Mechatronics Homework 6

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1 RC Circuit

For the following circuit, please tune the potentiometer to 10 Ω, 100 Ω, 1000 Ω, and 10000 Ω and get the system response. Please use the system modeling and derive to get system response in time domain, for both rising edge and falling edge. Plot those two results in time domain and compare them. What are your observations from this experiment? What is the time constant τ for each of the case with 10 Ω, 100 Ω, 1000 Ω, and 10000 Ω resistor (for both experiment and modeling)? How much is the error between them in percentage The fitting results are shown in the figure below:

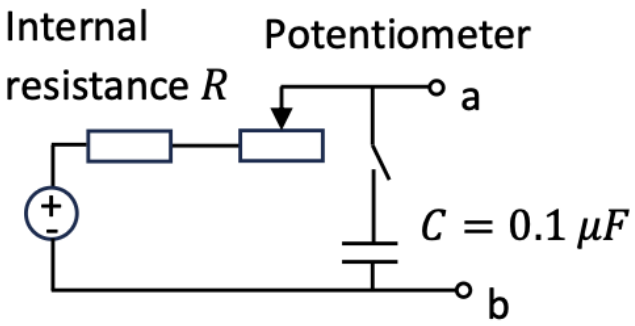
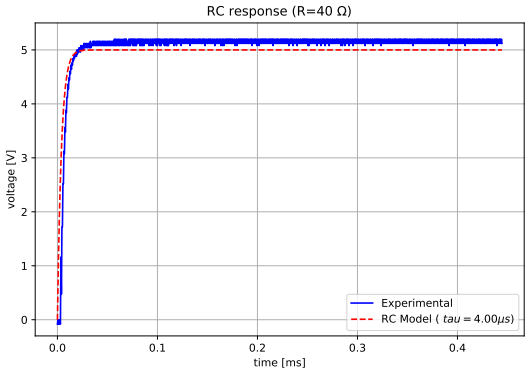
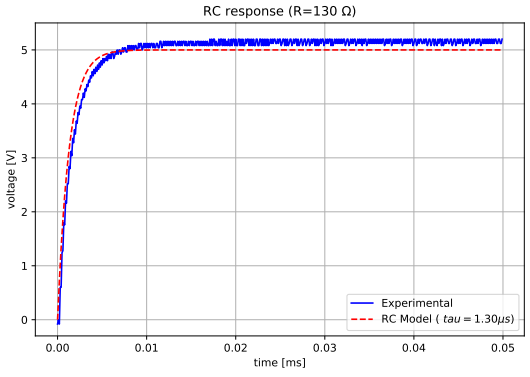


Figure 1: RC circuit

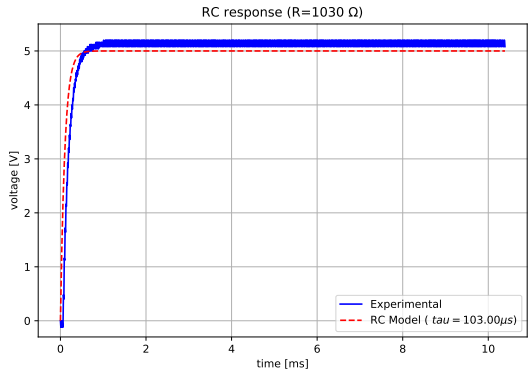


(a) 10 ohm up

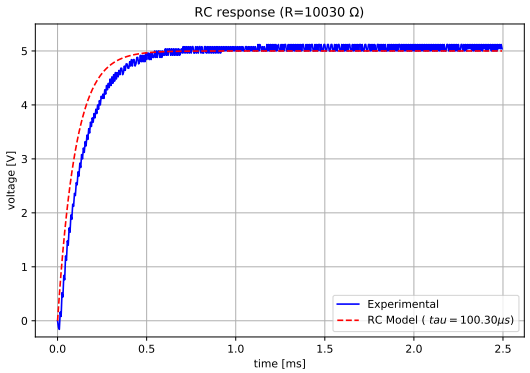


(b) 100 ohm up

Figure 2: Results for RC circuit charge (part 1)



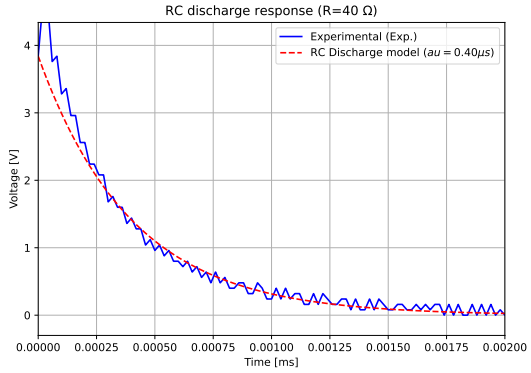
(a) 1000 ohm up



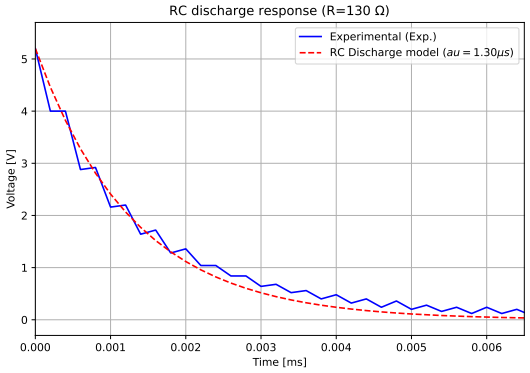
(b) 10000 ohm up

Figure 3: Results for RC circuit charge (part 2)

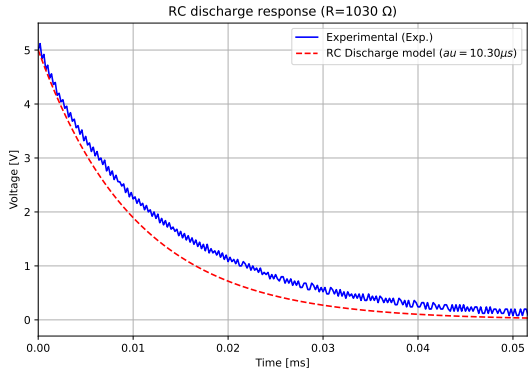
For Discharging part:



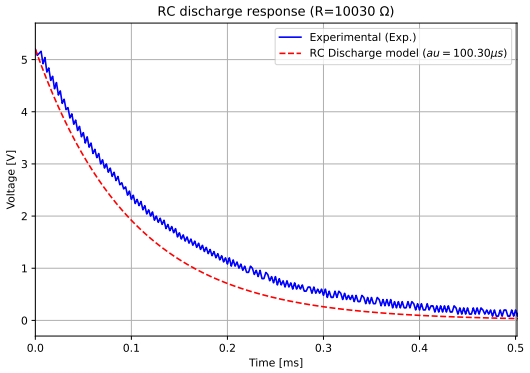
(a) 10 ohm down



(b) 100 ohm down



(c) 1000 ohm down



(d) 10000 ohm down

Figure 4: Results for RC circuit discharge

Then we compare the time constant τ from experimental data with theoretical time constant

Table 1: Experimental Results for time constant

R_{ent}	R_{ixt}	R_{tot}	**C** (μ**F**)	$\tau = R_{tot} * C$ (μ**s**)	τ_{exp} (μ**s**)	**Error** (%)
10	30	40	0.01	0.4	0.5	25
100	30	130	0.01	1.3	1.8	38.5
1000	30	1030	0.01	10.3	13	26.2
10000	30	10030	0.01	100.3	140	39.6

2 RC Circuit

For the following circuit, please tune the potential meter to 10 Ω, 100 Ω, 1000 Ω, and 10000 Ω and get the system response. Please use the system modeling and derive to get system response in time domain, for only rising edge. Plot those two results in time domain and compare them. What are your observations from this experiment?

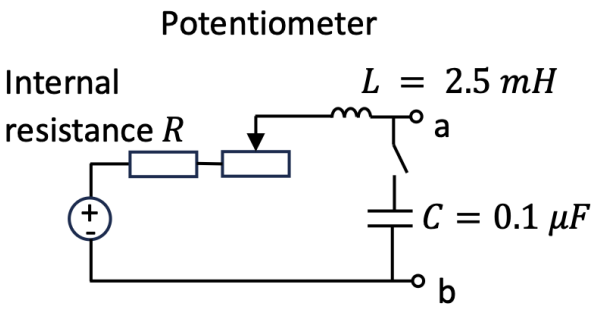
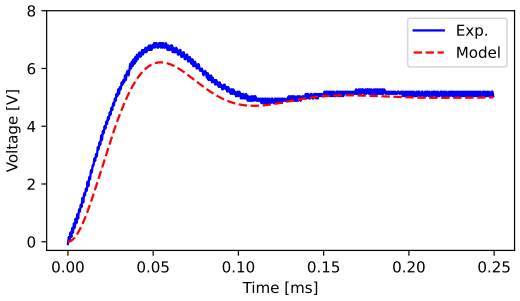
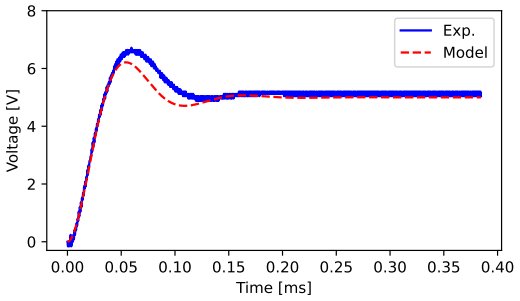


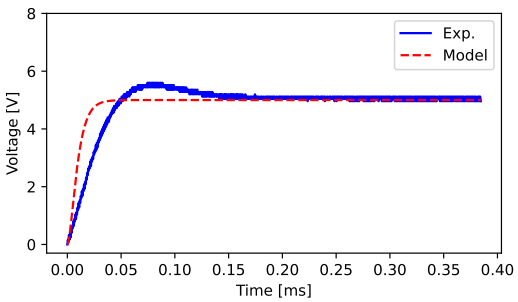
Figure 5: RLC circuit



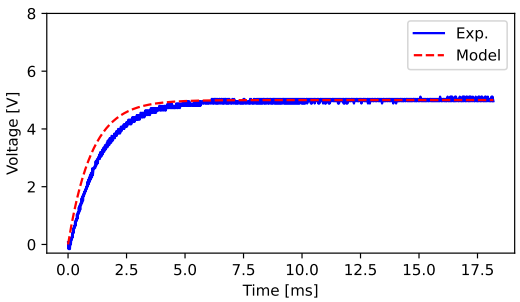
(a) 10 ohm RLC



(b) 100 ohm RLC



(c) 1000 ohm RLC



(d) 10000 ohm RLC

Figure 6: Results for RLC circuit charge