

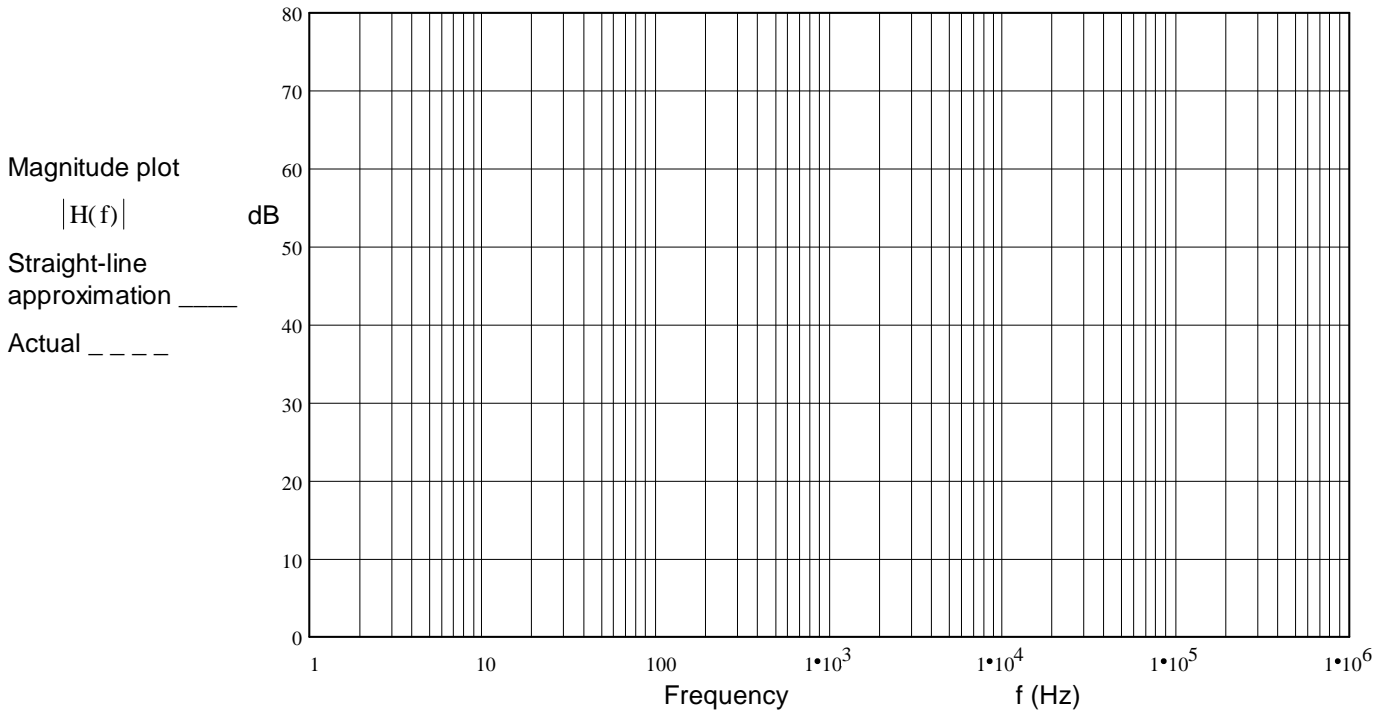
ECE 2210/00 Exam 3 given: Fall 12

(The space between problems has been removed.)

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..

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



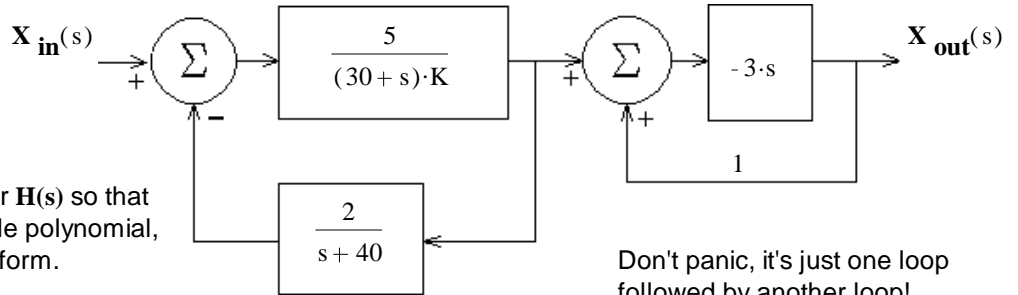
- b) The asymptotic Bode plot is not exact. Using a dotted line, sketch the actual magnitude of the transfer function $|H(f)|$ on the plot above. Indicate the point(s) where the difference between the two lines is the biggest (draw arrow(s)) and write down the actual magnitude(s) at that (those) point(s).

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.



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

- 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.

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3. (32 pts) The switch has been open for a long time and is closed (as shown) at time $t = 0$.

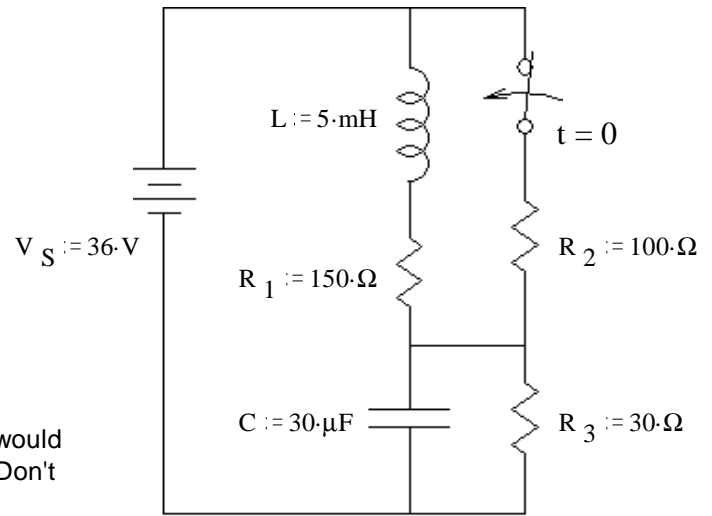
SHOW YOUR WORK, no credit for guesses!

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

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

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. (22 pts) Analysis of a circuit (not pictured) yields the characteristic equation below.

$$0 = s^2 + 120 \cdot s + 66100$$

$$R := 20 \cdot \Omega$$

$$L := 60 \cdot \text{mH}$$

$$C := 20 \cdot \mu\text{F}$$

Further analysis yields the following initial and final conditions:

$$i_L(0) = 100 \cdot \text{mA}$$

$$v_L(0) = -9 \cdot \text{V}$$

$$v_C(0) = 8 \cdot \text{V}$$

$$i_C(0) = 70 \cdot \text{mA}$$

$$i_L(\infty) = 600 \cdot \text{mA}$$

$$v_L(\infty) = 0 \cdot \text{V}$$

$$v_C(\infty) = 2 \cdot \text{V}$$

$$i_C(\infty) = 0 \cdot \text{mA}$$

Write the full expression for $i_L(t)$, including all the constants that you find.

$$i_L(t) = ?$$

Answers

1.

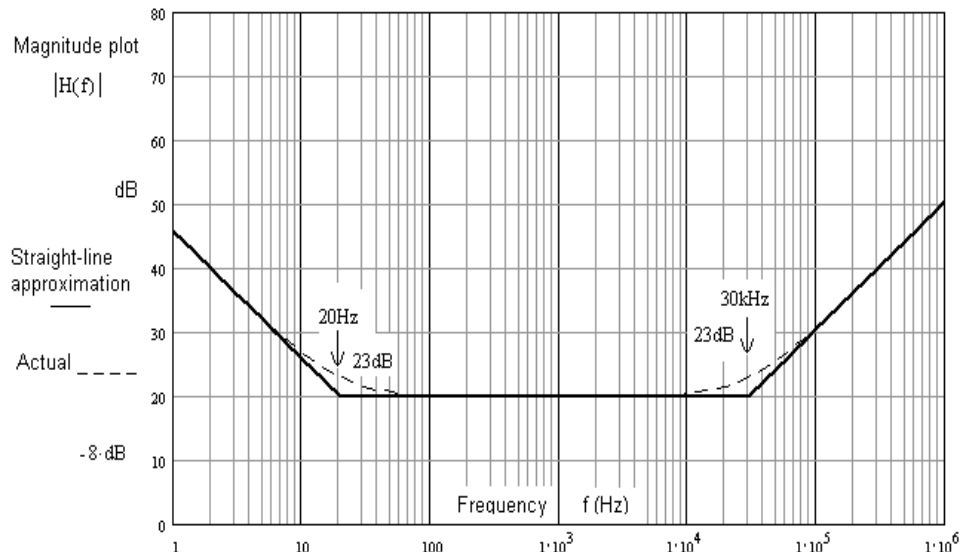
2. a)
$$\frac{-15 \cdot s}{K} \cdot (s + 40)}{\left(s^2 + 70 \cdot s + 1200 + \frac{10}{K}\right) \cdot (1 + 3 \cdot s)}$$

b) 0.4 c) 0 -40 d) $-\frac{1}{3}$

3. a) 160·mA 12·V

b) 200·mA $0 \cdot \frac{\text{A}}{\text{sec}}$

c) 6·V $10000 \cdot \frac{\text{V}}{\text{sec}}$



4.
$$i_L(t) := 600 \cdot \text{mA} + e^{-60 \cdot t} \cdot (-500 \cdot \text{mA} \cdot \cos(250 \cdot t) - 720 \cdot \text{mA} \cdot \sin(250 \cdot t))$$