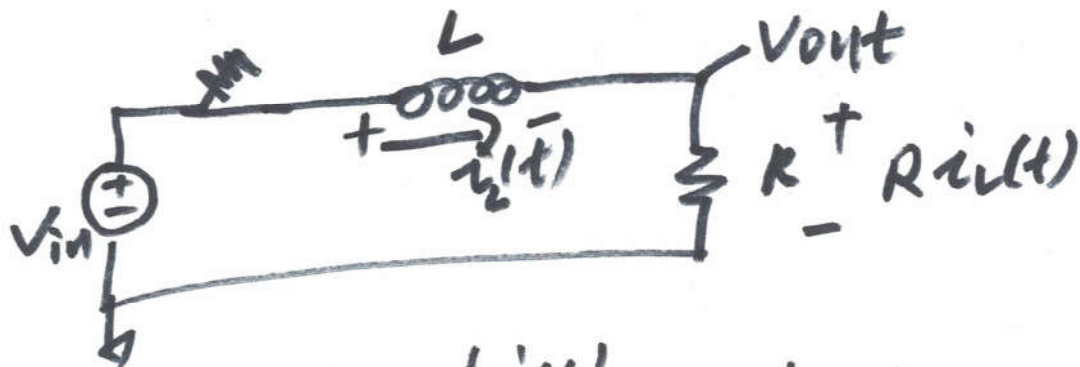


△ Time Delay — RL Circuit



$$V_{in} = L \frac{di_L(t)}{dt} + Ri_L(t)$$

$$\frac{1}{L} (V_{in} - Ri_L(t)) dt = di_L(t)$$

$$\int_0^t \frac{1}{L} dt = \int_0^{i_L(t)} \frac{1}{V_{in} - Ri_L(t)} di_L(t)$$

$$= \frac{1}{R} \int_{V_{in}}^{V_{in} - Ri_L(t)} \frac{1}{V_{in} - Ri_L(t)} di_L(t)$$

$$-\frac{R}{L} t = \ln \frac{V_{in} - Ri_L(t)}{V_{in}}$$

$$e^{-\frac{R}{L} t} = 1 - \frac{Ri_L(t)}{V_{in}}$$

$$i_L(t) = \frac{V_{in}}{R} (1 - e^{-\frac{R}{L} t})$$

$$\underline{V_{out}} = i(t) \cdot R$$

$$\underline{V_{out}} = V_{in} (1 - e^{-t/(L/R)})$$

$$\frac{1}{2} V_{in} = V_{in} (1 - e^{-t/(L/R)})$$

$$e^{-td/(L/R)} = 0.5$$

$$\frac{-td}{(L/R)} = \ln 0.5$$

$$= 0.7$$

$$td = 0.7 (L/R)$$