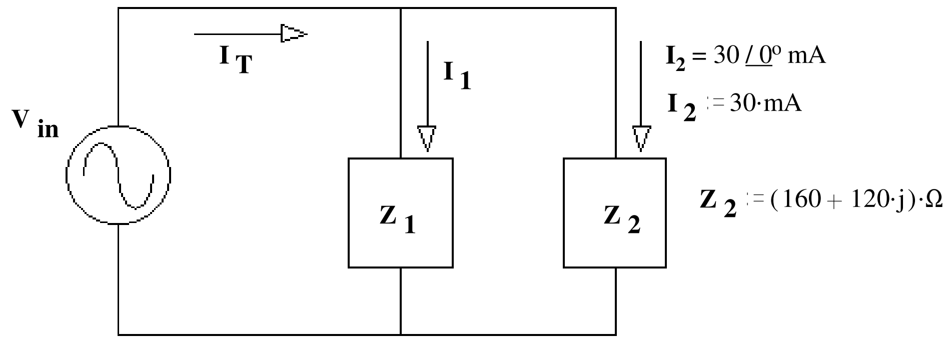
ECE2210 Exam 3 given: Fall 07

(The space between problems has been removed.)

1. (18 pts)

   a) Find $\mathbf{V_{in}}$ in polar form.

   b) Find $\mathbf{I_T}$.



$\mathbf{Z_1} = 100\,\underline{/\,\text{-}32^o}\ \Omega$

   c) Circle 1: i) The source current leads the source voltage

   ii) The source voltage leads the source current

   d) By how much? I.E. what is the phase angle between the voltage and current?

2. (18 pts) Analysis of a circuit (not pictured) yields the characteristic equation below.

$0 = s^2 + 100\cdot s + 42500$ $\qquad R := 10\cdot\Omega \qquad L := 100\cdot\text{mH} \qquad C := 20\cdot\mu\text{F}$

Further analysis yields the followiing initial and final conditions:

$i_L(0) = 120\cdot\text{mA} \qquad v_L(0) = -8\cdot\text{V} \qquad v_C(0) = 6\cdot\text{V} \qquad i_C(0) = 80\cdot\text{mA}$

$i_L(\infty) = 80\cdot\text{mA} \qquad v_L(\infty) = 0\cdot\text{V} \qquad v_C(\infty) = 2\cdot\text{V} \qquad i_C(\infty) = 0\cdot\text{mA}$

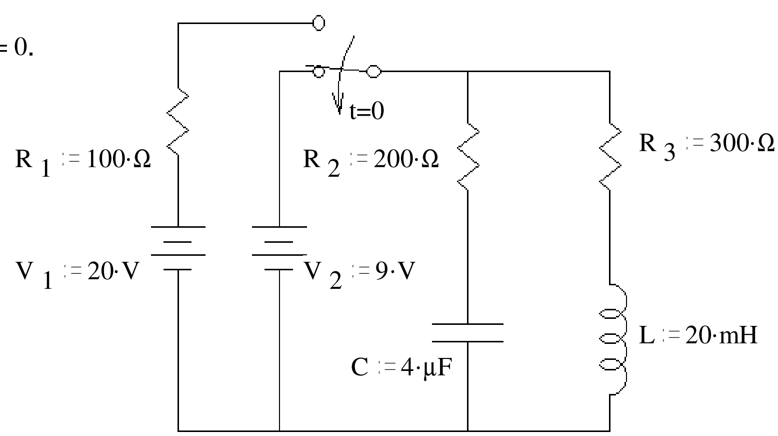
Write the full expression for $i_L(t)$, including all the constants that you find. $\qquad i_L(t) = ?$

3. (22 pts) The switch has been the upper position for a long time and is switched down (as shown) at time $t = 0$.

   Show Units !

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

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

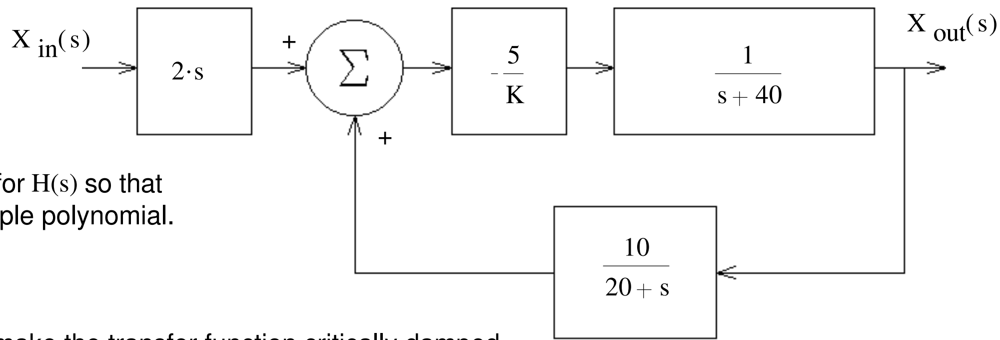


   b) Find the initial condition and initial slope of i_L that you would need to have in order to find all the constants in $i_L(t)$. Don't find $i_L(t)$ or it's constants, just the initial conditions.

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

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



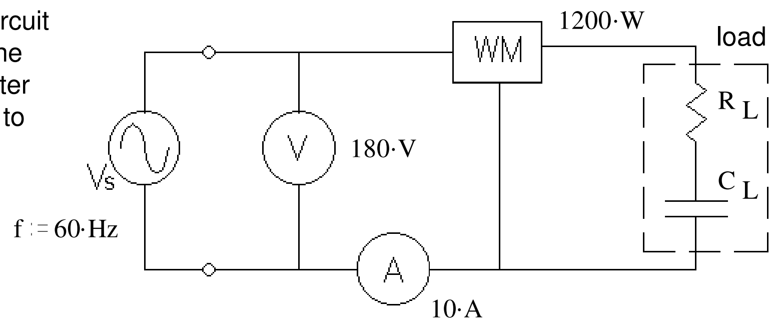
Simplify your expression for $H(s)$ so that the denominator is a simple polynomial.

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).

5. (20 pts) R_L, & C_L together are the load in the circuit shown. The RMS voltmeter measures $180\ V$, the RMS ammeter measures $10\ A$, and the wattmeter measures $1200\ W$. Find the following: Be sure to show the correct units for each value.



a) The real power. P = ?

b) The value of the load resistor. R_L = ?

c) The apparent power. $|\mathbf{S}|$ = ?

d) The reactive power. Q = ?

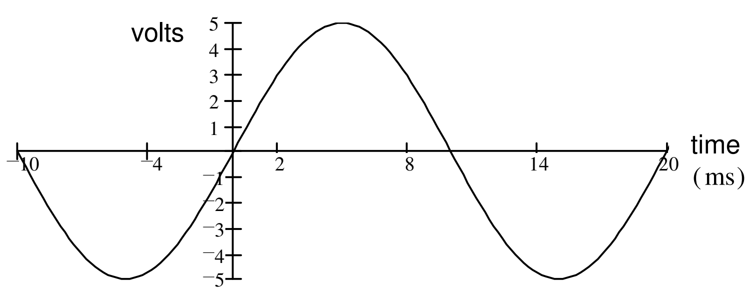
e) The complex power. $\mathbf{S}$ = ?

f) The power factor. pf = ?

g) The power factor is: i) leading ii) lagging (circle one)

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 <u>find its value</u>. This component should not affect the real power consumption of the load.

6. (4 pts) Find:
a) The average, DC (V_{DC}) voltage.
b) The RMS (effective) voltage



<u>Answers</u>

1. a) 6V <u>/36.9°</u> b) 76.1mA <u>/47.3°</u> c) i) d) $10.4\cdot deg$

2. $80\cdot mA + e^{-\frac{50}{sec}\cdot t}\cdot\left(40\cdot mA\cdot\cos\left(\frac{200}{sec}\cdot t\right) - 390\cdot mA\cdot\sin\left(\frac{200}{sec}\cdot t\right)\right)$

3. a) $30\cdot mA$ $9\cdot V$ b) $50\cdot mA$ $-300\cdot\frac{A}{sec}$ c) $15\cdot V$ $-7500\cdot\frac{V}{sec}$

4. a) $2\cdot s\cdot\dfrac{\frac{-5}{K}\cdot(s+20)}{s^2+60\cdot s+800+\frac{50}{K}}$ b) 0.5 c) underdamped d) $s = 0$ $s = -20$

5. a) $1200\cdot W$ b) $12\cdot\Omega$ c) $1.8\cdot kVA$ d) $-1.342\cdot kVAR$ e) $(1.2-1.342\cdot j)\cdot kVAR$ f) .667 g) i) leading h) $64.1\cdot mH$

6. a) $0\cdot V$ b) $3.54\cdot V$