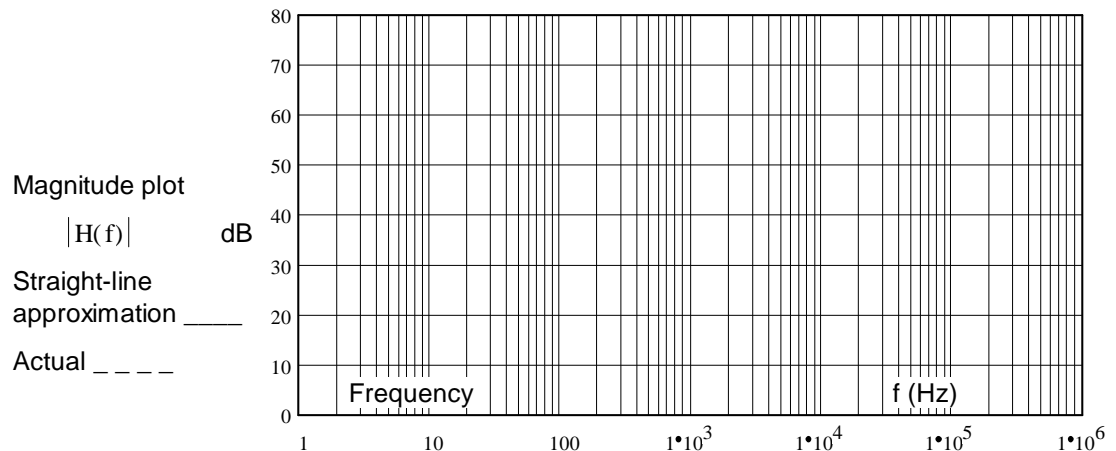


# ECE 2210 Exam 3 given: Spring 16

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.

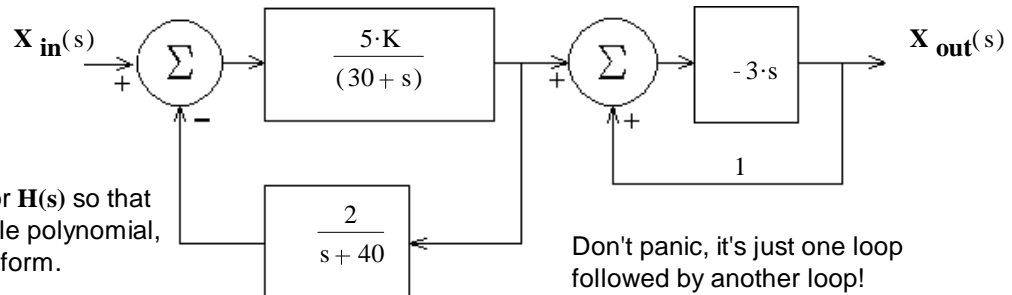
You must show and use the method from the class notes to get the Bode plot. That is, show things like the corner frequency(ies), the approximations of the transfer function in each frequency region, calculations of dB, etc..

$$H(f) := \frac{(1000 \cdot j \cdot f + 20000 \cdot \text{Hz})}{j \cdot f \cdot \left(20 + \frac{j \cdot f}{2 \cdot \text{kHz}}\right)}$$



- 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

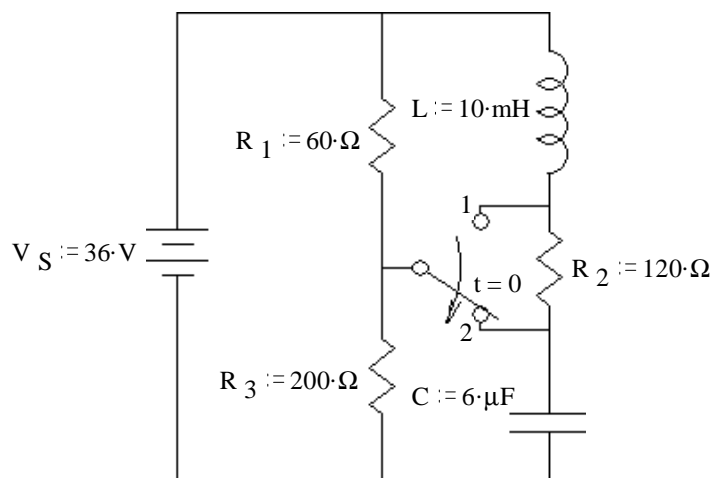
Simplify your expression for  $H(s)$  so that the denominator is a simple polynomial, or better still, in a factored form.

- b) Find the value of  $K$  to make the transfer function of the first loop critically damped.
- c) Does the transfer function have a zero? Answer no or find the  $s$  value of the zero(s).
- 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. (34 pts) The switch has been up in position 1 for a long time and is switched down to position 2 (as shown) at time  $t = 0$ .

SHOW YOUR WORK, no credit for guesses!

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

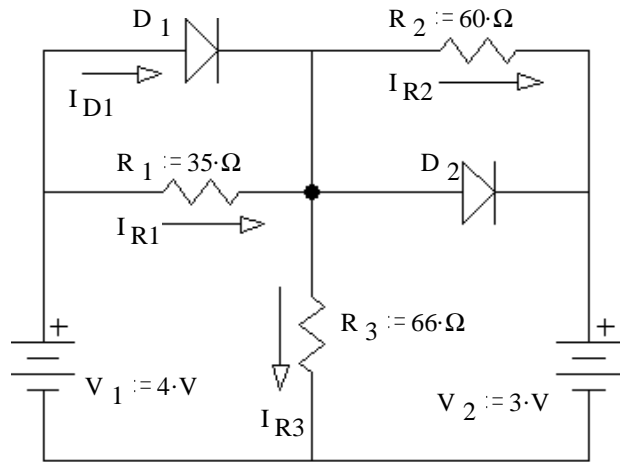


3, continued

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. (20 pts) Assume that diode  $D_1$  does conduct.  
 Assume that diode  $D_2$  does NOT conduct.  
 a) Find  $I_{R1}$ ,  $I_{R2}$ ,  $I_{R3}$ , &  $I_{D1}$  based on these assumptions.  
 Stick with these assumptions even if your answers come out absurd.

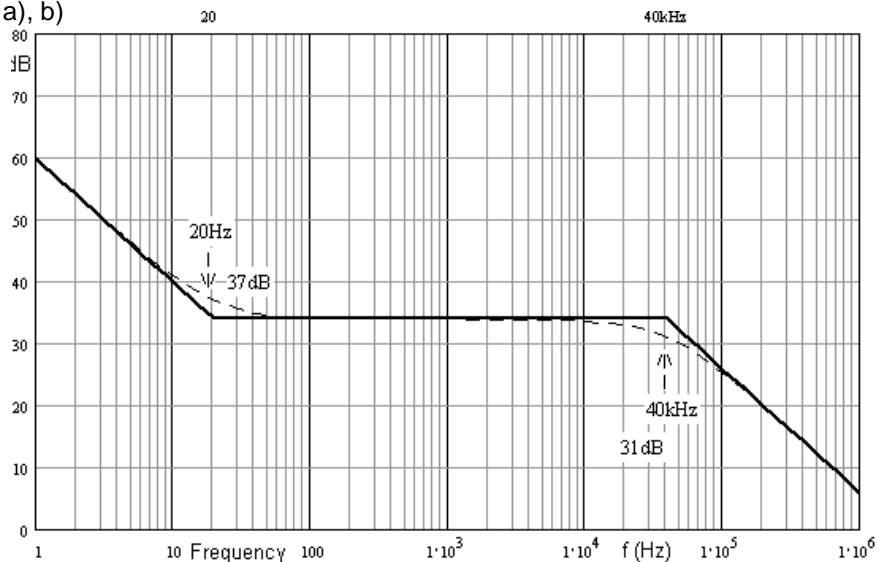


b) Was the assumption about  $D_1$  correct?    yes    no    (circle one)  
 How do you know? (Specifically show a value which is or is not within a correct range.)

c) Was the assumption about  $D_2$  correct?    yes    no    (circle one)    How do you know?

**Answers**

1. a), b)



2. a)  $\frac{-15 \cdot K \cdot s \cdot (s + 40)}{(s^2 + 70 \cdot s + 1200 + 10 \cdot K) \cdot (1 + 3 \cdot s)}$

b) 2.5    c) 0    -40    d)  $-\frac{1}{3}$

3. a) 50 mA    30 V

b) 180 mA     $-2160 \cdot \frac{A}{sec}$

c) 36 V     $0 \cdot \frac{V}{sec}$

4. a) 20 mA    5 mA    50 mA    35 mA

b) yes    35 mA > 0

c) yes    0.3 V < 0.7 V