Inter American University of Puerto Rico
Bayamón Campus
School of Engineering
Department of Electrical Engineering

ELEN 3301 – Electric Circuits I

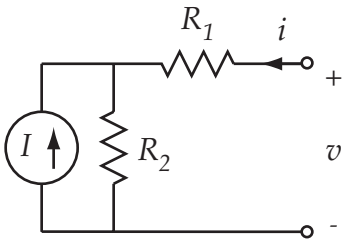
Problem Set 12

Note: Do not hand in. This is a review for the final exam.

Reminder: The final exam will be offered Monday, December 13 and will cover all the material given in class.

Problem 1:

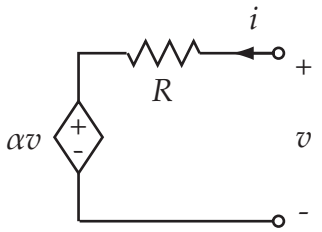
(A) Find the Thevenin equivalent of the circuit shown below when looking into the marked terminals.



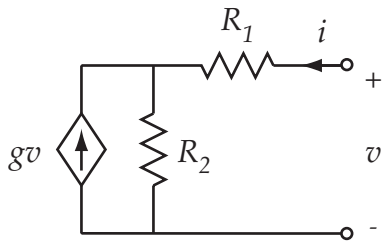
(B) Find the Norton equivalent of the same circuit when looking into the marked terminals.

Problem 2:

(A) Find the equivalent resistance between the marked terminals of the circuit shown below.



(B) Find the equivalent resistance between the marked terminals of the circuit shown below.



Problem 3:

(A) A circuit is described by the differential equation shown below. Provide an algebraic expression for $i_L(t)$ if $i_L(0) = i_0$.

$$L\frac{di_L}{dt} + Ri_L = V_S$$

(B) A circuit is described by the equations below. Provide an algebraic expression for the general solution of $i(t)$ if $i(0) = 0$ and $v(0) = v_0$.

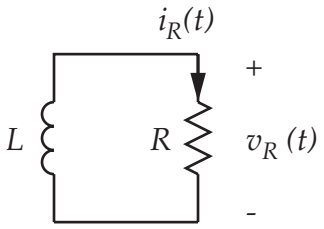
$$C\frac{dv}{dt} + i = 0 \qquad v = L\frac{di}{dt}$$

(C) The voltage $v_C(t)$ across an capacitor with capacitance C is described by the expression shown below. Find an algebraic expression for the current $i_C(t)$ through the same capacitor.

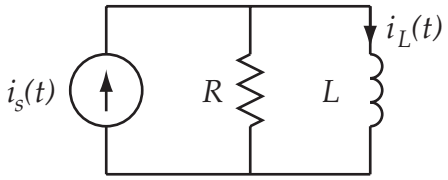
$$v_C(t) = v_0 e^{-\frac{t}{RC}} \cos(\omega t + \phi)$$

Problem 4:

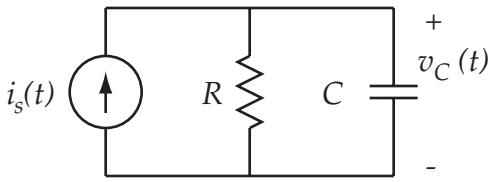
(A) In the circuit below, $i_L(0) = i_0$. Provide an algebraic expression and a *neat* sketch of $i_R(t)$ and $v_R(t)$ for $0 \leq t \leq 3L/R$.



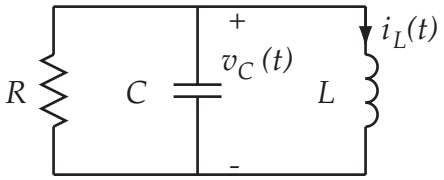
(B) In the circuit below, $i_S(t) = I_S u(t)$ and $i_L(0) = 0$. Provide an algebraic expression and a *neat* sketch of $i_L(t)$ and $v_L(t)$ for $0 \leq t \leq 3L/R$.



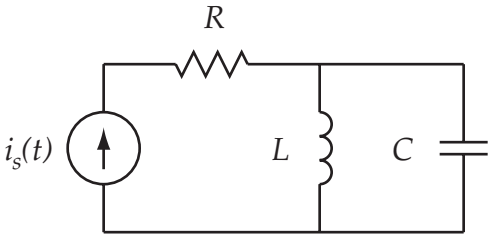
Problem 5: In the circuit below, $i_S(t) = I_S \cos(\omega t)$. Find an algebraic expression for the sinusoidal steady state of $v_C(t)$.



Problem 6: In the circuit below, $v_C(0) = v_0$ and $i_L(0) = i_0$. Find the total power dissipated in the resistor R and the energy stored in the inductor L after all transients have died. Find the energy stored in the resistor as function of time. How much energy does the inductor and the capacitor dissipate after all transients die?



Problem 7: Determine the numerical value of the *time-averaged* power P dissipated in the resistor R of the circuit shown below when $i_S(t)$ and R have the values specified in each part. The following identity might be useful: $\cos^2(\omega t) = \frac{1}{2} + \frac{1}{2}\cos(2\omega t)$. *Hint: An time-average is independent of time.*



(A) $i_S(t) = \sqrt{2}$ A
$R = 1\ \Omega$

(B) $i_S(t) = \sqrt{2}$ A $\cdot \cos(2\pi t)$
$R = 1\ \Omega$