1500 \cdot \frac{A}{sec}$
- c) 9·V $6000 \cdot \frac{V}{sec}$
4. a) 1.3·V 15·mA 43·mA 63·mA
- b) $V_{D1} = 1.3 \cdot V > 0.7V$ no
- c) $I_{D2} = 15 \cdot mA > 0$ yes
- d) $I_{D3} = 43 \cdot mA > 0$ yes