ECE 2210 Exam 3 given: Fall 15

(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..

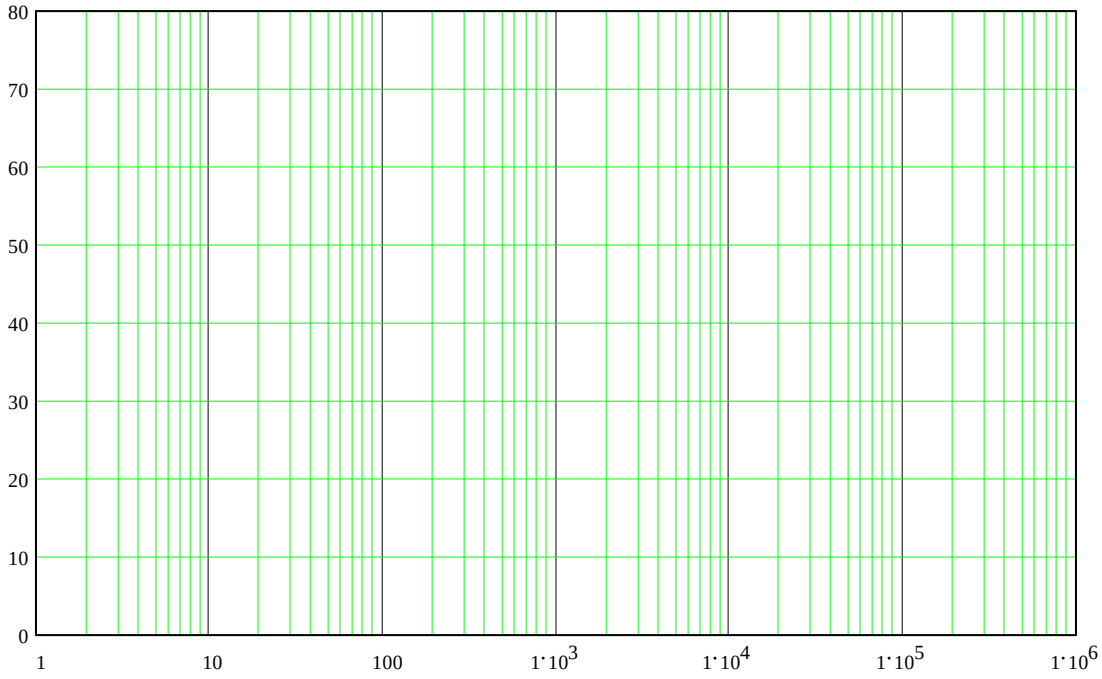
$$H(f) := \frac{(j\cdot f + 20\cdot Hz)\cdot\left(30 + \frac{j\cdot f}{1\cdot kHz}\right)}{3\cdot j\cdot f}$$

Magnitude plot

$|H(f)|$ dB

Straight-line approximation ____

Actual _ _ _ _



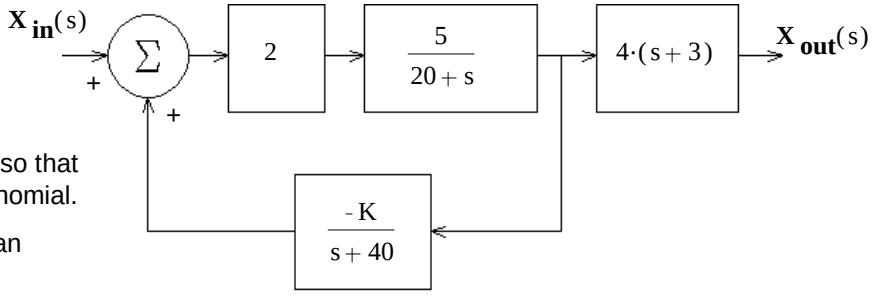
   b) The asymptotic Bode plot is not exact. Using a dotted line, sketch the actual magnitude of the transfer function $|H(f)|$ on the plot above. Indicate the point(s) where the difference between the two lines is the biggest (draw arrow(s)) and write down the actual magnitude(s) at that (those) point(s).

   c) If there are any corners in the Bode plot associated with **poles** in the transfer function, list that/those corner frequency(ies) here (f_p).

   d) If there are any corners in the Bode plot associated with **zeroes** in the transfer function, list that/those corner frequency(ies) here (f_z).

2. (19 pts) a) A feedback system is shown in the figure. What is the transfer function of the whole system, with feedback.

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



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

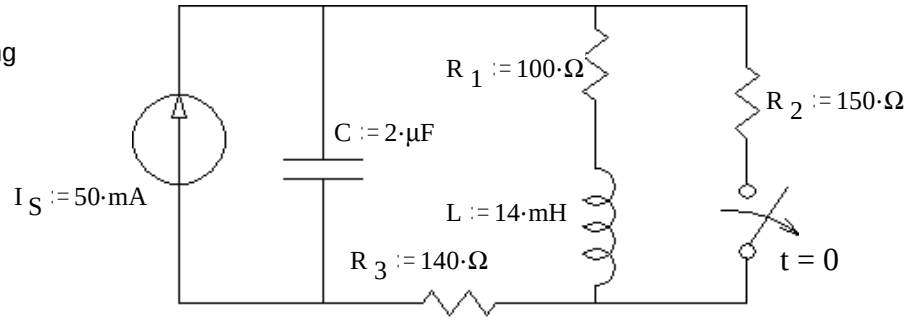
   Be clear about your signs, so I can tell you know what you're doing.

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



SHOW YOUR WORK, no credit for guesses!

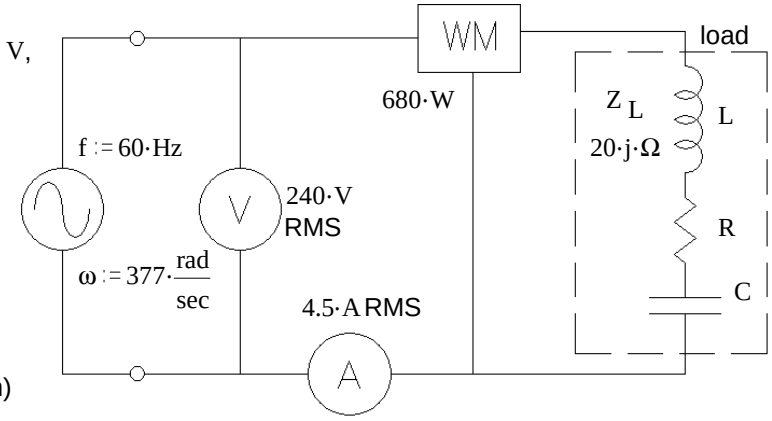
a) What are the final conditions of i_L and the v_C?

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

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. (21 pts) L, R, & C together are the load in the circuit shown. The RMS voltmeter measures 240 V, the RMS ammeter measures 4.5 A, and the wattmeter measures 680 W. Find the following: Be sure to show the correct units for each value.



a) The value of the load resistor. R = ?

b) The apparent power. |S| = ?

c) The magnitude of the reactive power. |Q| = ?
(sign unknown)

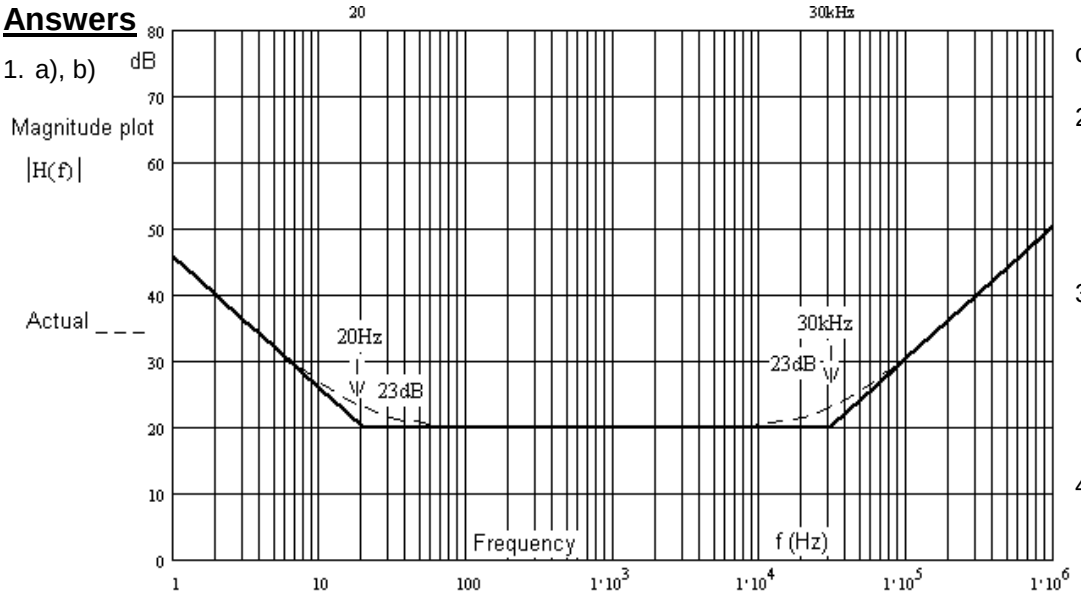
d) The impedance of the capacitor. $\mathbf{Z_C}$ = ?

e) The complex power. **S** = ? f) The power factor. pf = ? g) The power factor is: (circle one) i) leading ii) lagging

h) The two components of the load are in a box which cannot be opened. Add (draw it) another component to the circuit above which can correct the power factor (make pf = 1). Show the correct component in the correct place and find its value. This component should not affect the real power consumption of the load.

Answers

1. a), b)



c) none d) $20\cdot Hz$ $30\cdot kHz$

2. a) $\dfrac{10\cdot(s+40)}{s^2+60\cdot s+800+10\cdot K}\cdot 4\cdot(s+3)$

b) 10 c) overdamped

d) -40 -3

3. a) $50\cdot mA$ $12\cdot V$

b) $30\cdot mA$ $200\cdot\dfrac{A}{sec}$

c) $10\cdot V$ $10000\cdot\dfrac{V}{sec}$

4. a) $33.6\cdot\Omega$ b) $1080\cdot VA$

c) $839\cdot VAR$ d) $-61.43\cdot j\cdot\Omega$

e) $(680 - 839\cdot j)\cdot VA$ f) 0.63

g) Leading, capacitor dominates

h) Add an second inductor of 182mH in parallel with load