ECE 2210 Exam 3 given: Fall 13

(The space between problems has been removed.)

1. (20 pts) Analysis of a circuit (not pictured) yields the characteristic equation below.

$0 = s^2 + 800 \cdot s + 160000$ $\quad R_1 := 100 \cdot \Omega$ $\quad R_2 := 20 \cdot \Omega$ $\quad L := 200 \cdot mH$ $\quad C := 40 \cdot \mu F$ $\quad V_{in} := 18 \cdot V$

Further analysis yields the following initial and final conditions:

$i_L(0) = 40 \cdot mA$ $\quad v_L(0) = -12 \cdot V$ $\quad v_C(0) = 5 \cdot V$ $\quad i_C(0) = 60 \cdot mA$

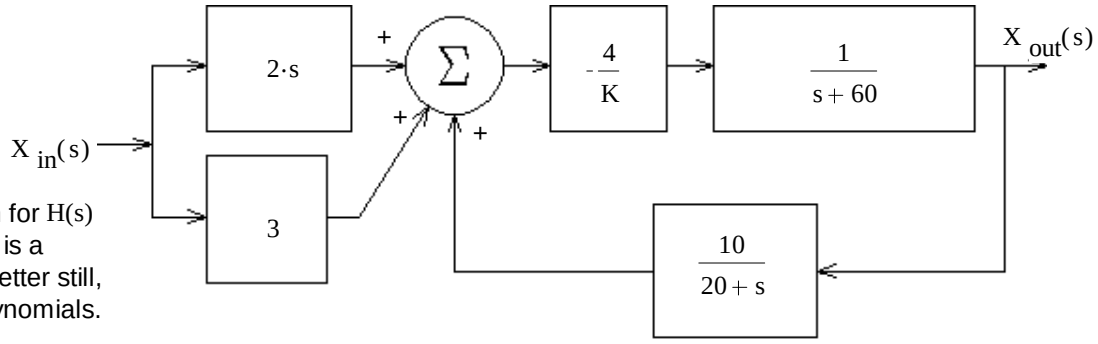
$i_L(\infty) = 120 \cdot mA$ $\quad v_L(\infty) = 0 \cdot V$ $\quad v_C(\infty) = 15 \cdot V$ $\quad i_C(\infty) = 0 \cdot mA$

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

Include **units** in your answer

2. (24 pts) a) A feedback system is shown in the figure. What is the transfer function of the whole system, with feedback.

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



Simplify your expression for $H(s)$ so that the denominator is a simple polynomial, or, better still, a multiple of simple polynomials.

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

c) If K 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(s) of the zero(s).

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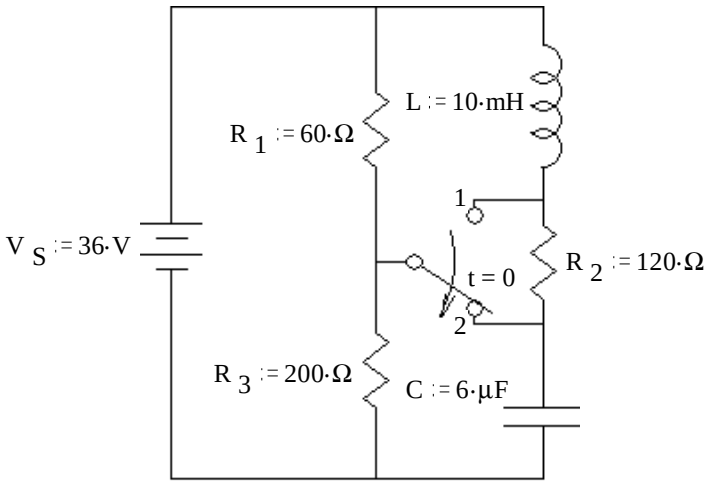
3. (36 pts) The switch has been up in position 1 for a long time and is switched down to postion 2 (as shown) at time $t = 0$.

   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.

4. (20 pts) The transformer shown in the circuit below is ideal. It is rated at 300/100 V, 1.0 kVA, 60 Hz

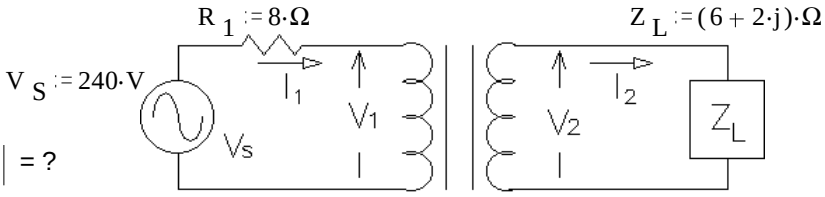
   All values are RMS unless specified otherwise.

   Find the following:

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

   b) The secondary current (magnitude). $|\mathbf{I_2}| = ?$

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



   d) The complex power (P and Q) used by the load. $\mathbf{S_L} = ?$

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

Answers

1. $120\cdot mA - 80\cdot mA\cdot e^{-\frac{400}{sec}\cdot t} - 92\cdot\frac{A}{sec}\cdot t\cdot e^{-\frac{400}{sec}\cdot t}$

2. a) $(2\cdot s + 3)\cdot\dfrac{\frac{-4}{K}\cdot(s + 20)}{s^2 + 80\cdot s + 1200 + \frac{40}{K}}$ b) 0.1 c) overdamped d) -20 $-\left(\frac{3}{2}\right)$

3. a) $50\cdot mA$ $30\cdot V$ b) $180\cdot mA$ $-2160\cdot\frac{A}{sec}$ c) $36\cdot V$ $0\cdot\frac{V}{sec}$

4. a) $3.72\cdot A$ b) $11.15\cdot A$ c) $70.5\cdot V$ d) $746 + 249\cdot j$ VA e) NO $11.15\cdot A > 10\cdot A$