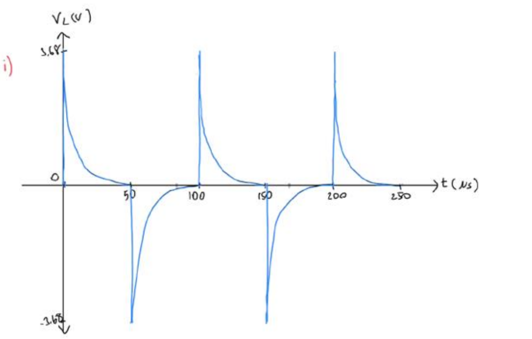
# EXPERIMENT 5 – ONLINE VERSION
# FIRST ORDER CIRCUITS

## Preliminary Work:

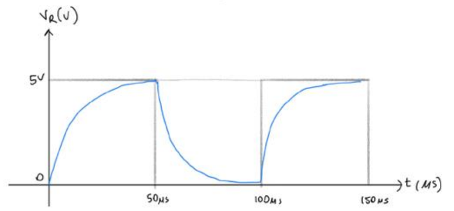
**1**.

$v_L$ versus $t$ graph

i)




$v_R$ versus $t$ graph




$v_R(t) = i(t).R$

$= \frac{v_{in}(t)}{R}(1-e^{-\frac{t}{\tau}}).R = v_{in}(t)(1-e^{-\frac{t}{7.8\mu}})$ when $\left(\begin{smallmatrix}V_0=0\\ I_0=0\end{smallmatrix}\right)$

$v_L(t) = L.\frac{di}{dt} = v_{in}\frac{L}{\tau.R}e^{-\frac{t}{\tau}}$ $\quad v_L(t) = v_{in}e^{-t/\tau} = v_{in}e^{-\frac{t}{7.8\mu}}$

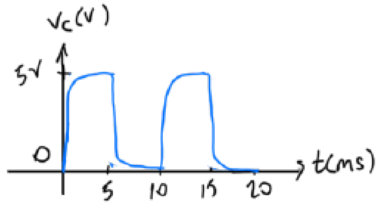
ii) $\tau = \frac{L}{R} = \frac{39.10^{-4}}{500}$ $\quad \tau = 7.8\mu s$

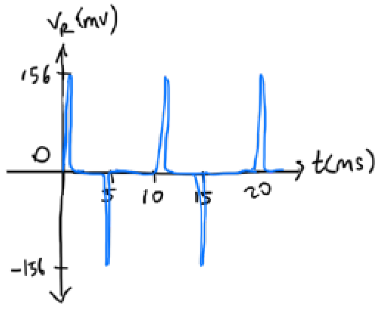
**2.**

case 1)

$$v_c(t) = \frac{1}{(3.3k).(4.7n)}\int_0^t v_{in}(t)\,dt \qquad v_R(t) = (3.3k)(4.7n)\frac{dv_{in}(t)}{dt}$$

$$= \frac{1}{(1,551).(10^{-5})}\int_0^t v_{in}(t)\,dt \qquad = (1,551).(10^{-5})\frac{dv_{in}(t)}{dt}$$




$\tau = (3.3k).(4.7n) = 15,51\mu s$

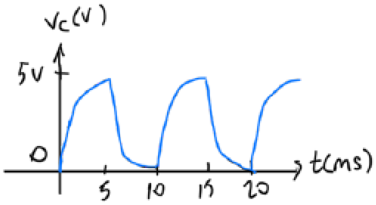
case 2)

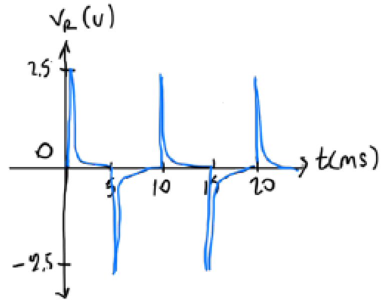
$$v_C(t) = \frac{1}{(33k).(10n)} \int_0^t v_{in}(t)\,dt$$

$$= \frac{1}{(3,3)(10^{-4})} \int_0^t v_{in}(t)\,dt$$

$$v_R(t) = (33k)(10n)\,\frac{d\,v_{in}(t)}{dt}$$

$$= (3,3)(10^{-4})\,\frac{d\,v_{in}(t)}{dt}$$




$T = (33k).(10n) = 330\mu s$

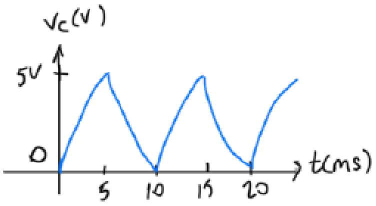
case 3)

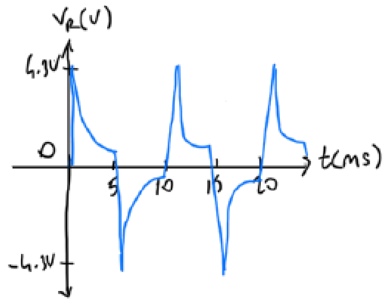
$$v_C(t) = \frac{1}{(33k).(47n)} \int_0^t v_{in}(t)\,dt$$

$$= \frac{1}{(1,551)(10^{-3})} \int_0^t v_{in}(t)\,dt$$

$$v_R(t) = (33k)(47n)\,\frac{d\,v_{in}(t)}{dt}$$

$$= (1,551)(10^{-3})\,\frac{d\,v_{in}(t)}{dt}$$




$T = (33k)(47n) = 1,551\ ms$

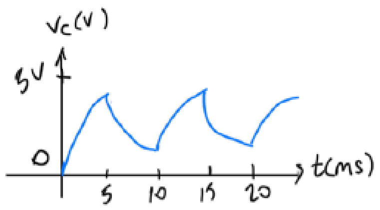
case 4)

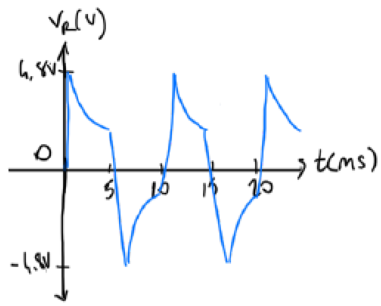
$$v_C(t) = \frac{1}{(100k)\cdot(47n)} \int_0^t v_{in}(t)\,dt$$

$$= \frac{1}{(4{,}7)(10^{-3})} \int_0^t v_{in}(t)\,dt$$

$$v_R(t) = (100k)(47n)\,\frac{d\,v_{in}(t)}{dt}$$

$$= (4{,}7)(10^{-3})\,\frac{d\,v_{in}(t)}{dt}$$




$\tau = (100k)(47n) = 4{,}7$ ms

**3.** If we choose time as τ (exponent of the e will be -1, since in all equations e in the form of e^(-t/τ) ), solve the equation, we get a voltage value. At the first period, if we look at the corresponding time of this voltage we can find τ from graph.(fort he 1st question)
For second question, since the given input is seen on the capacitor with exponential, then t= τ, exponential is equal to 0.68 times of the Vin, so the corresponding time of this voltage we can find τ from graph.

# EXPERIMENT 5
# REPORT SHEET

**Name :**

**Derya TINMAZ**

**Date : 31.12.2020**

**Experimental Work : 5**

**1)**

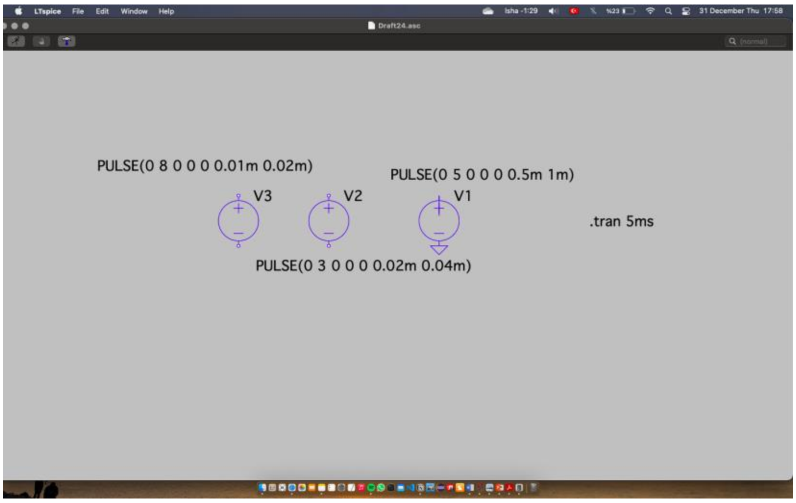



**Figure 1:** the image of the schematic of square wave sources

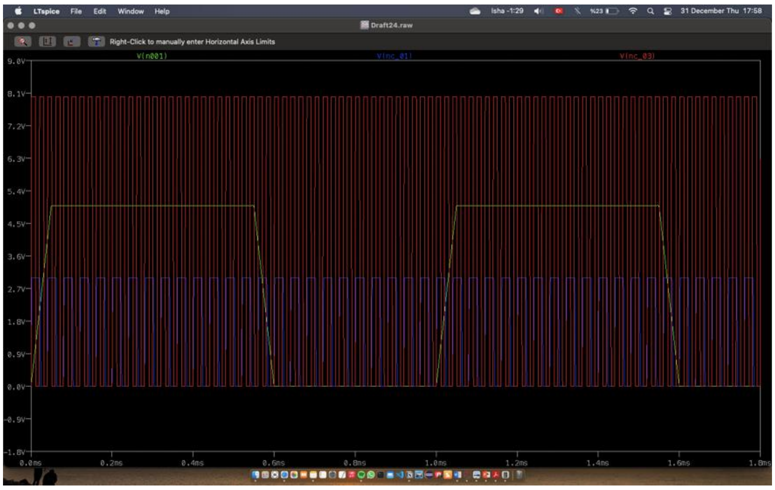


**Figure 2:** all the signals in a single scope output

**Comments:** The signal with greastest frequency has the smallest period, and its waves are closer to each other than other waves.

**2.**

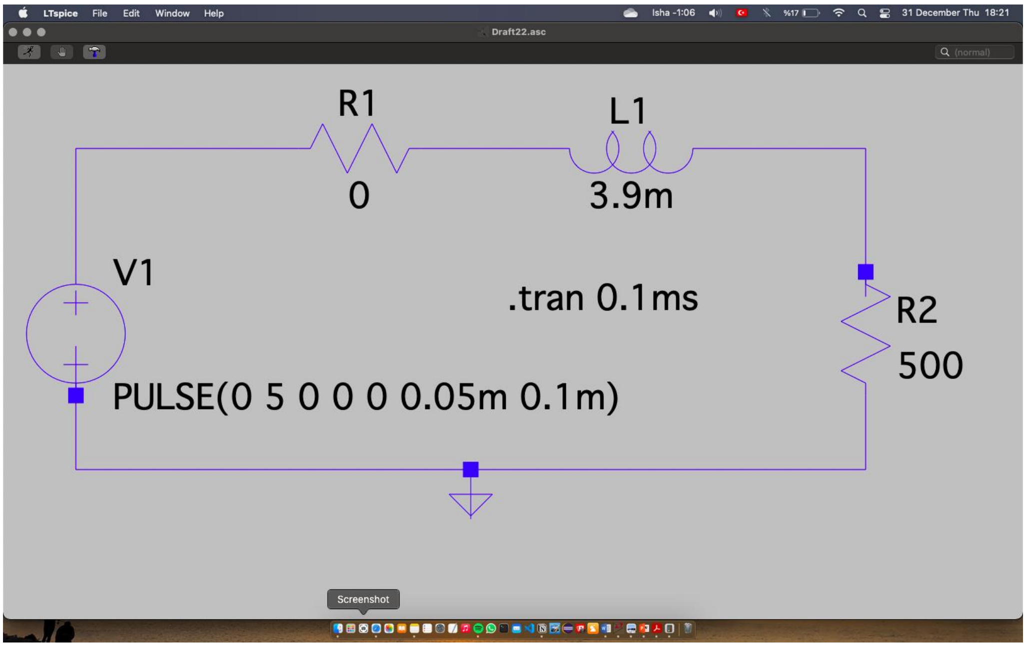



**Figure 3:** The schematic of the circuit in Figure 1a

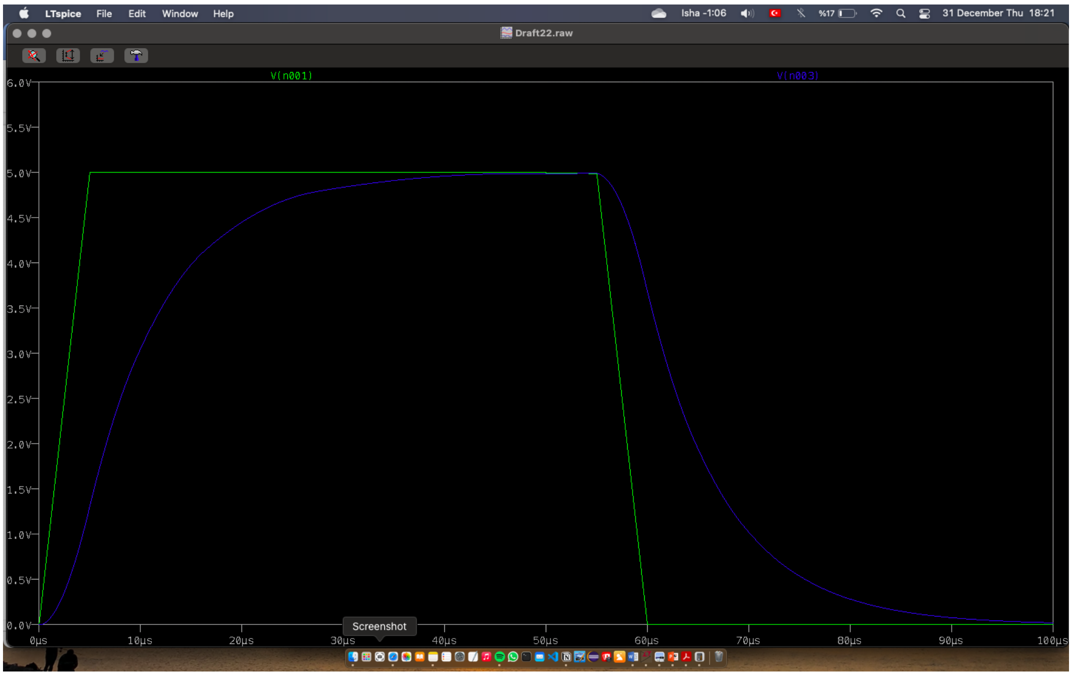
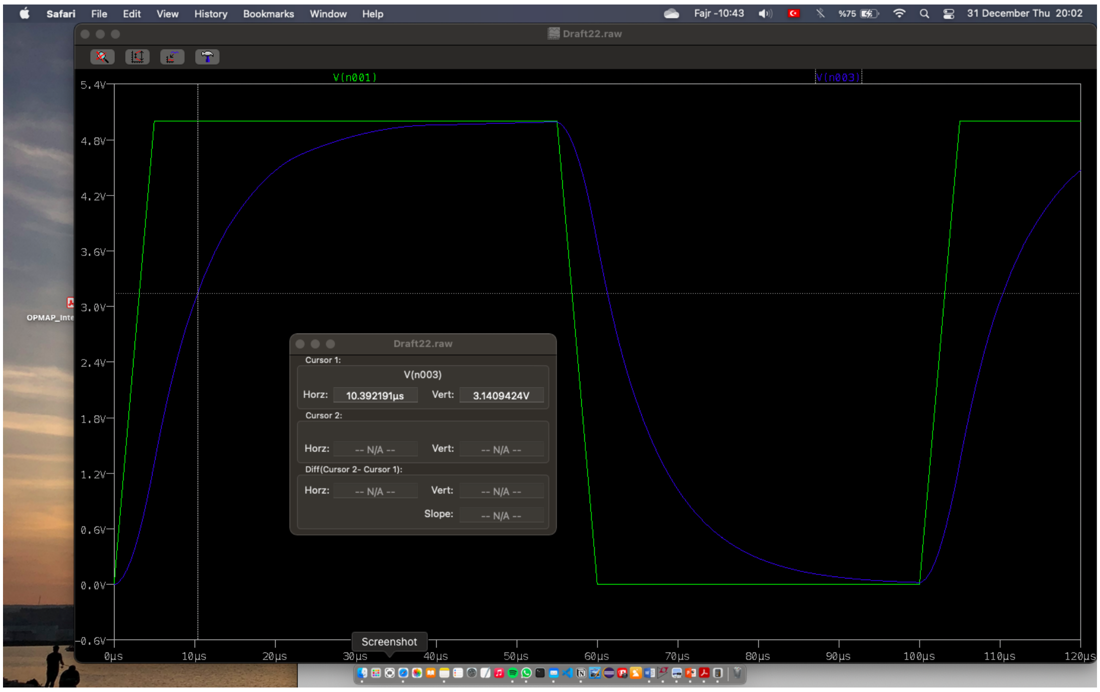



**Figure 4:** The scope output of the circuit($V_{in}(t)$ and $V_R(t)$)

**Time constant τ:**




to find $\tau$ in the $V_R(t)$ graph:

$$V_R(t) = V_{in}(t)\left(1 - e^{-\frac{t}{\tau}}\right)$$

when $t = \tau$ $\quad = V_{in}(t)\left(1 - e^{-1}\right)$

$$= V_{in}(t)(0{,}632)$$

between $(50\mu s - 0)$ $V_{in} = 5$ $\quad = 5 \cdot 0{,}632 = 3{,}16$

so when $V = 3{,}16$ the time is $\tau$ which is $10{,}4\,\mu s$

**Comments:** The results are same as expected, just little differences due to floating point precisions.

**3.**

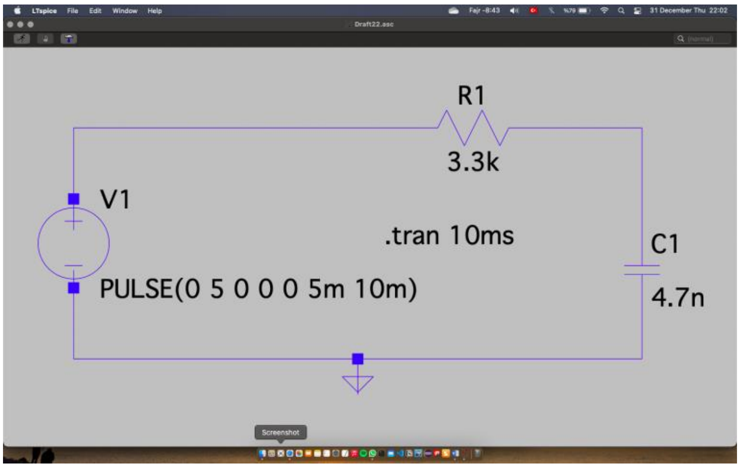



**Figure 5:** The schematic of the circuit in Figure 1b with case 1.

**Case 1:** f=100Hz, R=3.3kΩ, C = 4.7

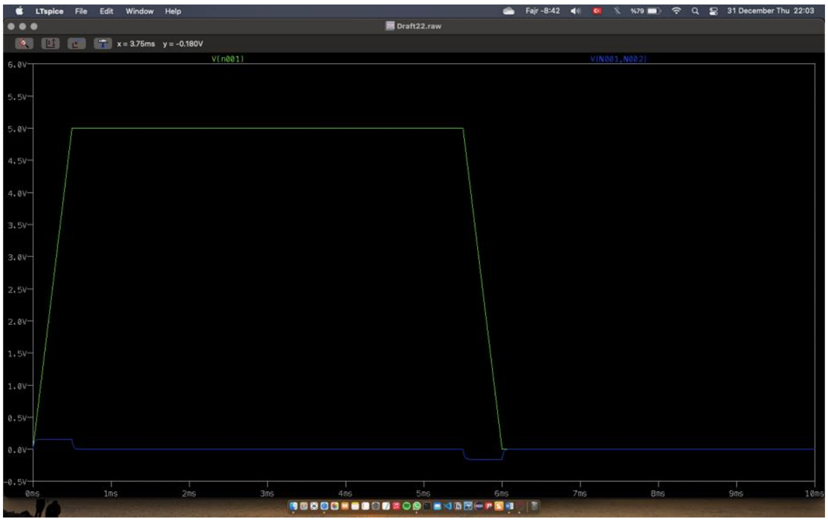



**Figure 6:** The scope output of the circuit($V_{in}(t)$ and $V_R(t)$)

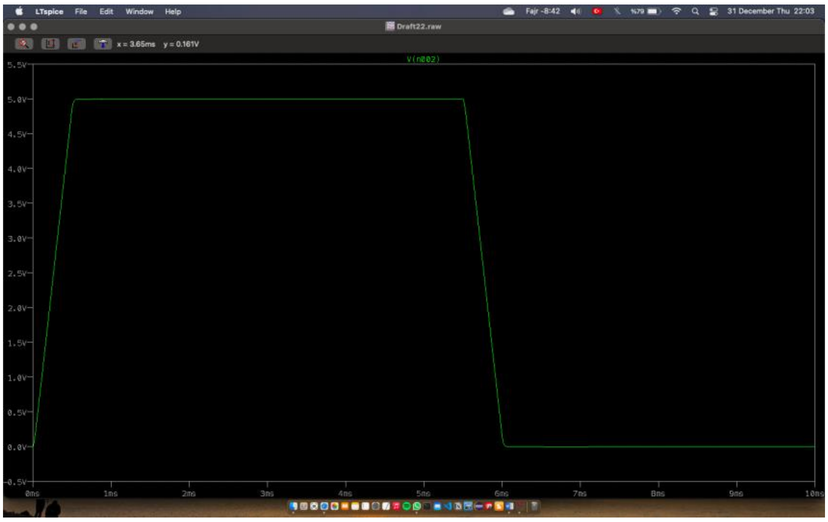
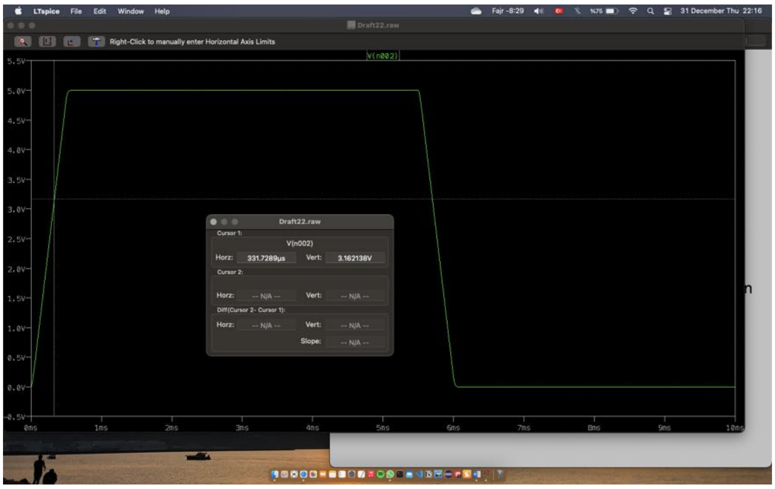



**Figure 7:** The scope output for Vc(t)

**Time constant τ:**




when $V_c(\tau) = 0.63 V_c$

$= 0.63 . 5 = 3,15$

if we look corresponding time when $V_c = 3,15$ we get $\tau$ which is 331,7 $\mu s$.

**Comments:** The results are same as expected, just little differences due to floating point precisions.

**Case 2:** f=100Hz, R=33kΩ, C = 10 nF

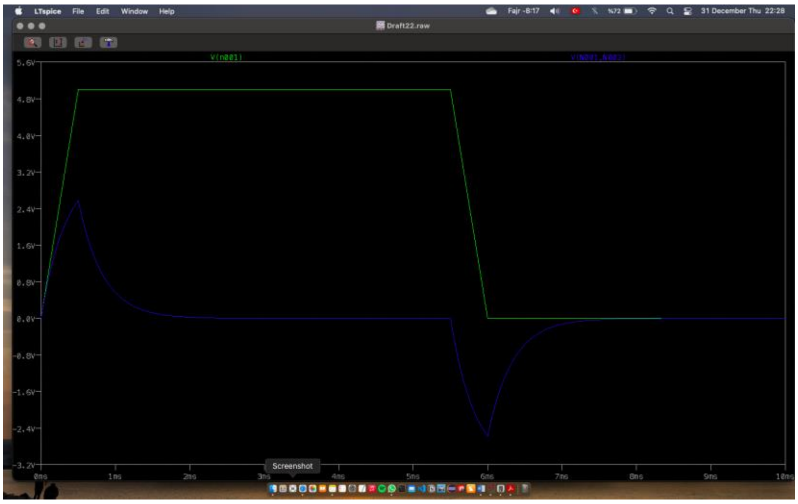


**Figure 8:** The scope output of the circuit($V_{in}$(t) and $V_R$(t))

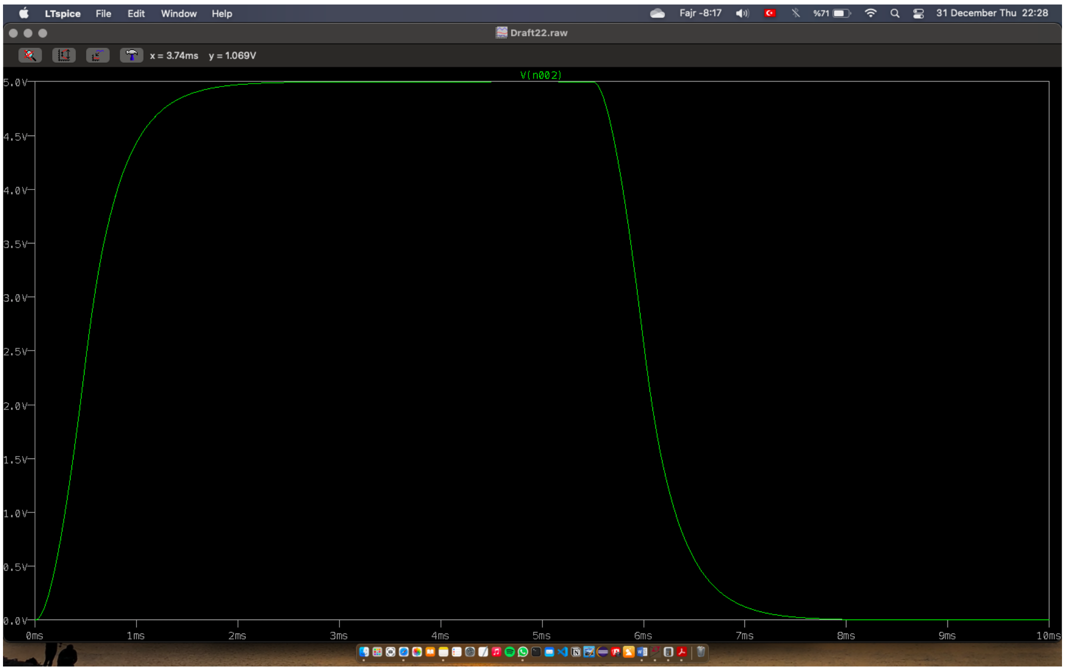
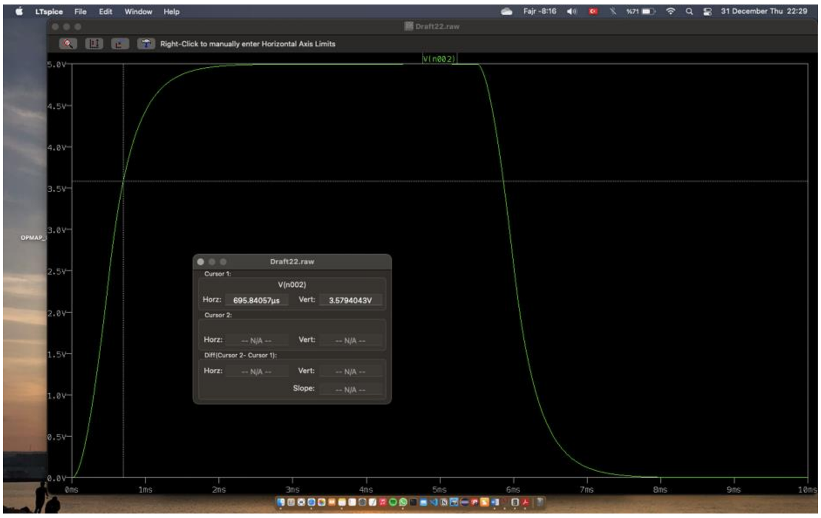



**Figure 9:** The scope output for Vc(t)

**Time constant τ:**




when $V_c(\tau) = 0.63 V_c$
$= 0.63 . 5 = 3,15$

if we look corresponding time when $V_c = 3,15$ we get $\tau$ which is $695,8 \mu s.$

**Comments:** The results are same as expected, just little differences due to floating point precisions.

**Case 3:** f=100Hz, R=33kΩ, C = 47 nF

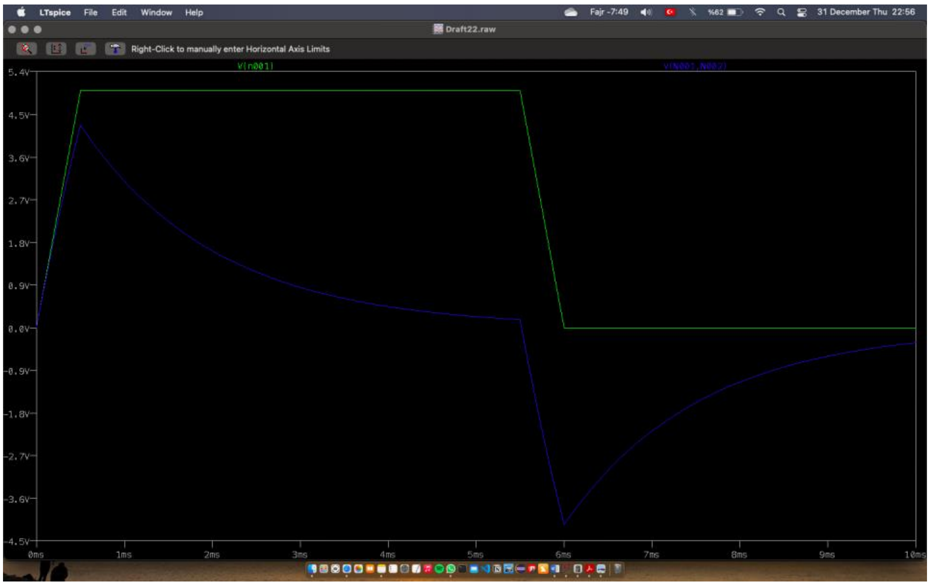


**Figure 10:** The scope output of the circuit($V_{in}(t)$ and $V_R(t)$)

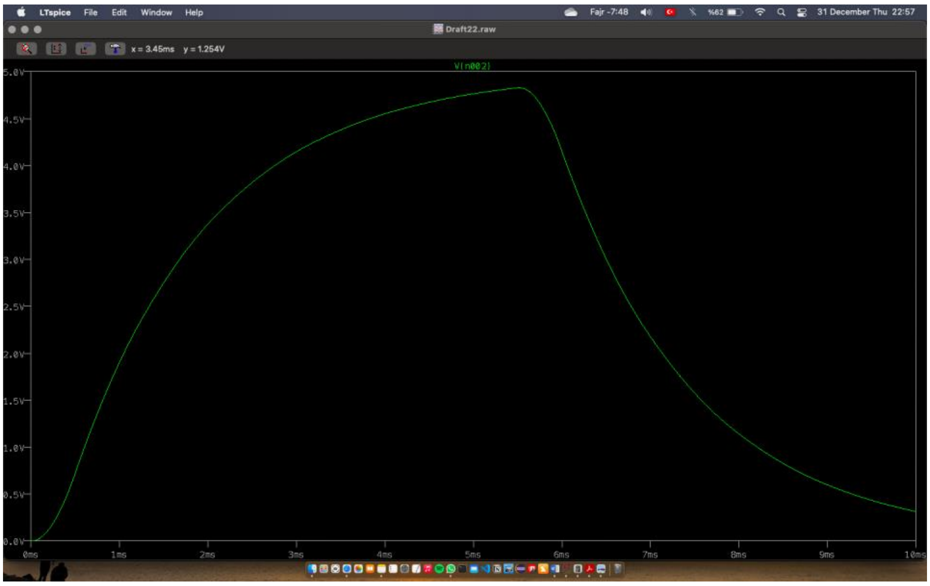
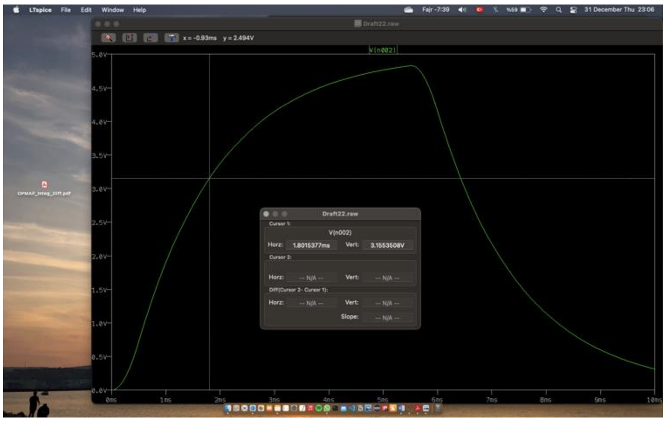


**Figure 11:** The scope output for Vc(t)

**Time constant τ:**



when $V_c(T) = 0.63 V_c$

$= 0.63 . 5 = 3{,}15$

if we look corresponding time when $V_c = 3{,}15$ we get $T$ which is 1.8 ms

**Comments:** The results are same as expected, just little differences due to floating point precisions.

**Case 4:** f=100Hz, R=100kΩ, C = 47 nF

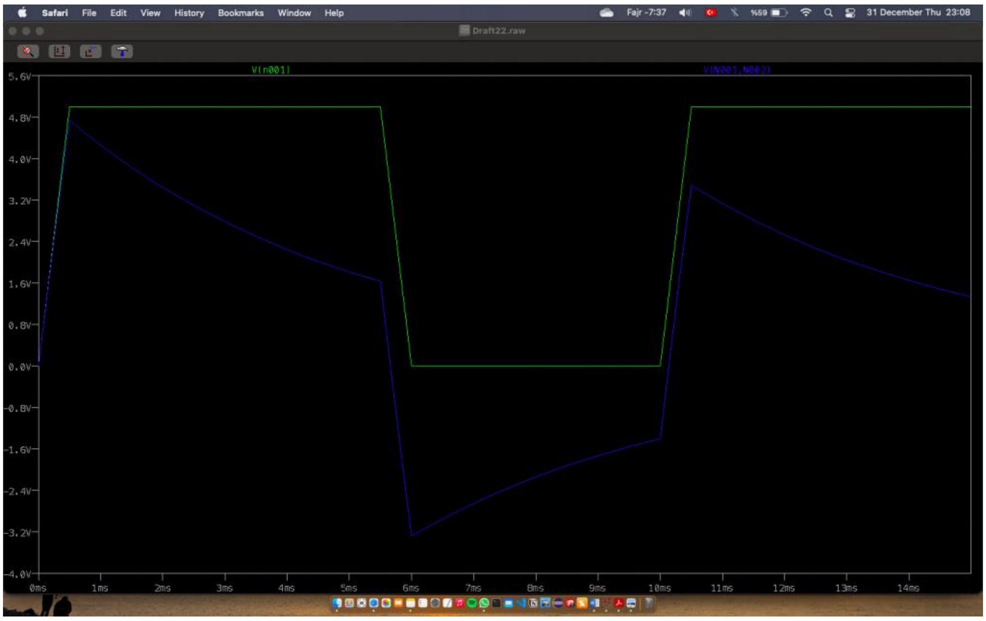



**Figure 12:** The scope output of the circuit($V_{in}(t)$ and $V_R(t)$)

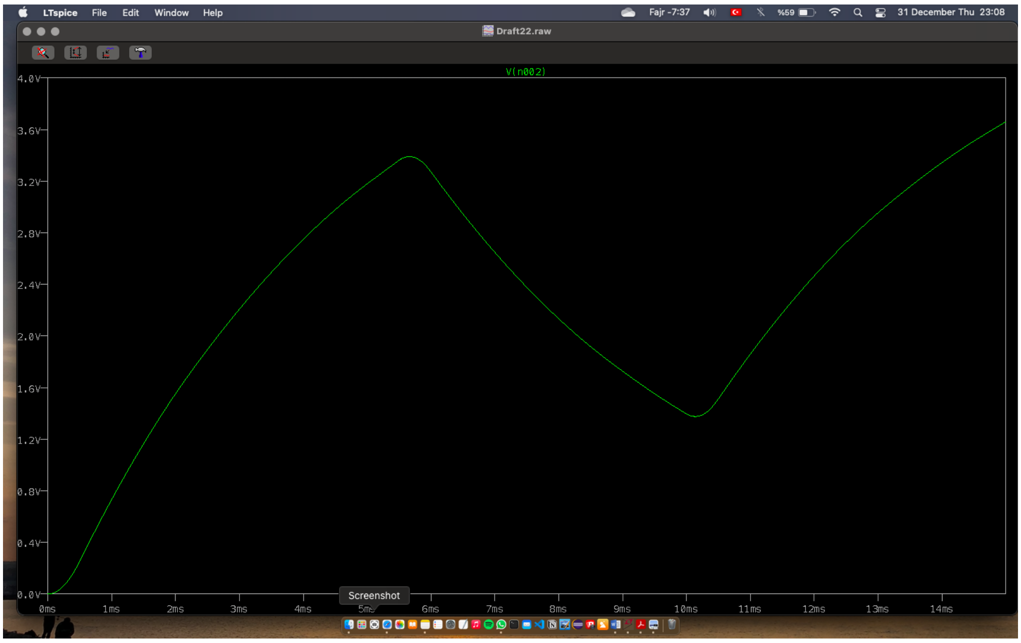
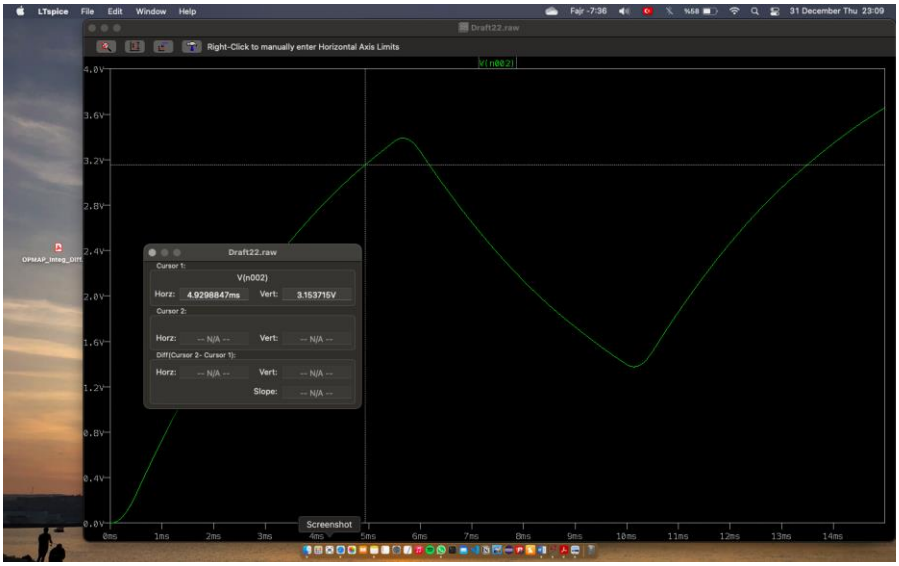



**Figure 13:** The scope output for Vc(t)

**Time constant τ:**




when $V_c(\tau) = 0.63 V_c$

$= 0.63 . 5 = 3,15$

if we look corresponding time when $V_c = 3,15$ we get $\tau$ which is 4.92ms

**Comments:** The results are same as expected, just little differences due to floating point precisions.