Circuits Process Guidesheet

Topic

Natural Response of RL and RC Circuits

Governing Equations and Assumptions

RL

$$i(t) = I_0 e^{-(R/L)t}$$
$$V_R(t) = I_0 R e^{-2(R/L)t}$$
$$P_R(t) = I_0^2 R e^{-2(R/L)t}$$
$$W_R(t) = \frac{1}{2} L I_0^2 \left(1 - e^{-2(R/L)t}\right)$$

RC

$$v(t) = V_0 e^{-\left(\frac{1}{RC}\right)t}$$
$$i_R(t) = \frac{V_0}{R} e^{-\left(\frac{1}{RC}\right)t}$$
$$P_R(t) = \frac{V_0^2}{R} e^{-\left(\frac{2}{RC}\right)t}$$
$$W_R(t) = \frac{1}{2} C V_0^2 \left(1 - e^{-\left(\frac{2}{RC}\right)t}\right)$$

Circuit Analysis

Process

1. Find I_0 or V_0 (After a "long" time) $\Rightarrow V_{inductor} = 0$, $i_{capacitor} = 0$
2. Apply the equations for the RL or RC Circuit