ECE 2210 Exam 3 given: Spring 10

(The space between problems has been removed.)

1. (24 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..

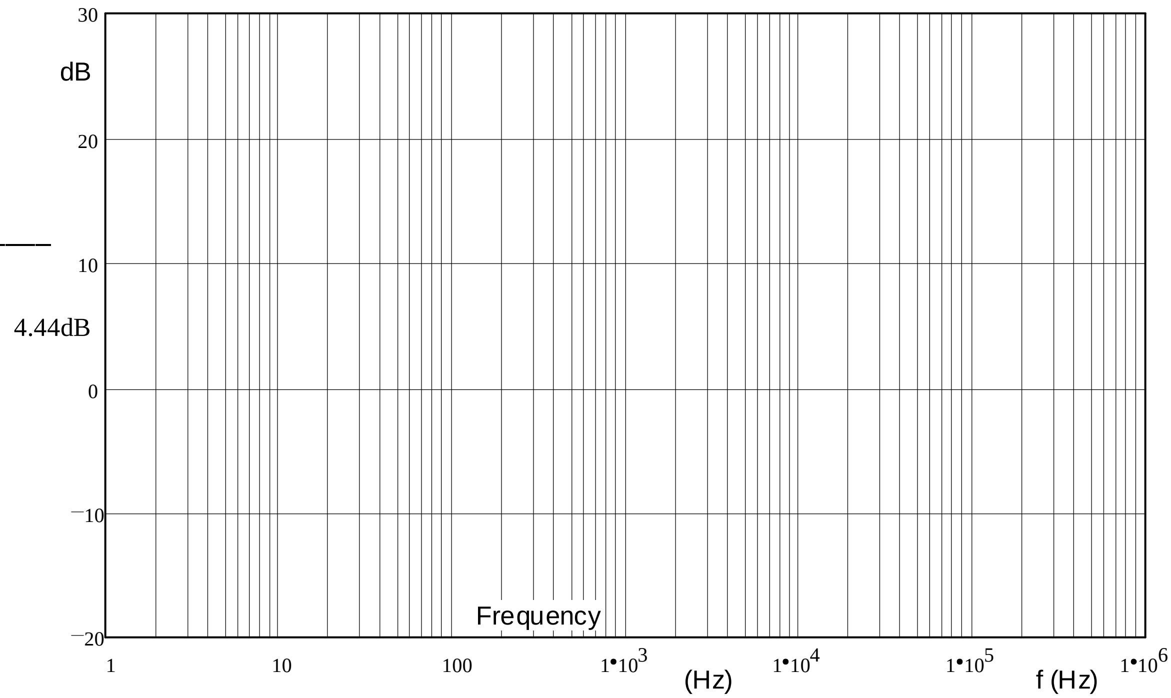
$$H(f) := \frac{1\cdot \text{MHz}\cdot(1\cdot\text{Hz} + 0.05\cdot j\cdot f)}{j\cdot f\cdot(30\cdot\text{kHz} + j\cdot f)}$$

Magnitude plot

$|H(f)|$

Straight-line approximation ____

Actual _ _ _ _



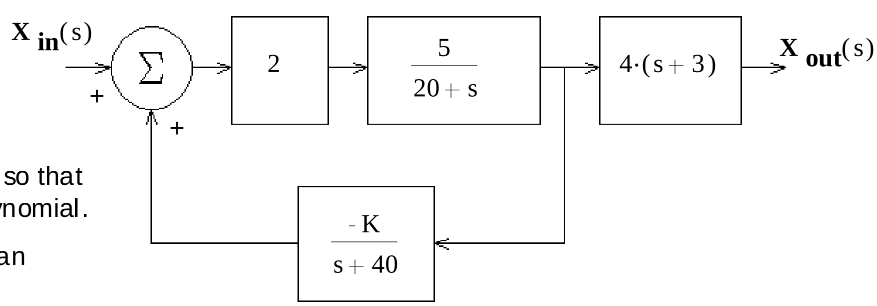
b) The asymptotic Bode plot is not exact. Using a dotted line, sketch the actual magnitude of the transfer function $|H(f)|$ on the plot above. Indicate the point(s) where the difference between the two lines is the biggest (draw arrow(s)) and write down the actual magnitude(s) at that (those) point(s).

c) List any corners in the Bode plot associated with **<u>zeroes</u>** in the transfer function.

d) List any corners in the Bode plot associated with **<u>poles</u>** in the transfer function.

2. (20 pts) a) A feedback system is shown in the figure. What is the transfer function of the whole system, with feedback.

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



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

Be clear about your signs, so I can tell you know what you're doing.

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

c) If K is **less** than this value the system will be: underdamped or overdamped Circle one

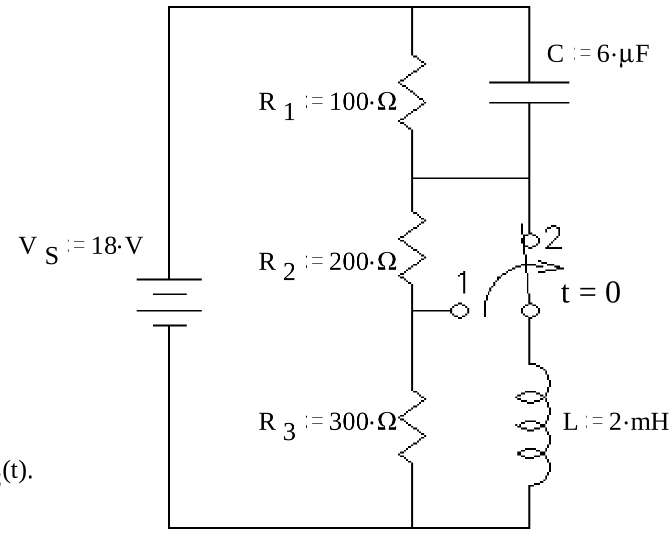
d) Does the transfer function have a zero? Answer "no" or find the s value(s) of the zero(s).

3. (30 pts) The switch has been down in position 1 for a long time and is switched up to postion 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.

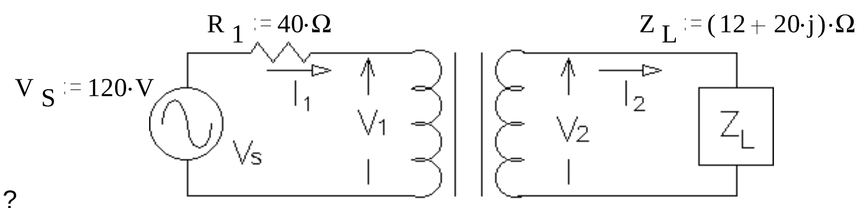


4. (26 pts) The transformer shown in the circuit below is ideal. It is rated at 240/80 V, 100 VA, 60 Hz

   All values are RMS unless specified otherwise.

   Find the following:

   a) The primary current (magnitude). $|\mathbf{I_1}| = ?$



   b) The primary voltage (magnitude). $|\mathbf{V_1}| = ?$

   c) The secondary voltage (magnitude). $|\mathbf{V_2}| = ?$

   d) The power supplied by the source (Vs). $P_S = ?$

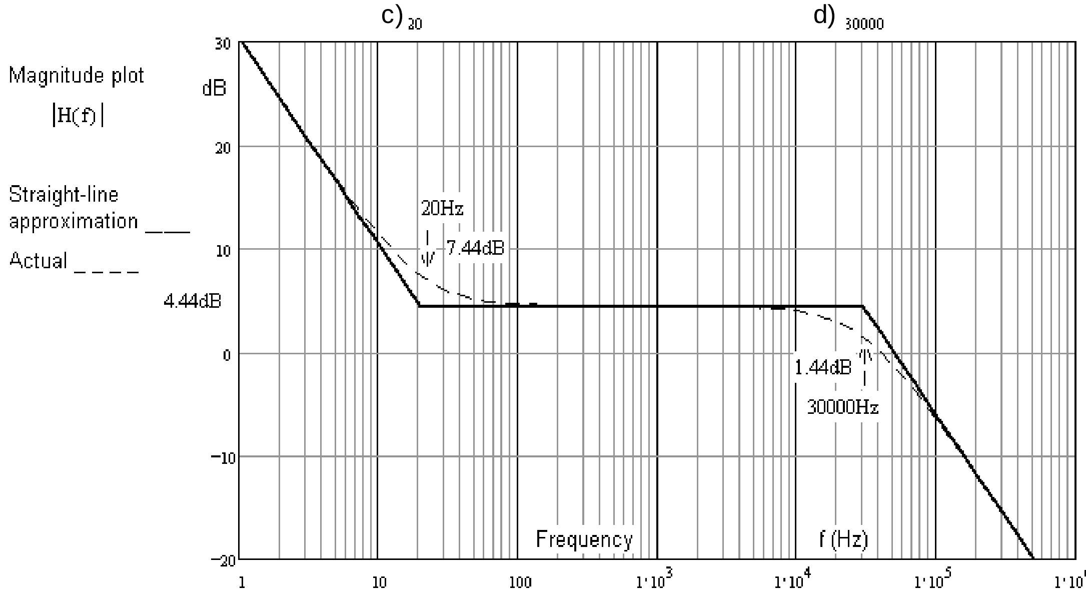
   e) The power factor as seen by the source (Vs). pf = ? leading or lagging?

   f) Is this transformer operating within its ratings? Show your evidence.

Answers

c) 20 d) 30000

1. a) & b)



2. a) $\frac{10\cdot(s+40)}{s^2+60\cdot s+800+10\cdot K}\cdot 4\cdot(s+3)$ b) 10 c) overdamped d) -40 , -3

3. a) $180\cdot mA$ $18\cdot V$ b) $60\cdot mA$ $6000\cdot\frac{A}{sec}$ c) $6\cdot V$ $4000\cdot\frac{V}{sec}$

4. a) $0.515\cdot A$ b) $108\cdot V$ c) $36\cdot V$ d) $39.25\cdot W$ e) 0.705 lagging f) NO, $I_{1max} = \frac{100\cdot VA}{240\cdot V} = 0.417\cdot A < 0.515\cdot A$