ECE 182 Lab #4 Phasor Voltages
Day of Submission: 09/19/2025
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<u>Circuit and Schematic</u>

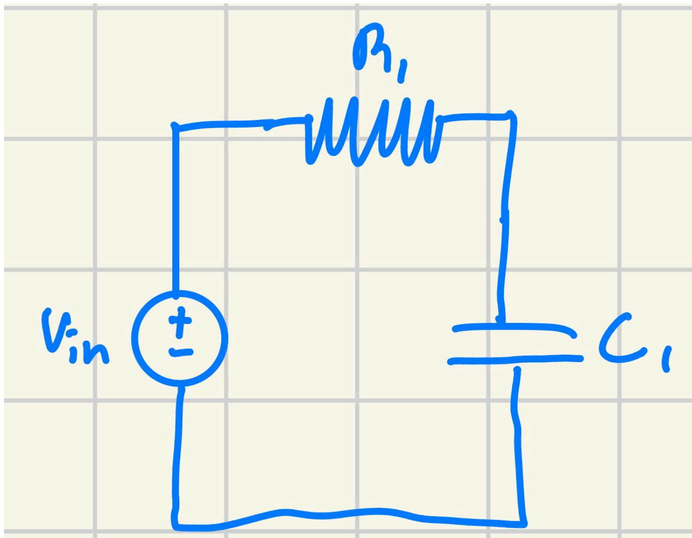


Figure 1

- Theoretical vs Experimental
- R1:100 ohms vs 96.55 ohms
- C1: 22 farads vs 20.69 farads

Equations for Theoretical Basis

$$Z = R - jX_c \Rightarrow 96.55 - j\,76.92\,\Omega$$

Results and Calculations

Figure 1 on Breadboard

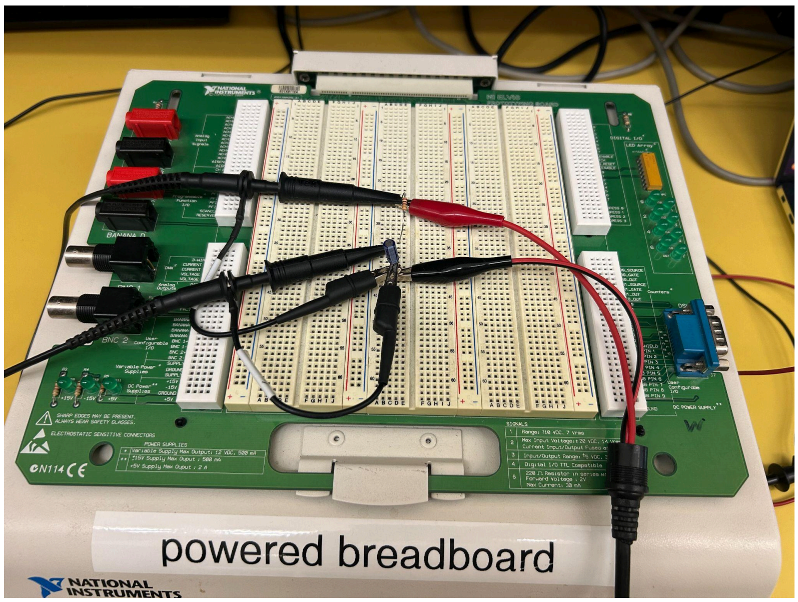
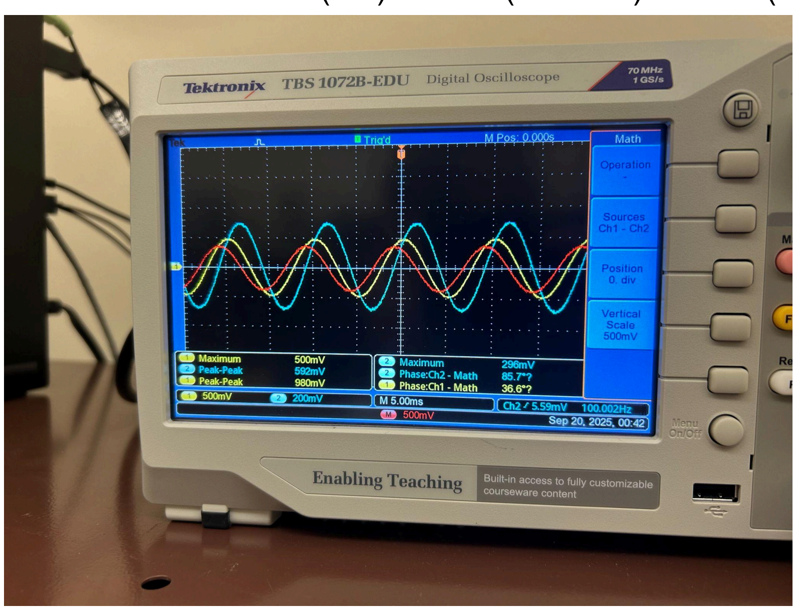
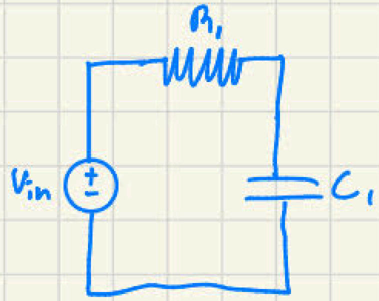


Figure 1 Measurements Yellow (Vin) vs Red (Resistor) vs Blue (Capacitor)





$R_1 = 96.55$ ohm
$C_1 = 20.69\,\mu F$

$V_{in} = 1\angle 0^\circ V$ 100 cycles/second

$\omega = 2\pi f = 200\pi$

$v(t) = V_m \cos(\omega t + \phi)$
$v(t) = \cos(200\pi t) V$

$$X_C = \frac{1}{j\omega C} = \frac{1}{(200\pi)(20.69\times10^{-6})} = 76.92\,\Omega$$

$R = 96.55$ ohm

$Z = R - jX_C \Rightarrow 96.55 - j\,76.92\,\Omega$

$|Z| = \sqrt{R^2 + X_C^2}$
$|Z| = \sqrt{(96.55)^2 + (76.92)^2}$
$|Z| = 123.44$
$\phi = \tan^{-1}\left(\frac{-76.96}{96.55}\right)$
$\phi = \angle -38.54^\circ$

$\boxed{Z = 123.44\angle -38.54^\circ}$

$V = IZ \Rightarrow I = \frac{V}{Z}$

$$I = \frac{1\angle 0^\circ}{123.44\angle -38.54^\circ}$$

$\boxed{I = 8.101\angle 38.54^\circ\, mA}$

$V_R = IR$
$V_R = 8.101\angle 38.54^\circ mA \cdot 96.55\,\Omega$
$V_R = 0.782\angle 38.54^\circ V$

$V_C = IZ_C$
$V_C = 8.101\angle 38.54^\circ mA \cdot (-jX_C)$
$V_C = 8.101\angle 38.54^\circ mA \cdot 76.923\angle -90$
$V_C = 0.623 V\angle -51.46^\circ$

Yellow = V_{in}
Red = Resistor = 36.6°
Blue = Capacitor = 85.7°

$$\begin{array}{r} 36.6^\circ \\ -85.7^\circ \\ \hline -49.1 \end{array}$$

Experimental	$V_R\angle\vartheta$	$V_C\angle\vartheta$
	$0.50V\angle 36.6^\circ$	$0.592V\angle -49.1^\circ$
Theoretical	$V_R\angle\vartheta$	$V_C\angle\vartheta$
	$0.782V\angle 38.59^\circ$	$0.623V\angle -51.46^\circ$

Summary

The measured phasor voltage confirmed the expected RC circuit behavior, with resistor voltage nearly in phase with the input and the capacitor voltage lagging close to 90 degrees. The overall phase/amplitude relationships matched theoretical predictions (Vr Experimental = 0.50V<36.6° and Theoretical 0.782V<38.59°, Vc Experimental = 0.592V<-49.1° and Theoretical = 0.623V<-51.47°), with only minor deviations due to component tolerances and measurement error. The resistor measured 96.55 ohms vs the expected 100 ohms, and the capacitor measured 20.69 micro farads vs the expected 22 micro farads. These minor differences lead to small shifts in the observed voltages. Overall, the lab was a success because the experimental data closely followed the expected phasor analysis and validated the theoretical model.