Lab 5 : DC transients and AC Analysis

<table>
<tr><td rowspan="5">Name:____________________________

Matric. No.________________________

Day / Table No.___________________</td><td>Activities Completed</td><td>Verified By</td><td>Marks From 2</td></tr>
<tr><td>A</td><td></td><td rowspan="4"></td></tr>
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1. Objectives of the Experiment

a) To learn about the use of the Oscilloscope and understand the issue of common grounds.
b) To measure the time constants for RC circuits using the oscilloscope.
c) To measure the phase difference between two AC signals.
d) To measure AC power using the oscilloscope.

2. Equipment to be used

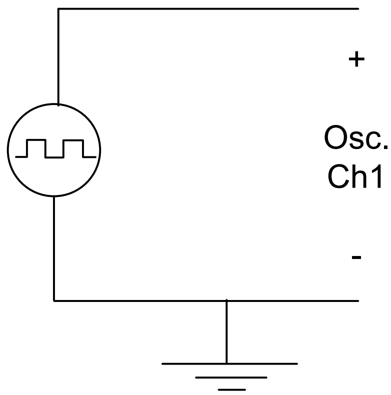
- Lab DC power supply
- Digital multi-meter
- Breadboard
- Oscilloscope

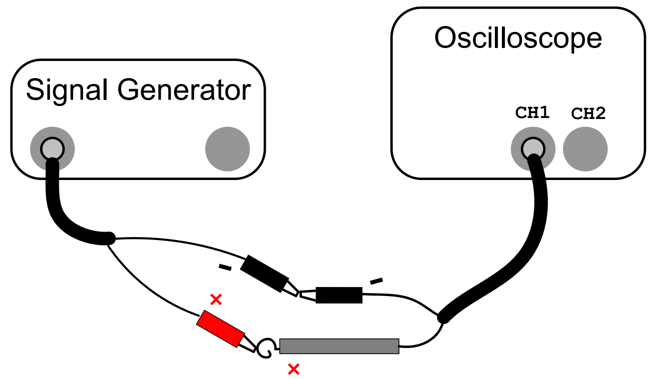
3. Components

- Resistors
- Capacitors
- Inductors

In-lab activities

a) **Getting to know the Oscilloscope and TTL Signal** [10%, 30mins]
Observe the TTL signal on the oscilloscope using the experimental setup shown below.





Obtain the following measurements.

$V_{MINIMUM}$ =

$V_{MAXIMUM}$ =

Frequency =

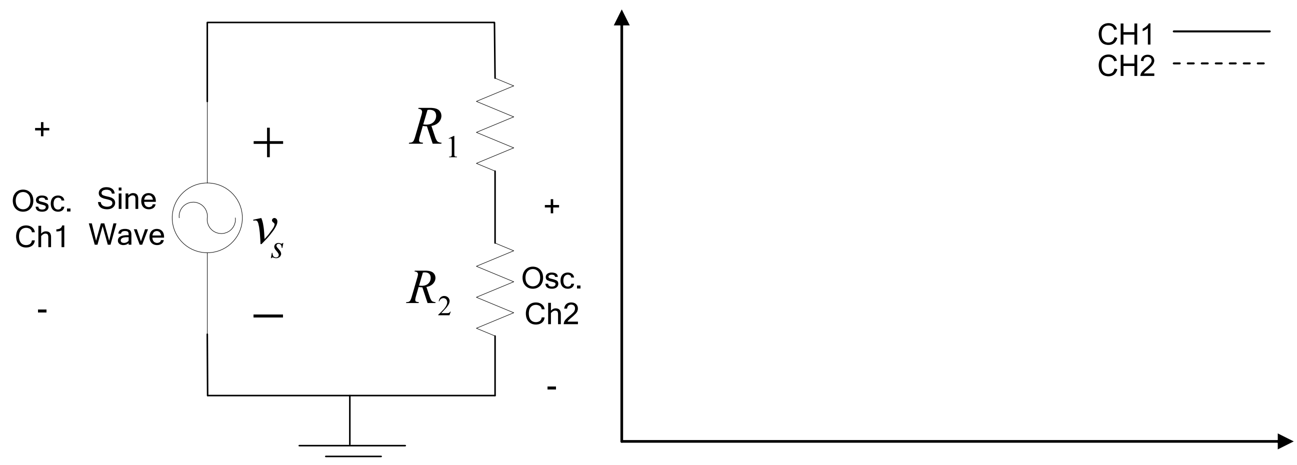
Period =

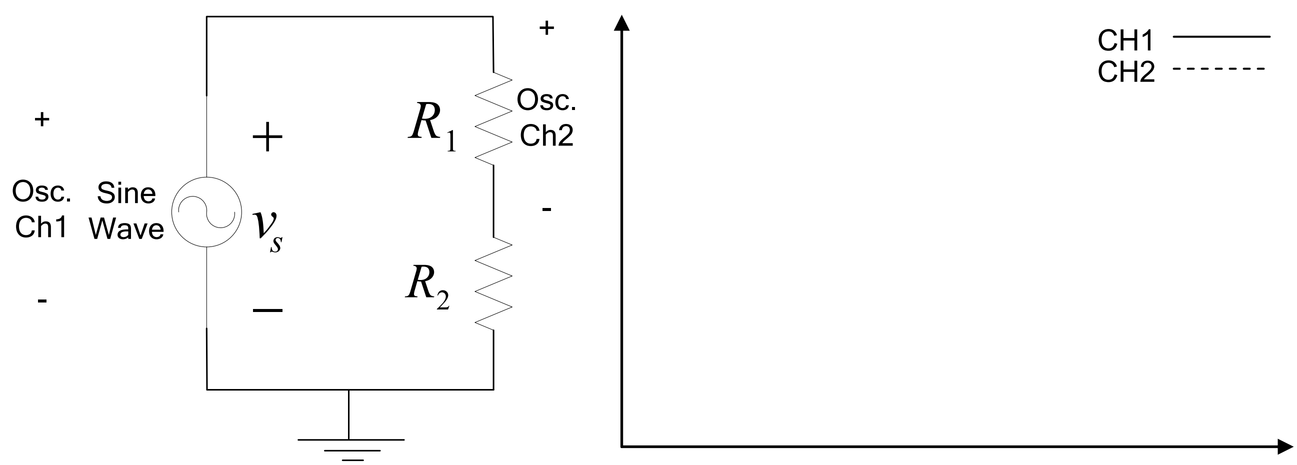
\+ Duty Cycle =

Adjust the voltage and time scales of the oscilloscope such that one cycle of the signal is centered on the screen and sketch one cycle below.

b) Common Grounds [10%, 30mins]

Set up the following circuit using a **1kHz sine wave** with **1V amplitude**. Choose the same values for both R1 and R2. Observe the signal across R2 and R1 as shown in the circuits below. Sketch the two signals in CH1 and CH2 for one cycle.





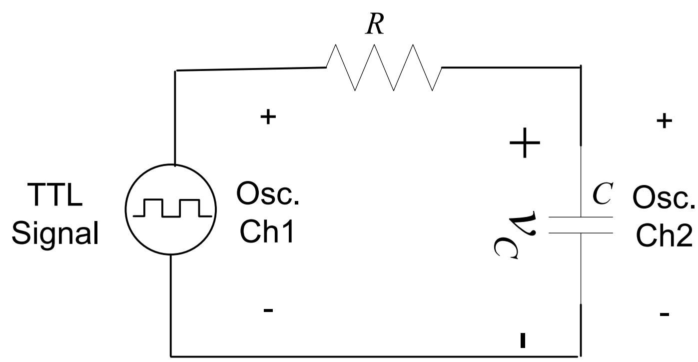
Explain whether the voltages that you have measured above are correct.
*(**Hint**: You may need to make use of the fact that the negative terminals of the oscilloscope probes are internally connected to the common protective GROUND.)*

c) Measuring the RC Time Constant [40%, 60mins]

Before you begin, *check that both channels of the oscilloscope are functional* using the oscilloscope's test signal.

Using the values of R, C and T_{PERIOD} you have chosen in Lab 4 part 1(a), construct the circuit below and apply a TTL Signal from the signal generator.

R = __________ ***C*** = __________ $\tau_{SIMULATED}$ = ______________



(1) Observe the voltage drop across the capacitor on the oscilloscope and obtain a clear waveform.

A good waveform will **clearly** demonstrate the charging and discharging process of the capacitor. You need to *adjust the frequency of the TTL signal* slightly in order to observe a nice waveform to measure the time constant.

Final Frequency of TTL Signal = ______________________

(2) Measure the value of the time constant.

The time constant is defined as the time taken from the signal change to reach 63.2% of final steady-state value.

Adjust the time scale in both vertical and horizontal axes **OR** use cursors to read the value of the time constant.

Time Constant Measurement from Oscilloscope, $\tau_{MEASURED}$ = _____________

(3) SKETCH one cycle of BOTH waveforms.

Mark out clearly on the waveform, the points used in measuring the time constant and the coordinates **(time, voltage)** of these points.

Note down the following

i. Voltage Scale = /Div

ii. Time Scale = /Div

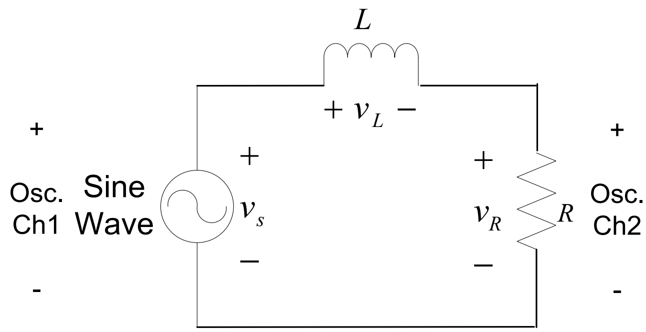
CH1 ———

CH2 ---------

d) Measuring the Phase Difference in a RL Circuit [40%, 60mins]

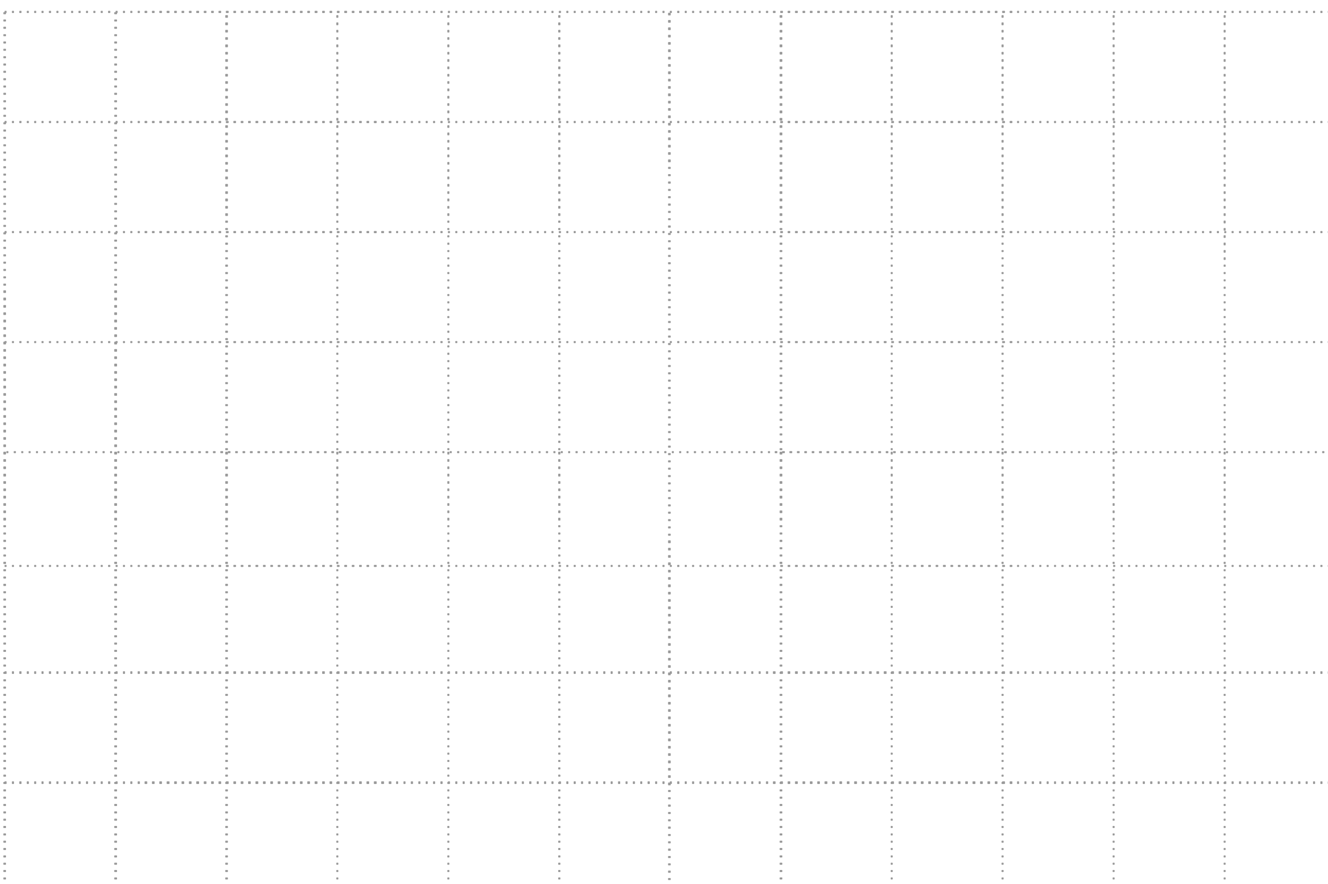
Using the values of R, L and frequency from Lab 4 part 2(b), construct the circuit below and apply a **SINUSOIDAL** Signal from the signal generator.

R = ________ **L** =_________ **Frequency of Input Sine Wave** = ___________



(1) Observe V_R and V_S on the oscilloscope and plot their waveforms below:

CH1 ———
CH2 ---------



(2) Measure the time difference between v_R (CH2) and v_S (CH1) and mark out on the waveform, the coordinates (time, voltage) of the points used.

Calculate the phase difference and explain how it compares with the calculated value.

$$\Delta t =$$

Phase Difference, $\Delta\phi = \frac{\Delta t}{T} \times 360^\circ =$

Which channel is leading?

(3) RMS Values

Measure the RMS values of the voltages shown in the circuit using the **oscilloscope**. (Note: You need to swap the positions of R and L to measure v_L. Why?)

$$v_S =$$

$$v_R =$$

$$v_L =$$

Does the KVL equation hold good here?