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CSE 4030
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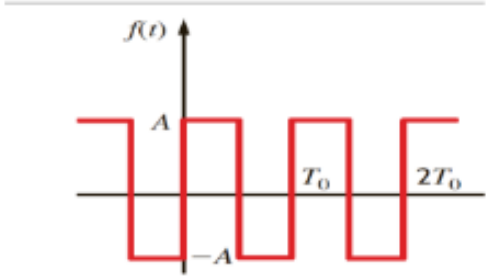
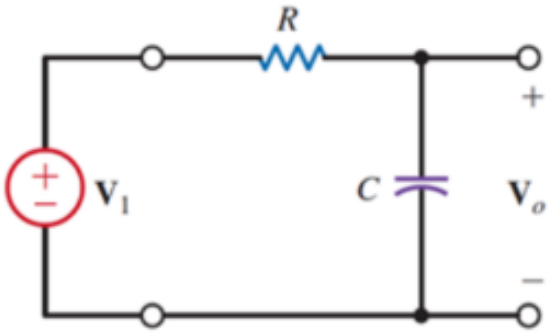
# Lab 14: Fourier Transform

## Introduction

In this lab, we have to find the missing value of each capacitor by using the Fourier transformation method on two different circuits. First, we show our work by hand then use Pspice simulation software to check. The purpose of this lab is to understand how to use Fourier Transform.



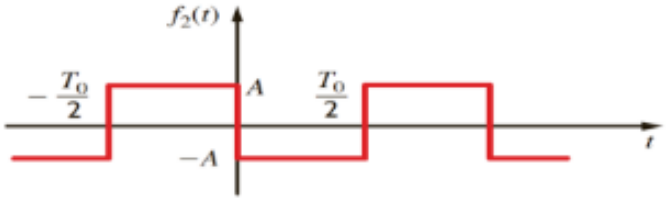

1-1

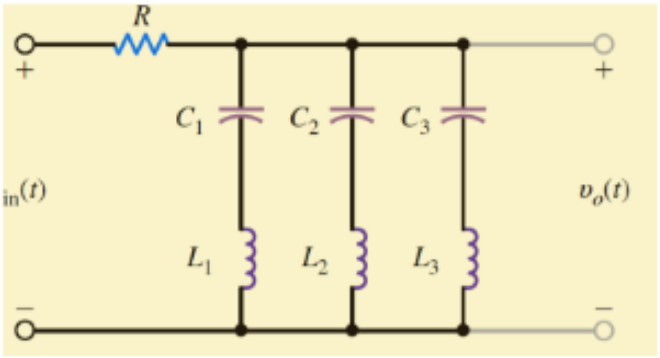
## Preparation

$$\frac{a_0}{2}+\sum_{n=1}^{\infty}\left[a_n\cos 2n\pi\frac{t}{T}+b_n\sin 2n\pi\frac{t}{T}\right]$$

1. Find f(t) by using Fourier Transform.( calculate by hand).
   1-1 A = 10V, To = 10ms, R = 1KΩ.
2. Find the value of C to keep on fundamental term and remove kth harmonic term
3. By using pspice simulation, find vo(t).
   Vi N1 N2 PULSE(10 -10 0 2n 2n 5m 10m) (V1 V2 TD TR TF PW PER)

1-2 ,



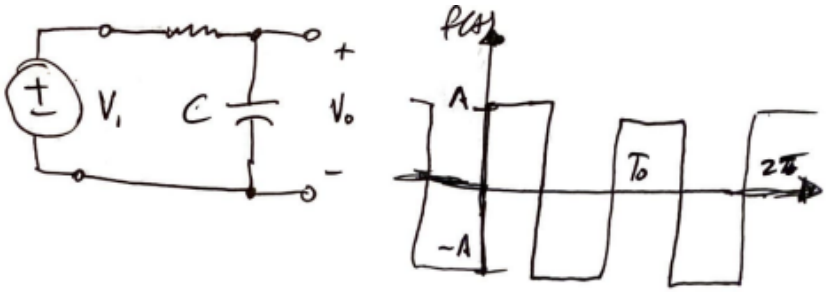

## Preparation

$$\frac{a_0}{2}+\sum_{n=1}^{\infty}\left[a_n\cos 2n\pi\frac{t}{T}+b_n\sin 2n\pi\frac{t}{T}\right]$$

4. Find f(t) by using Fourier Transform.( calculate by hand).
   1-2 A = 10V, To = 10ms, R = 1KΩ, L = 10uH
5. Find the value of and C to keep on fundamental term and remove 3rd, 5th, 7th harmonic term

**Hand Written Work**

Circuit 1:




$$\frac{a_0}{2} + \sum_{n=1}^{\infty}\left[a_n \cos 2\pi n \frac{t}{T} + b_n \sin 2\pi n \frac{t}{T}\right]$$

$A = 10V,\ T_0 = 10ms,\ R = 1K\Omega$

$$\rightarrow f(t) = \sum_{n=-\infty}^{\infty} C_n e^{jn\omega_0 t} \Rightarrow C_n = \frac{1}{T_0}\int_{t_1}^{t_1+T_0} f(t) e^{-jn\omega_0 t}\, dt$$

$$\begin{cases} a_n = \frac{2}{T_0}\int_{t_1}^{T_0+t_1} f(t)\cos n\omega_0 t\, dt \\ b_n = \frac{2}{T_0}\int_{t_1}^{T_0+t_1} f(t)\sin n\omega_0 t\, dt \end{cases}$$

$\rightarrow a_n = 0,\ b_n = \frac{20}{n\pi}\left[1-(-1)^n\right] \Rightarrow f(t) = \sum$

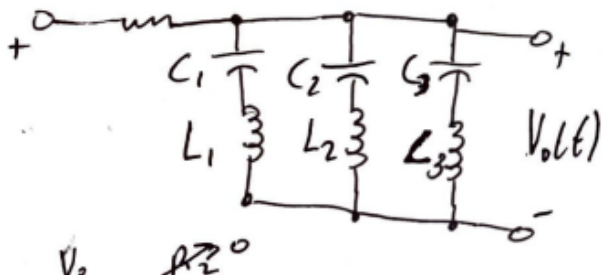
$f = \frac{1}{T_0} = \frac{1}{10ms} = 100Hz \times 2 = 200Hz$

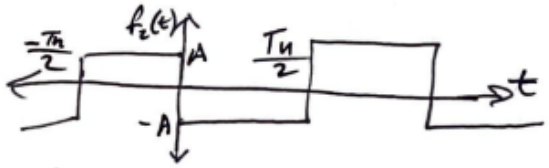
$X_C = R = 1K\Omega$

$$X_C = \frac{1}{\omega C} = \frac{1}{2\pi f C} \Rightarrow C = \frac{1}{2\pi f X_C} = \frac{1}{2\pi (200)(1000)}$$

$$\Rightarrow \boxed{C \simeq 0.8\mu F}$$

Circuit 2:




$A = 10V$, $T = 10ms$, $R = 0.1\Omega$, $L = 10\mu H$

$\frac{V_o}{V_x} = \frac{R_2}{R_1 + R}$ → if $f = 300\,Hz$, $500\,Hz$, $700\,Hz$ then $V_o = 0$

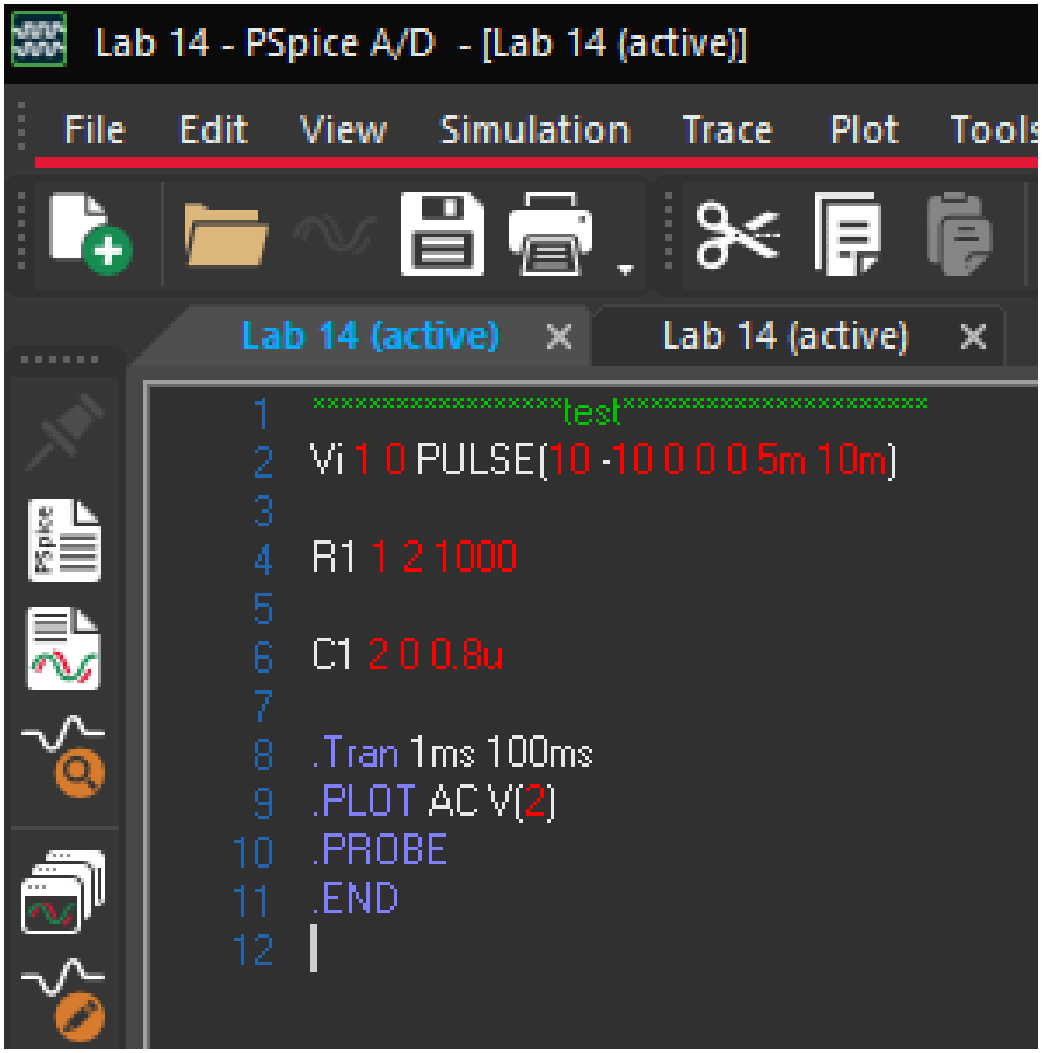
$C_1$: $\omega L = \frac{1}{\omega C} \Rightarrow \omega^2 LC = 1 \Rightarrow C_1 = \frac{1}{(2\pi(300))^2(10\times10^{-6})} = \boxed{0.0281\,F}$

$C_2$: $C_2 = \frac{1}{(2\pi(500))^2(10\times10^{-6})} = \boxed{0.0101\,F}$

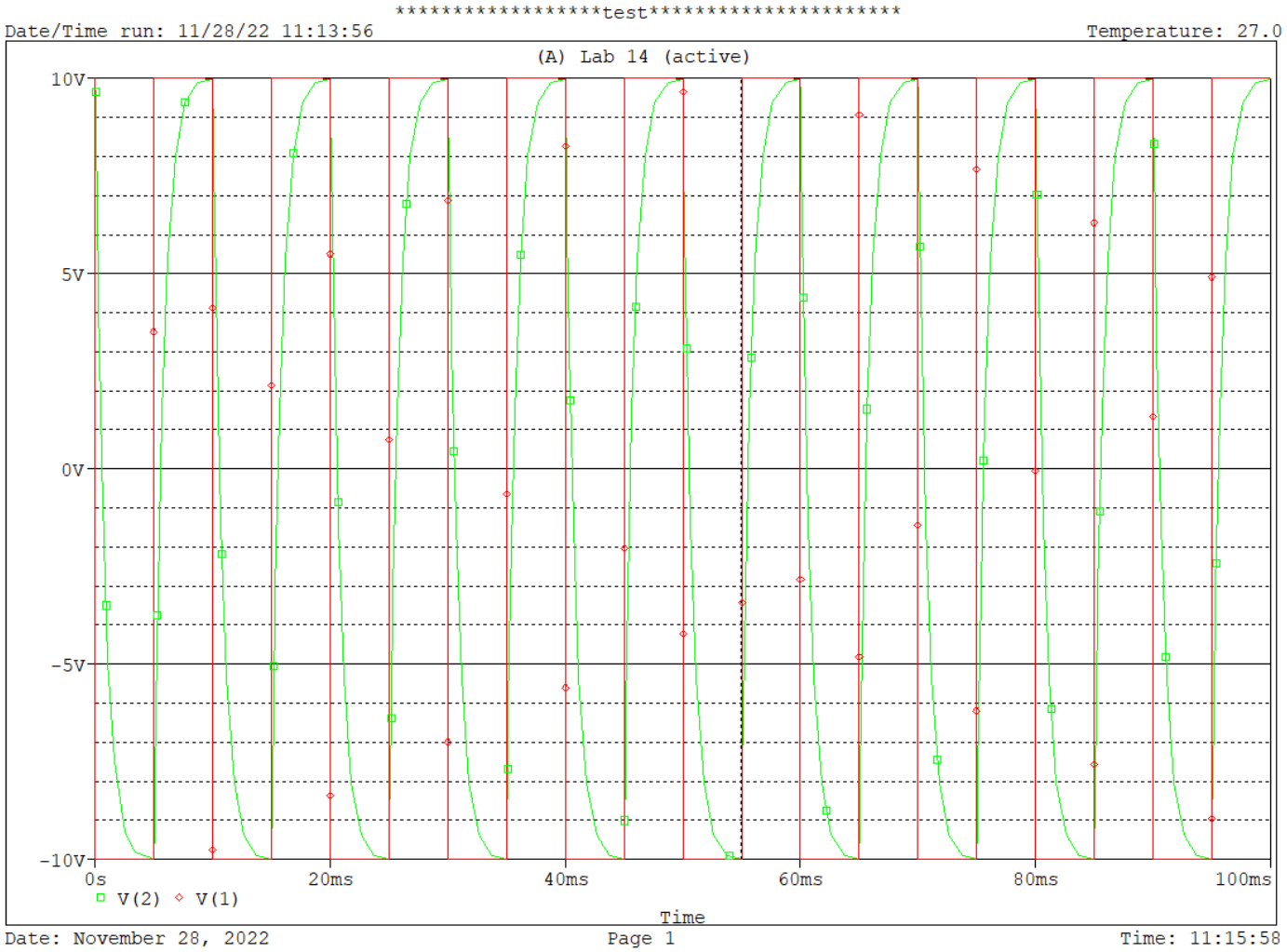
$C_3$: $C_3 = \frac{1}{(2\pi(700))^2(10\times10^{-6})} = \boxed{0.00517\,F}$

**Pspice simulation**

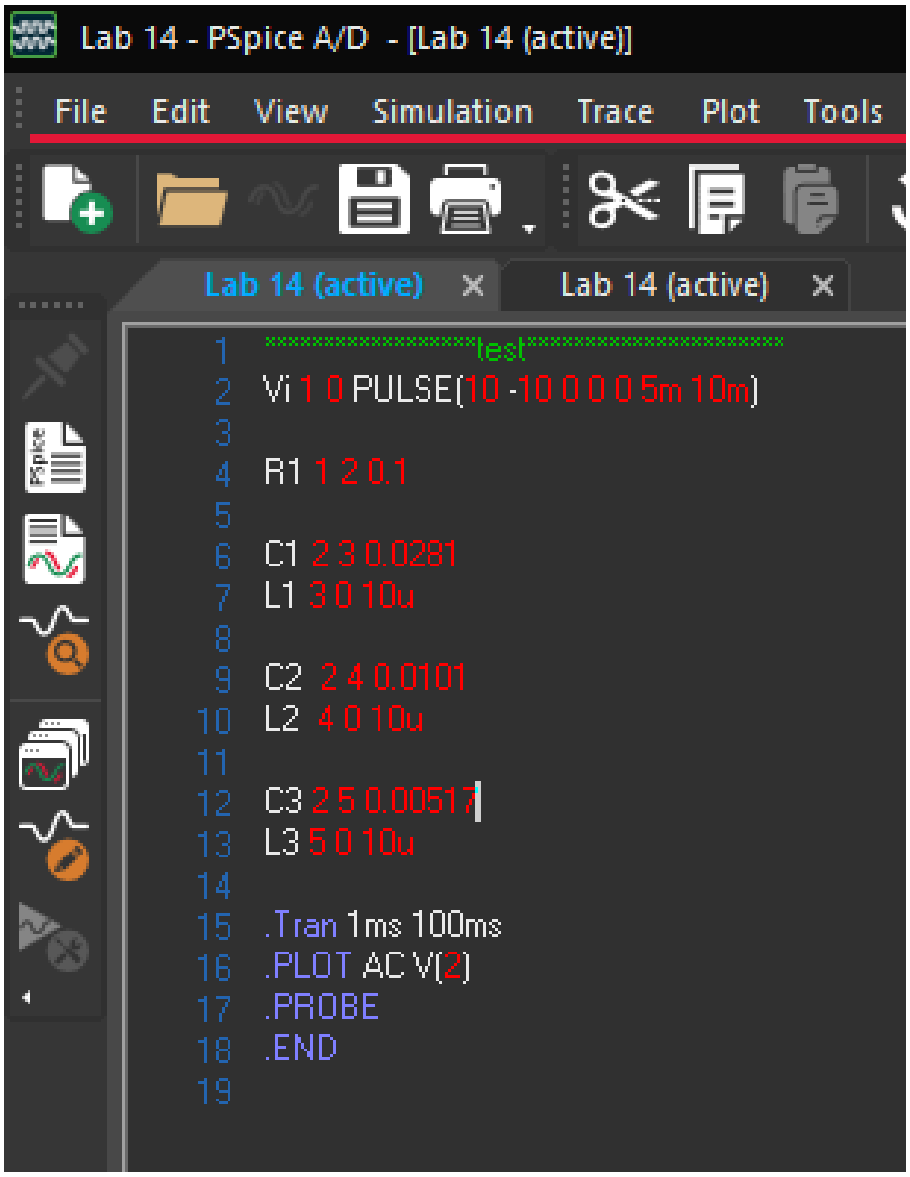
Circuit 1:
Code used



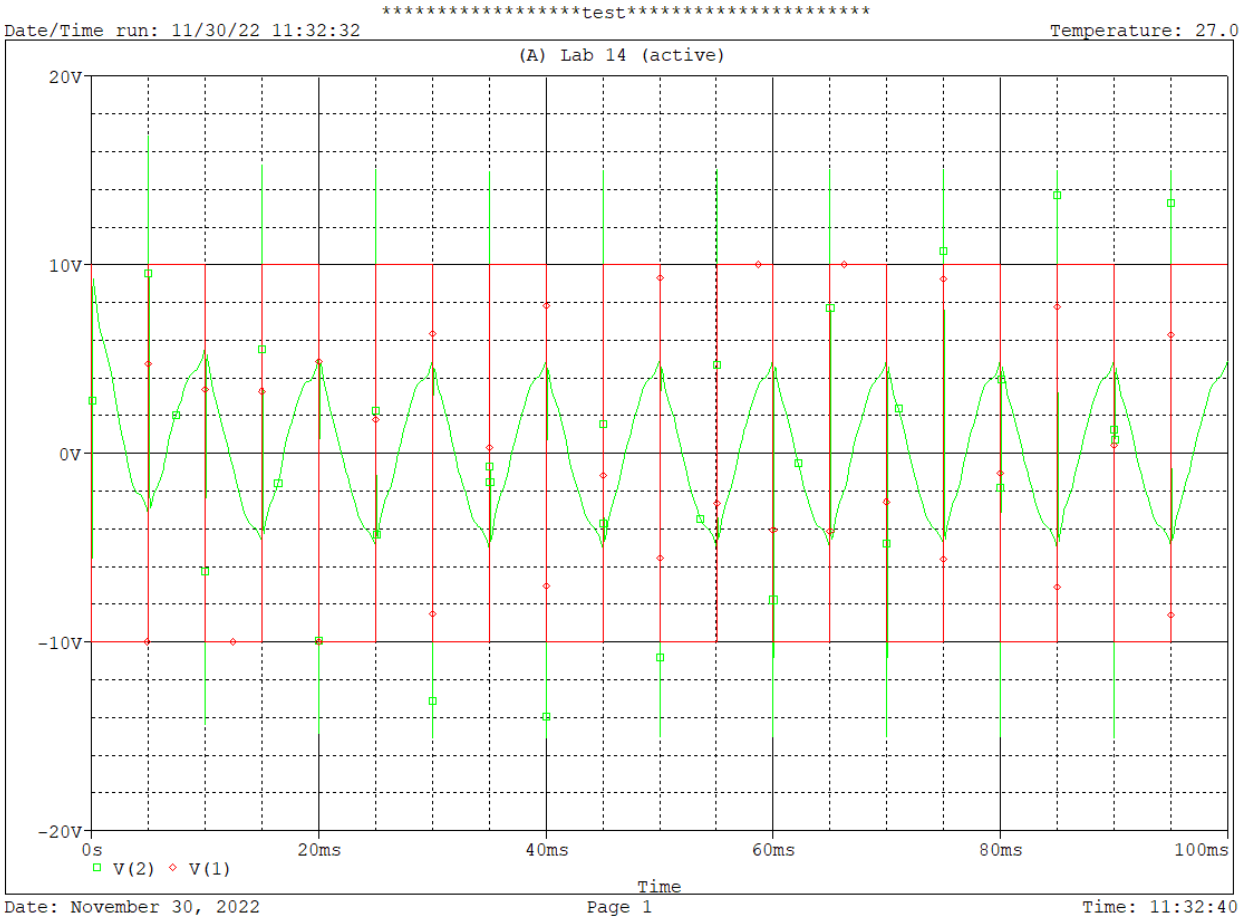
Voltage plot: $C = 0.8\mu F$



Circuit 2:
Code used



Voltage plot:



## Conclusion

In this lab, I learned how to find the missing capacitor values of two different circuits by applying fourier transformations. After reviewing the answers obtained from handwritten work and pspice, I can conclude the answers concur and are correct.