ECE 2210 Exam 3 given: Spring 13

(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..

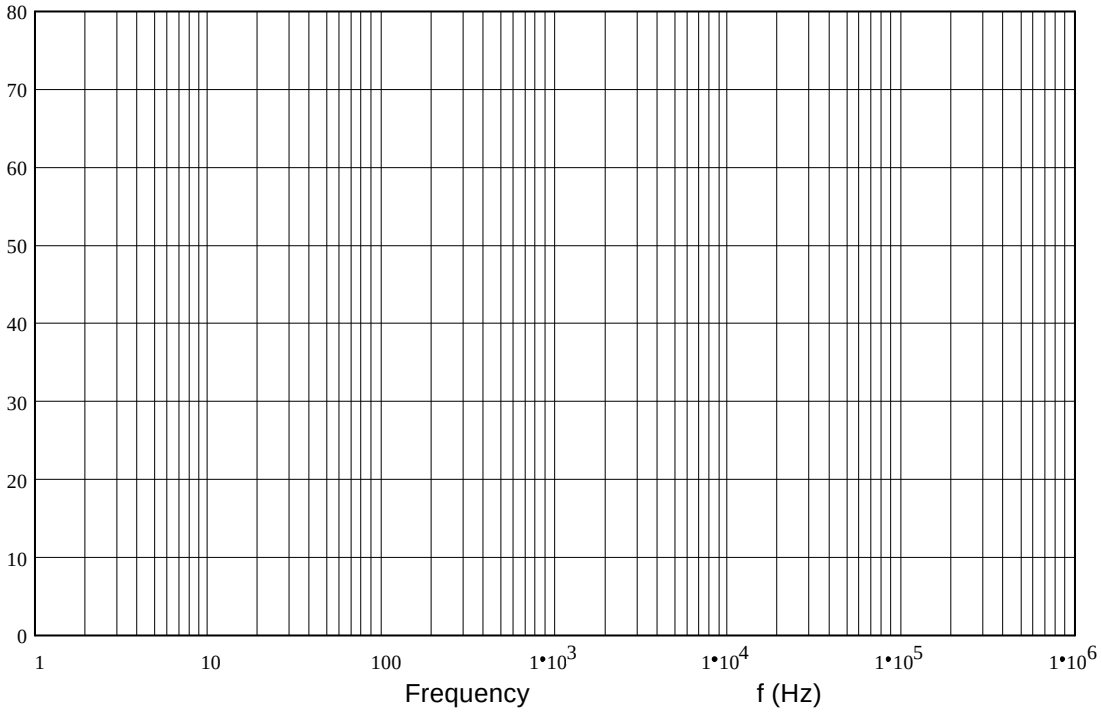
$$H(f) := \frac{(100\cdot kHz + 5\cdot j\cdot f)\cdot\left(\frac{j\cdot f}{800\cdot Hz}\right)}{j\cdot\frac{f}{3} + 20\cdot Hz}$$

Magnitude plot

$|H(f)|$ dB

Straight-line approximation ____

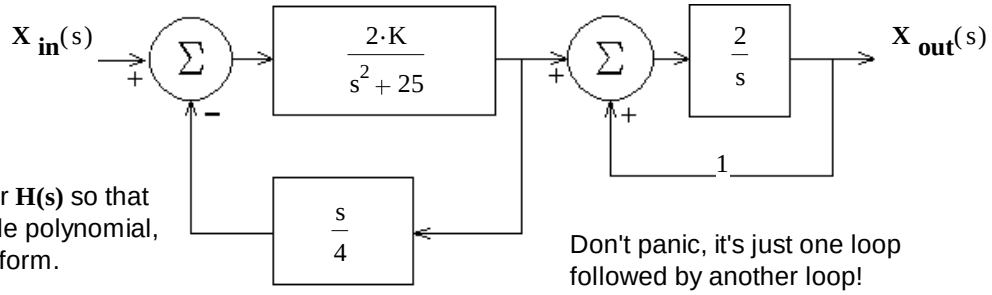
Actual _ _ _ _



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.

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



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) 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.

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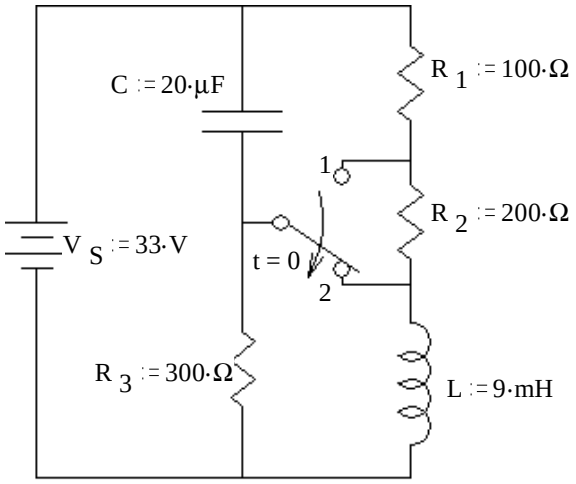
3. (34 pts) The switch has been up in position 1 for a long time and is switched down to position 2 (as shown) at time $t = 0$.

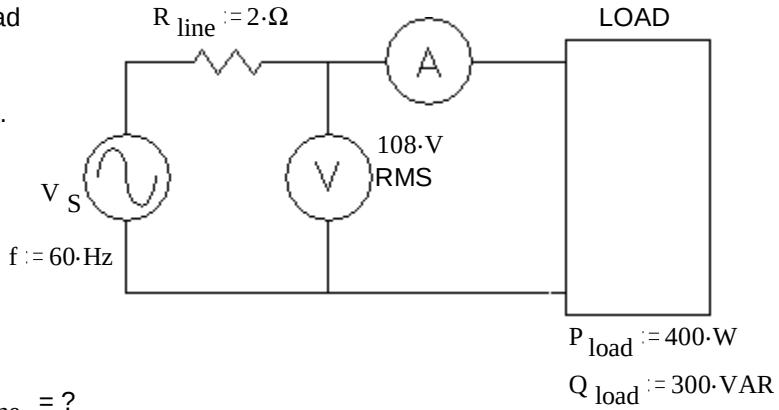


a) What are the final conditions of i_L and the v_C?
$i_L(\infty) = ?$ $v_C(\infty) = ?$

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.

4. (20 pts) A load is connected as shown. The load uses 400W and 300VAR. The RMS voltmeter measures 108 V. Find the following:
Be sure to show the correct units for each value.



a) What does the RMS ammeter measure?

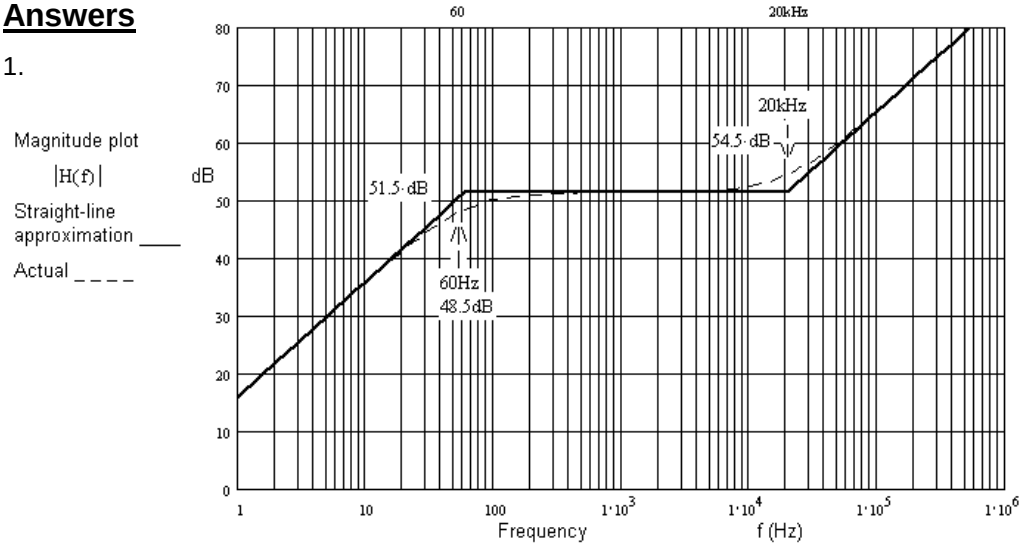
b) The load consists of two parts in series. Draw the parts in the box above and find the values.

c) How much power does R_{line} waste? $P_{Rline} = ?$

d) What is the source voltage? $|V_S| = ?$ Hint: Remember, you can't add magnitudes of complex numbers.

Answers

1.



2. a) $\frac{2 \cdot K}{s^2 + \frac{K}{2} \cdot s + 25} \cdot \frac{2}{s - 2}$ b) 20 c) -5 -5 2 d) 2

3. a) $110 \cdot mA$ $33 \cdot V$ b) $90 \cdot mA$ $2000 \cdot \frac{A}{sec}$ c) $15 \cdot V$ $5000 \cdot \frac{V}{sec}$

4. a) $4.63 \cdot A$ b) $18.7 \cdot \Omega$ $37.1 \cdot mH$ c) $42.9 \cdot W$ d) $115.5 \cdot V$