ECE 2210 Exam 3 given: Spring 11

(The space between problems has been removed.)

1. (21 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..

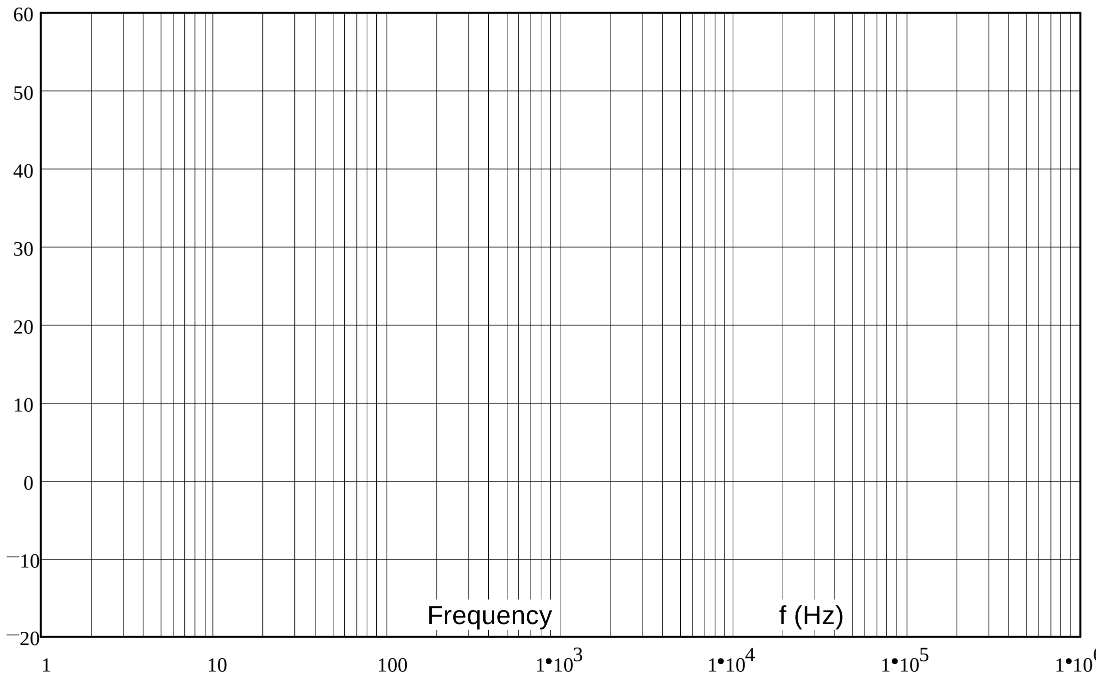
$$H(f) := \frac{1 \cdot kHz + 0.1 \cdot j \cdot f}{3 \cdot Hz + \frac{j \cdot f}{10}}$$

Magnitude plot

$|H(f)|$ dB

Straight-line approximation ____

Actual _ _ _ _



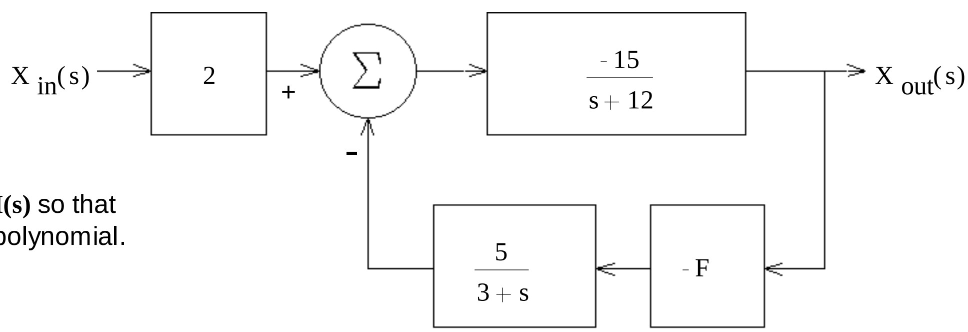
   b) The asymptotic Bode plot is not exact. Using a dotted line, sketch the actual magnitude of the transfer function $|H(f)|$ on the plot above. Indicate the point(s) where the difference between the two lines is the biggest (draw arrow(s)) and write down the actual magnitude(s) at that (those) point(s).

2. (21 pts) a) A feedback system is shown in the figure. What is the transfer function of the whole system, with feedback.

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

SHOW YOUR WORK

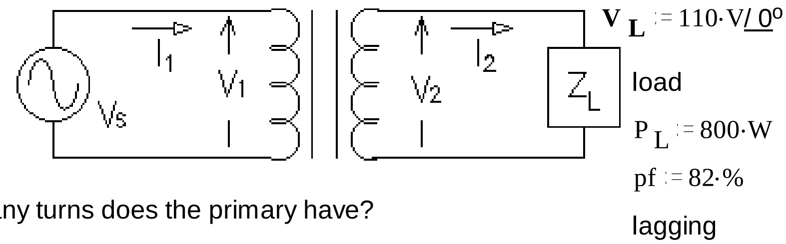
Simplify your expression for **H(s)** so that the denominator is a simple polynomial.



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

   c) If F is **Greater** 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 of that zero.



3. (29 pts) A transformer is rated at 480V / 120V, 1kVA. Assume the transformer is ideal and all voltages and currents are RMS.

   a) What is the current rating of the primary?

   b) The secondary has 150 turns of wire. How many turns does the primary have?

   c) The voltage across the load, $\mathbf{V_L} := 110 \cdot V$ How big is the source voltage ($|\mathbf{V_S}|$)?

   d) The secondary load ($\mathbf{Z_L}$) draws 800W at a power factor of 82%. Find the load, $\mathbf{Z_L}$ (magnitude and angle).

   e) What is the phase angle of the secondary current, $\mathbf{I_2}$?

   f) What is the load as seen by $\mathbf{V_S}$? (magnitude **and <u>angle</u>**)

   g) How much average power does the power source ($\mathbf{V_S}$) supply?

   h) Is this transformer operating within its ratings?
   How do you know? (Specifically show a values which are or are not within a correct range.)

   i) Using the given load voltage and power factor, what is the smallest load impedance magnitude that you could hook to this transformer and still operate within its ratings? $|\mathbf{Z_{Lmin}}| = ?$

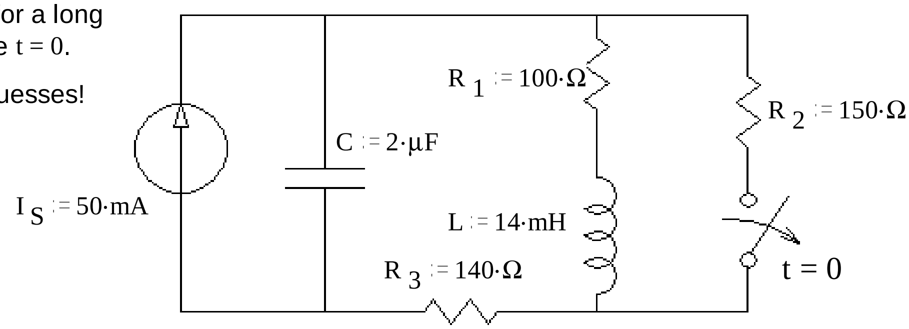
   j) Using the given load voltage and power factor, what is the maximum power that this transformer can deliver to the load and still operate within its ratings?

4. (29 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?

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

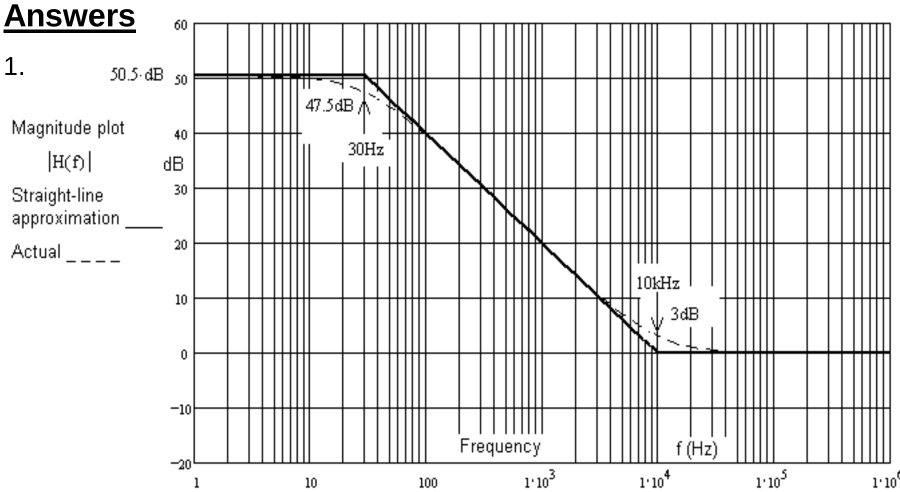


   b) Find the initial condition and initial slope of i_L that you would need to have in order to find all the constants in $i_L(t)$. Don't find $i_L(t)$ or it's constants, just the initial conditions.

   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.

<u>Answers</u>

1.



2. a) $\mathbf{H}(s) = \dfrac{-30 \cdot (s+3)}{s^2 + 15 \cdot s + 36 + 75 \cdot F}$

   b) 0.27 c) underdamped d) s = -3

3. a) 2.08·A b) 600 c) 440·V

   d) 12.4Ω <u>/ 34.9º</u> e) -34.9º

   f) 198.4Ω <u>/ 34.9º</u> g) 800·W

   h) No i) 13.2·Ω j) 752·W

4. a) 50·mA 12·V b) 30·mA $200 \cdot \dfrac{A}{sec}$

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