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Pre-Lab 3: First-Order and Second-Order Circuits
--- RC and RCL transient response

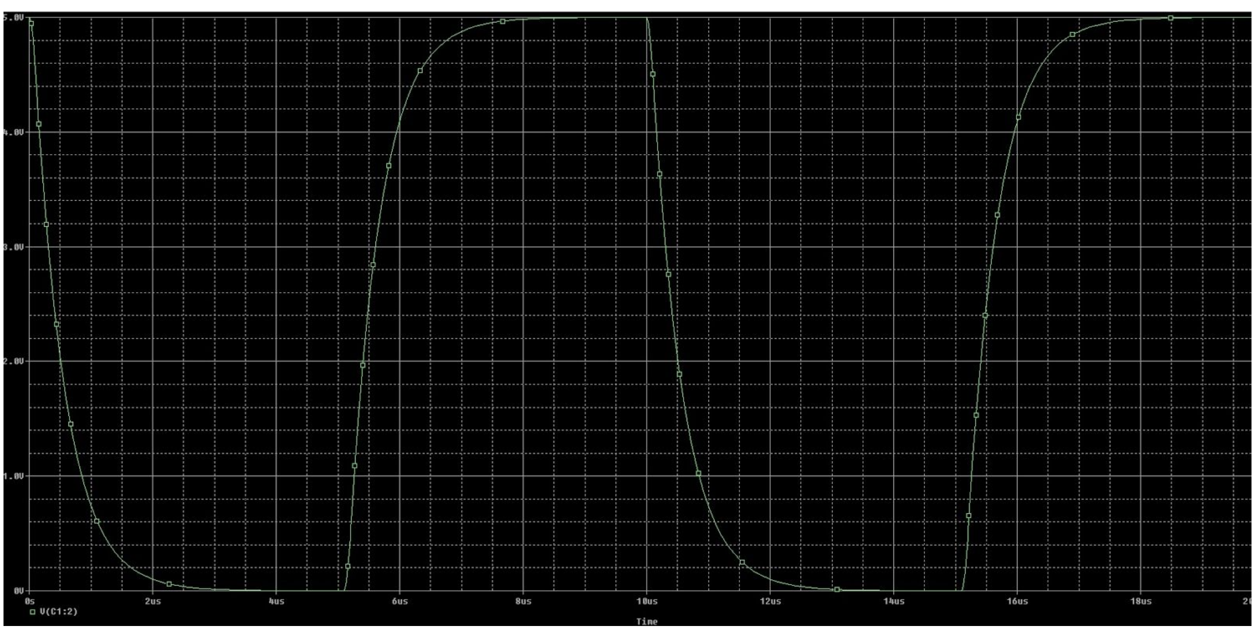
1. Calculations:
   Period = 1/frequency = 1/100 kHz = $1*10^{-5}$ sec
   Pulse width = Period/2 = $1*10^{5}/2 = 5*10^{-6}$ sec
   τ (time constant) = RC < 1/10 pulse width → $R(1*10^{-9}\text{ F}) < 1/10\ (5*10^{-6}\text{ sec})$

Solving the previous inequality for R indicates that a total resistance of 500 Ω is needed to obtain a time constant less than 1/10 of the pulse width. Therefore, the value of resistor R should be 450 Ω.

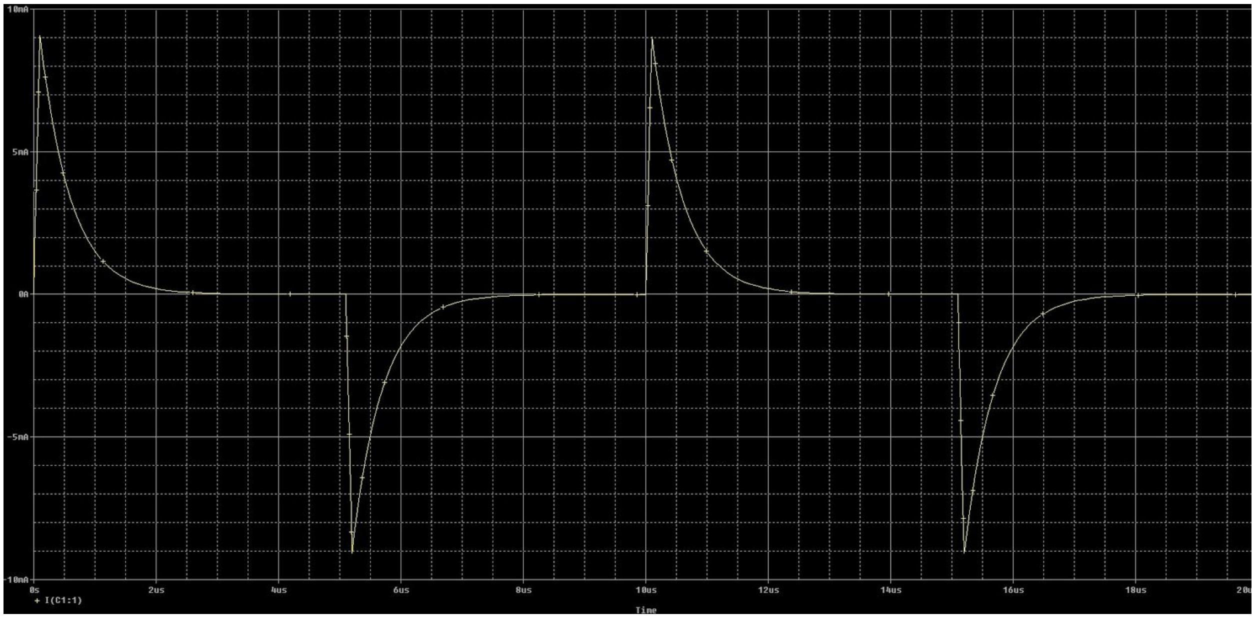
2. Pspice

a)

$V_c(t)$ vs. time



$i_c(t)$ vs. time



b) From the above waveform we can see that it takes approximately 5 microseconds for $V_c(t)$ to decrease from 5V to 1.84V (36.8% of the maximum voltage). This suggests that the time constant is about **5 micro sec.**

1. Calculations:

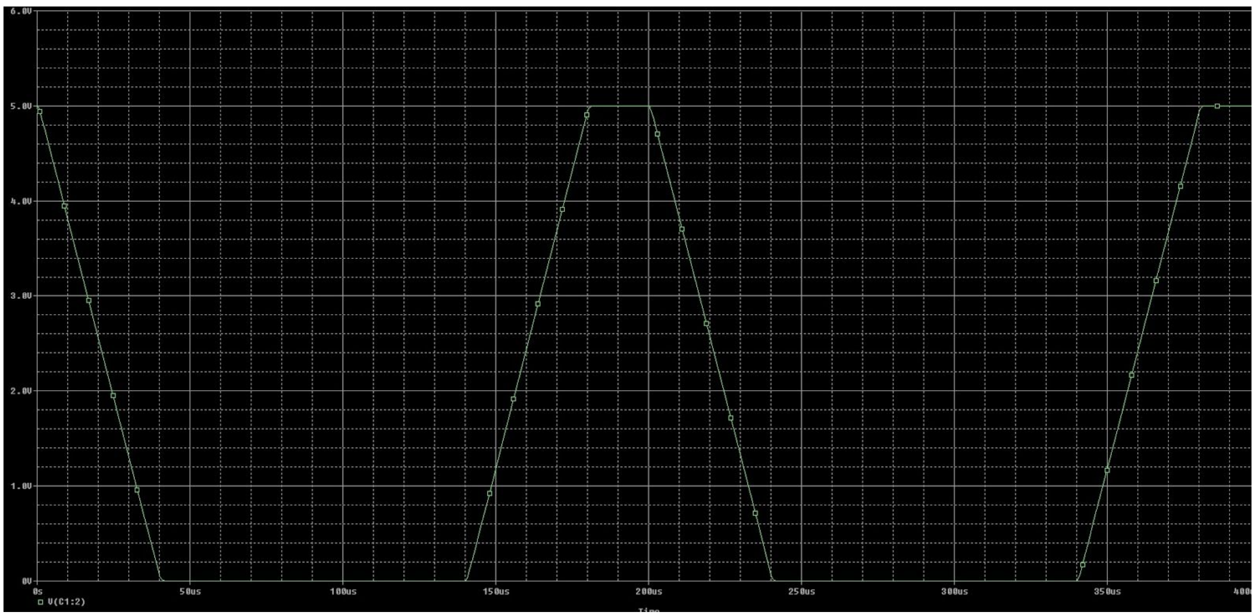
a) For the circuit to be underdamped R < 2 $\sqrt{L/C}$ → R < 2 $\sqrt{10mH/1nF}$ → R < 6325 Ω
Therefore the resistor must have a resitance of less than **6275 Ω.**

b) For the circuit to be critically damped R = 2 $\sqrt{L/C}$ → R = 2 $\sqrt{10mH/1nF}$ → R = 6325 Ω
Therefore the resistor must have a resitance of exactly **6275 Ω.**

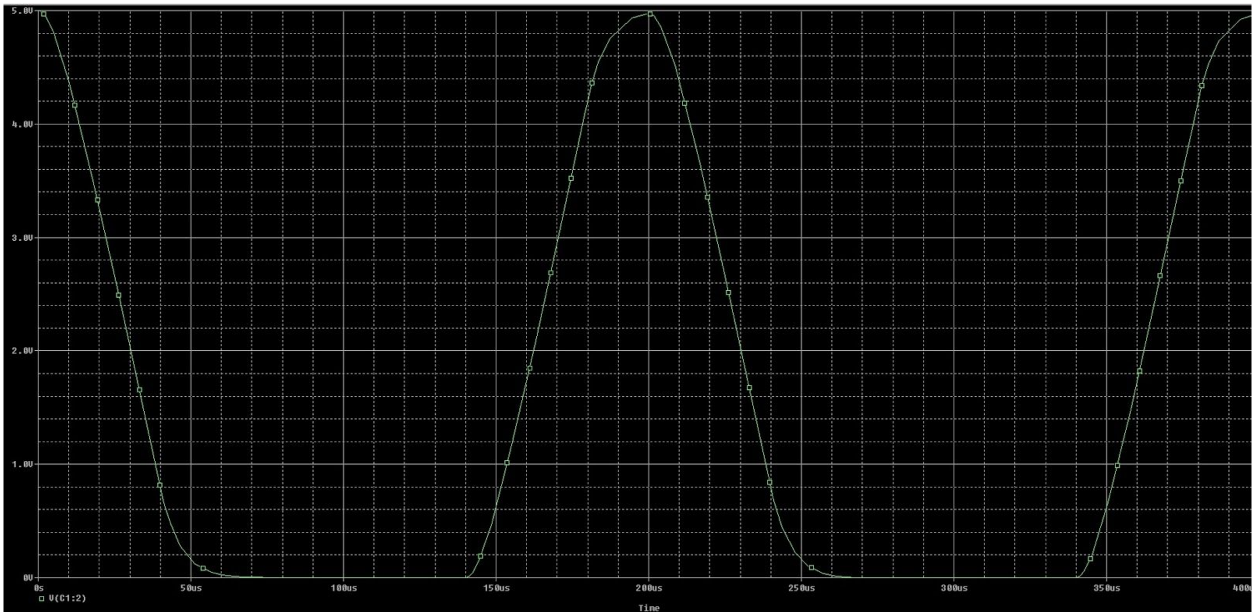
c) For the circuit to be overdamped R > 2 $\sqrt{L/C}$ → R > 2 $\sqrt{10mH/1nF}$ → R > 6325 Ω
Therefore the resistor must have a resitance greater than **6275 Ω.**

2. Pspice

V_c(t) vs. time (underdamped)



$V_c(t)$ vs. time (critically damped)



$V_c(t)$ vs. time (overdamped)