



**EE 250/251**

**BASIC ELECTRICAL ENGINEERING**

**SUMMER 2021**

**EXPERIMENT # 8**

**BASIC AC MEASUREMENT**

<b>STUDENT NAME:</b>		<b>SECTION:</b>
<b>STUDENT ID:</b>		<b>COURSE ID:</b>

<b>SOs # 5</b>	<b>KPI 5.2</b>		<b>KPI 5.1</b>	
<b>SOs # 6</b>	<b>KPI 6.1</b>	<b>KPI 6.2</b>	<b>KPI 6.3</b>	<b>GRADES</b>
<b>SCORE</b>				<b>R</b>
<b>ASSIGNMENT</b>	<b>LAB#8( BASIC AC MEASUREMENT )</b>			<b>Q</b>
<b>RELEVANT PARTS</b>	<b>DEVELOPING</b>	<b>CONDUCTING</b>	<b>ANALYSIS AND INTERPRETATION</b>	<b>T</b>

**Note: All the students are directed to do necessary theoretical calculation for the experiments and come for the laboratory session.**

**OBJECTIVE:**

The of this experiment is to familiarize the students with the equipment in the electrical lab, specially

1. To learn the operational controls of function generator.
2. To learn the operational controls of Oscilloscope
3. To learn to measure amplitude, frequency and RMS value of waveform.
4. Determine the phase shift for the given series RC circuit.

**EQUIPMENTS REQUIRED:**

Sr. no	Name	Range	Quantity
1	Resistor	220Ω	1
2	Capacitor	1μF	1
3	Function generator	0-200MHz	1
4	Oscilloscope	0-200MHz	1
5	MULTISIM		1

**Function Generator:**

A **function generator** is usually a piece of electronic test equipment or software used to generate different types of electrical waveforms over a wide range of frequencies. Some of the most common waveforms produced by the function generator are the sine wave, square wave, triangular wave and sawtooth shapes.

**Oscilloscope:**

An **oscilloscope** is a laboratory instrument commonly used to display and analyze the waveform of electronic signals. In effect, the device draws a graph of the instantaneous signal voltage as a function of time.

**PROCEDURE: (HOW TO USE FUNCTION GENERATOR AND OSCILLOSCOPE) "READ APPENDIX A"**

1. Use the function generator and connect it to the oscilloscope in MULTISIM.
2. Set a frequency of 1 KHz in the function generator and 5V p/p voltage.
3. Select the shape of the waveform (sine, triangle, and Square)



Figure 1. Function Generator And Real Time Oscilloscope

### PROCEDURE TO MEASURE AMPLITUDE

4. Use the volt/div knob to adjust the voltage per square block on the oscilloscope.
5. To measure the amplitude of the waveform from the oscilloscope count the number of square blocks in the vertical direction(Y-Axis) between the peaks of the waveform as shown in figure 4 below.

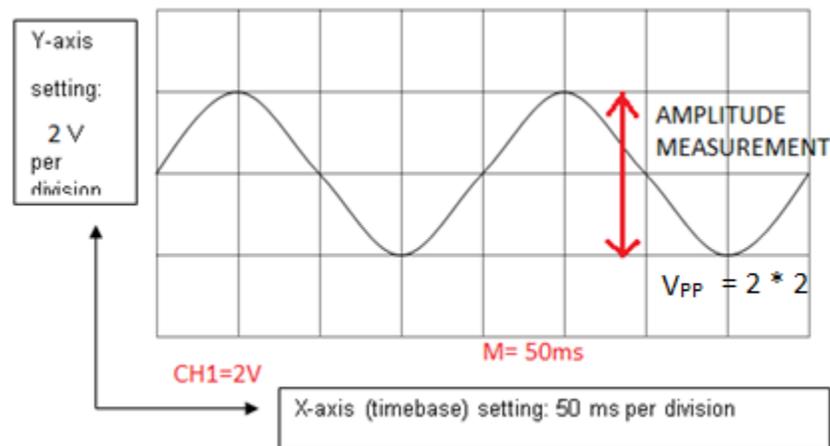


Figure 2. Schematic showing the measurement of amplitude from oscilloscope

6. Multiply the number of blocks with the voltage per block to get the peak to peak value of the amplitude.
7. Note the voltage in the table below.
8. Verify the voltage observed on the oscilloscope.

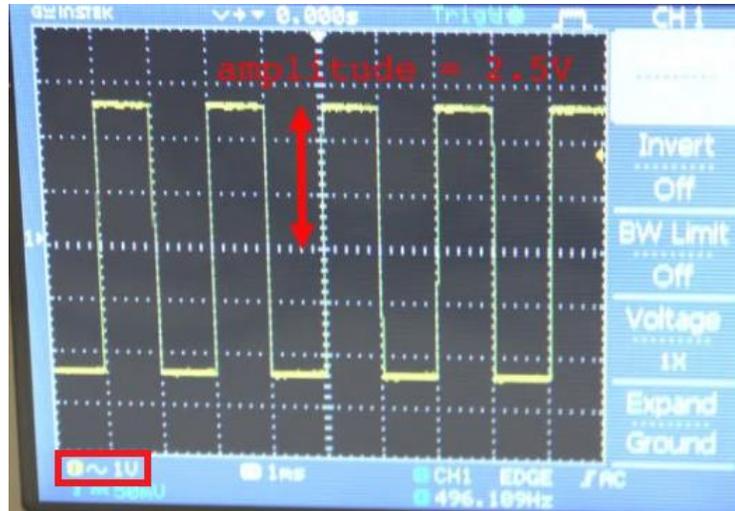
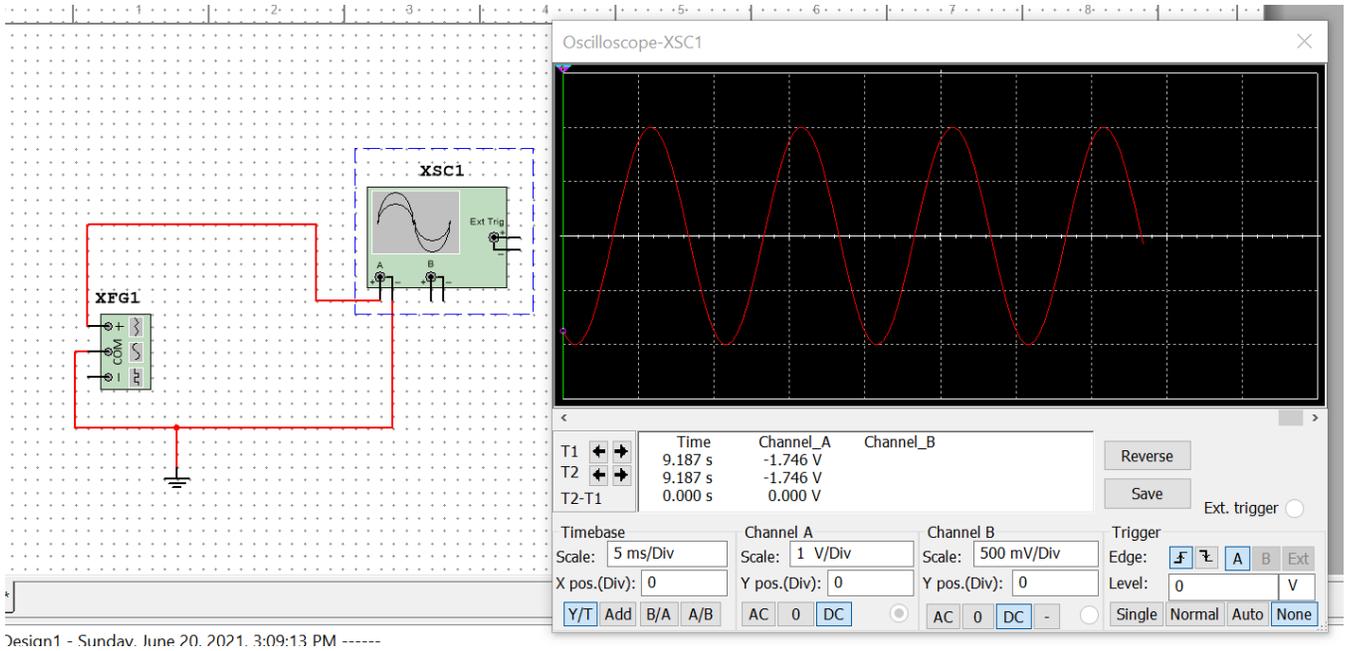


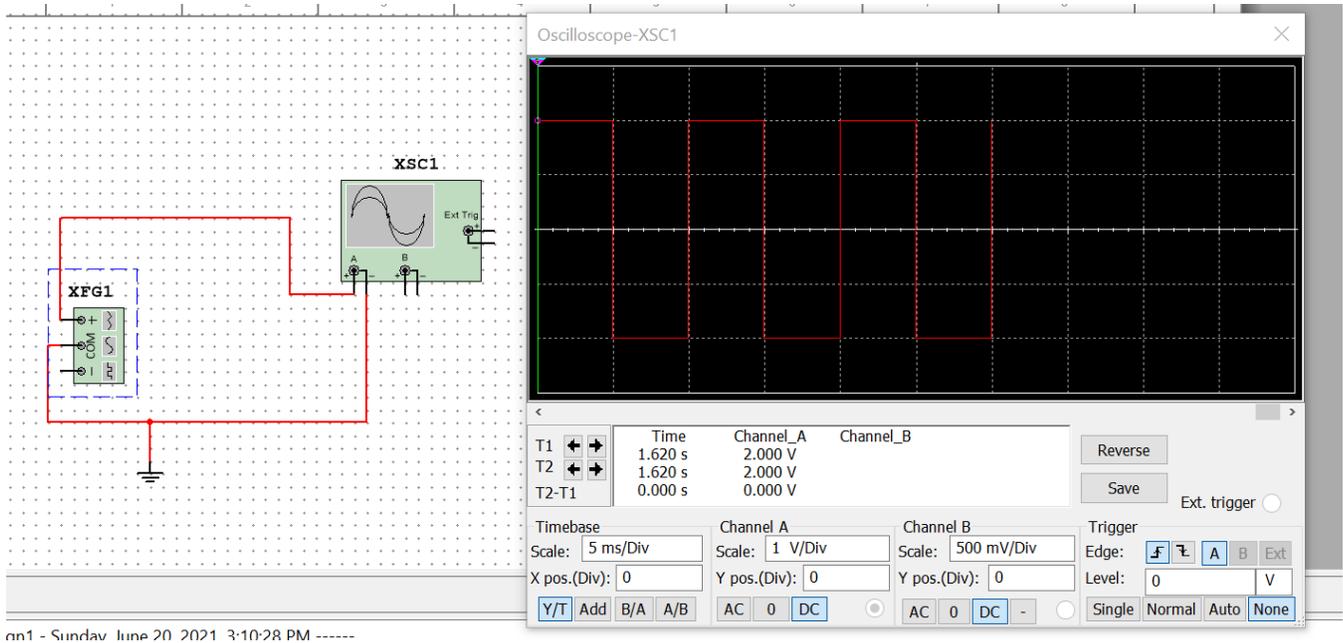
Figure 3. Image of waveform as on oscilloscope

**ADD SIMULATION RESULT HERE FOR ALL 3 WAVEFORMS**

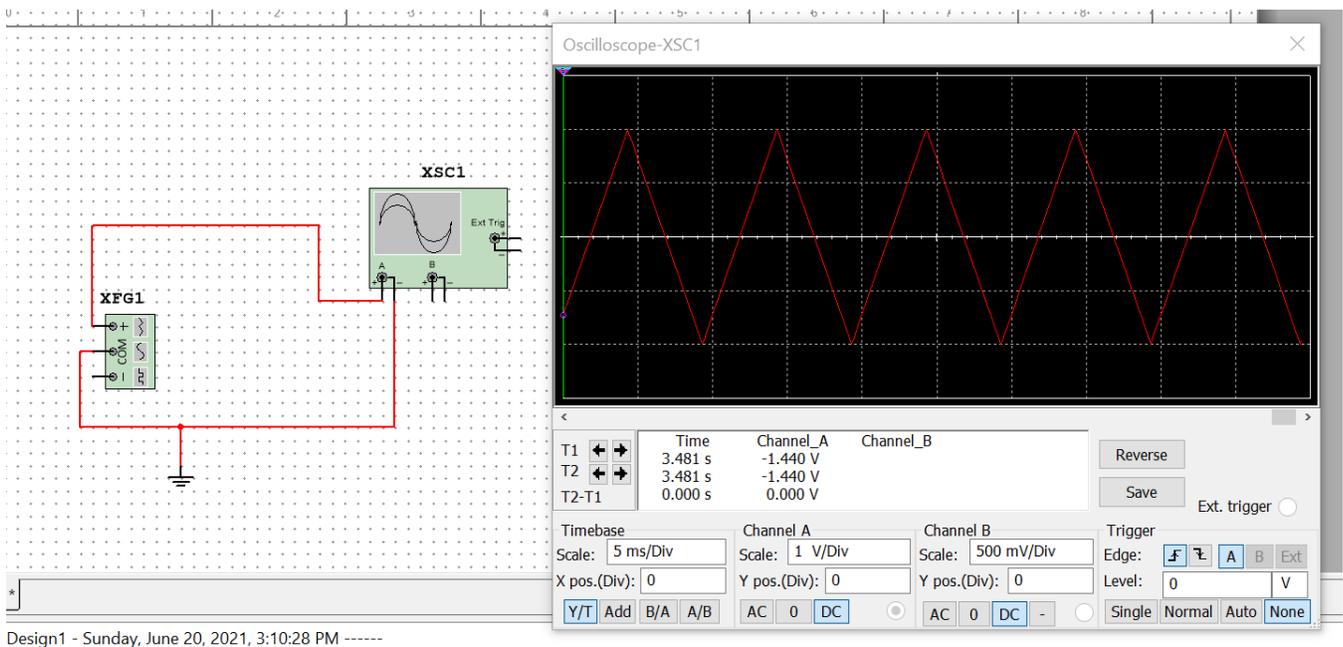
**1. SINE**



**2. SQUARE**



### 3. TRIANGLE



### PROCEDURE TO MEASURE FREQUENCY

1. Note the frequency set by function generator in the table below.
2. To measure frequency on oscilloscope, measure the time period of the waveform.
3. To measure the time period, count the number of square blocks between the peaks of the waveform in the horizontal direction(X-Axis) as shown in figure 6 below.

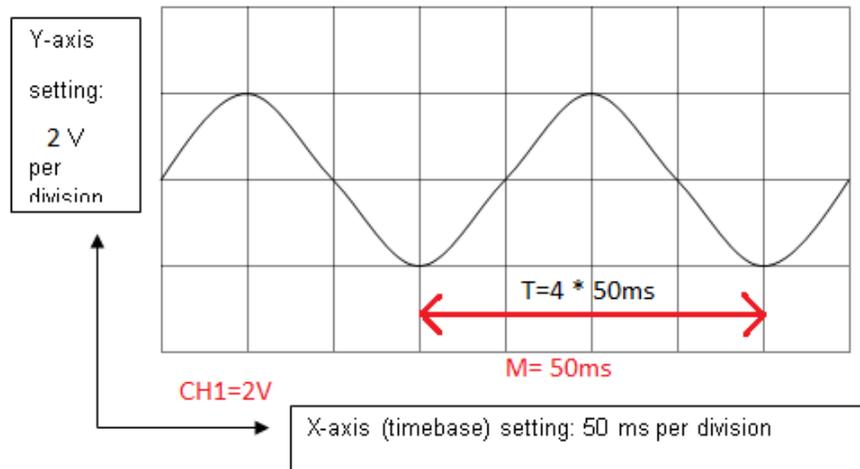


Figure 4. Schematic showing measurement of period of a waveform

4. Calculate the frequency using the formula  $F=1/T$

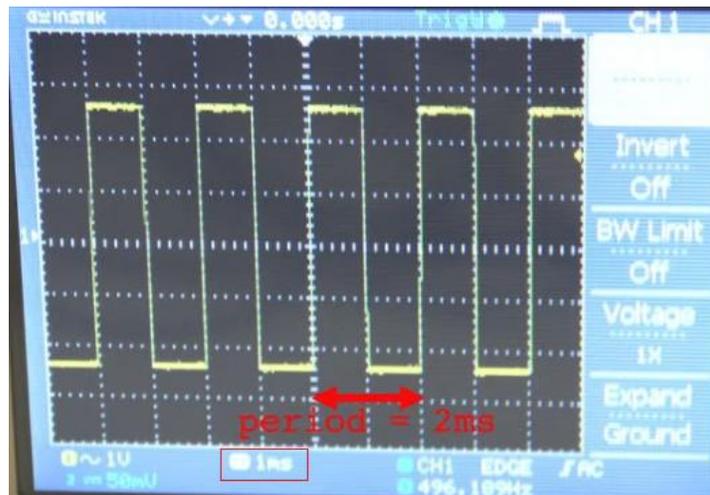
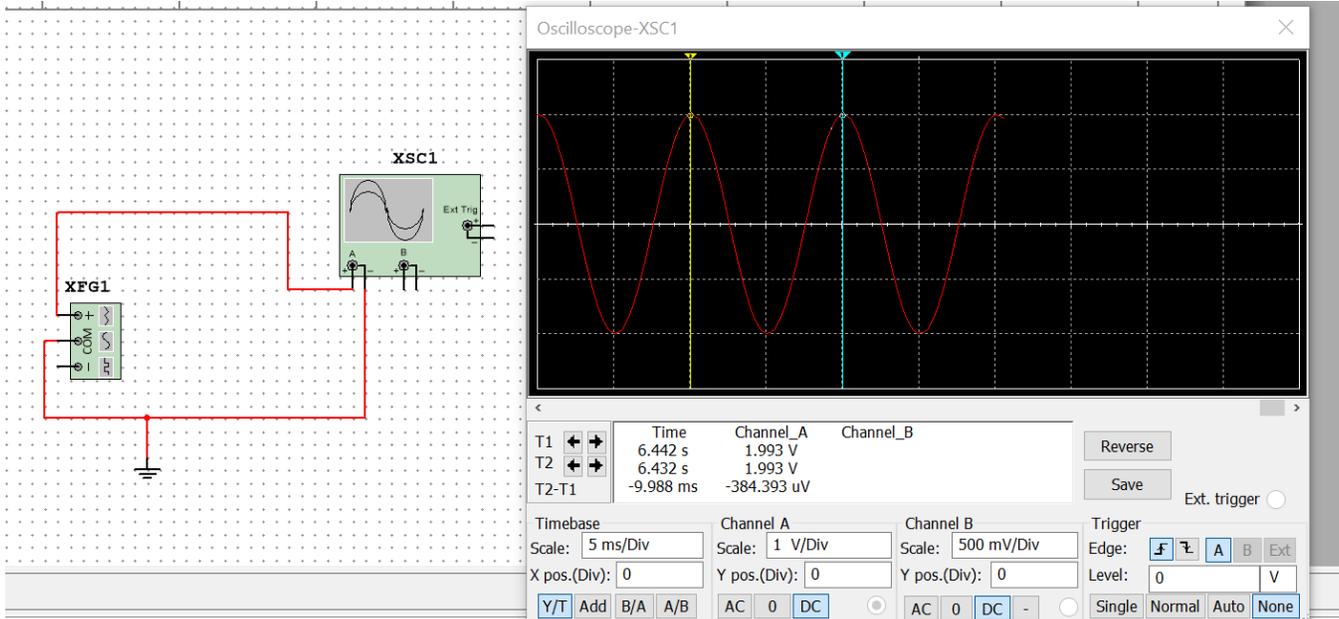


Figure 7. Image as seen on oscilloscope

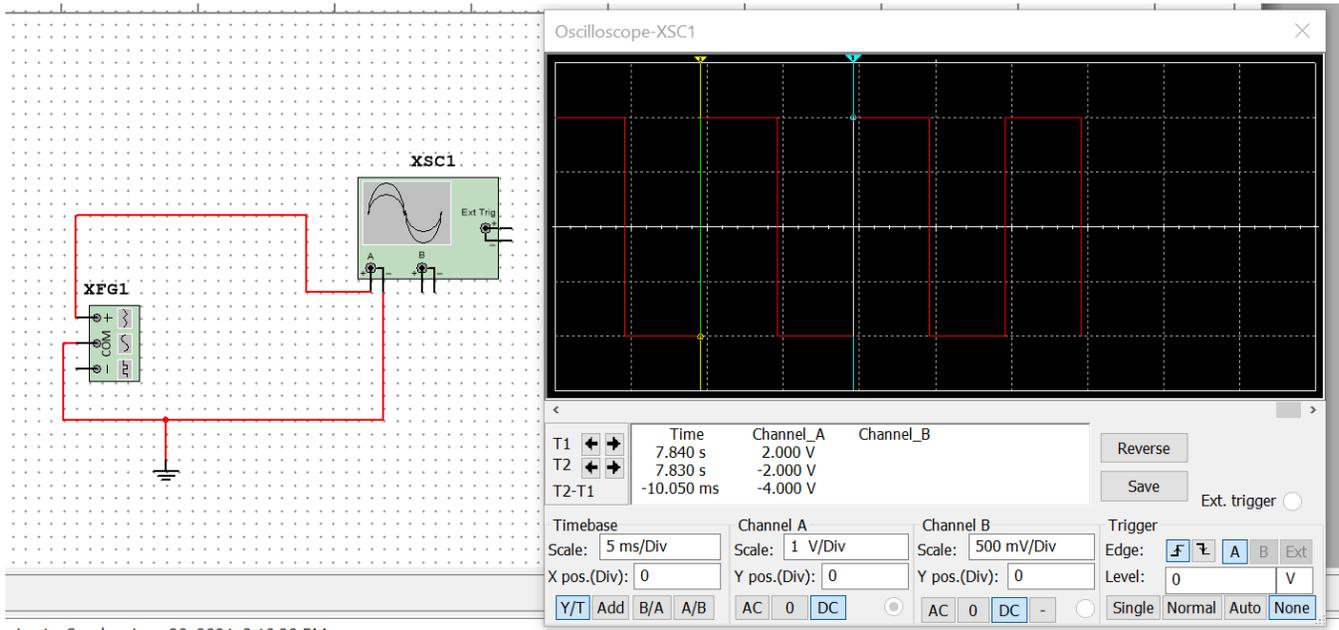
**ADD SIMULATION RESULT HERE FOR ALL 3 WAVEFORMS**

1. SINE



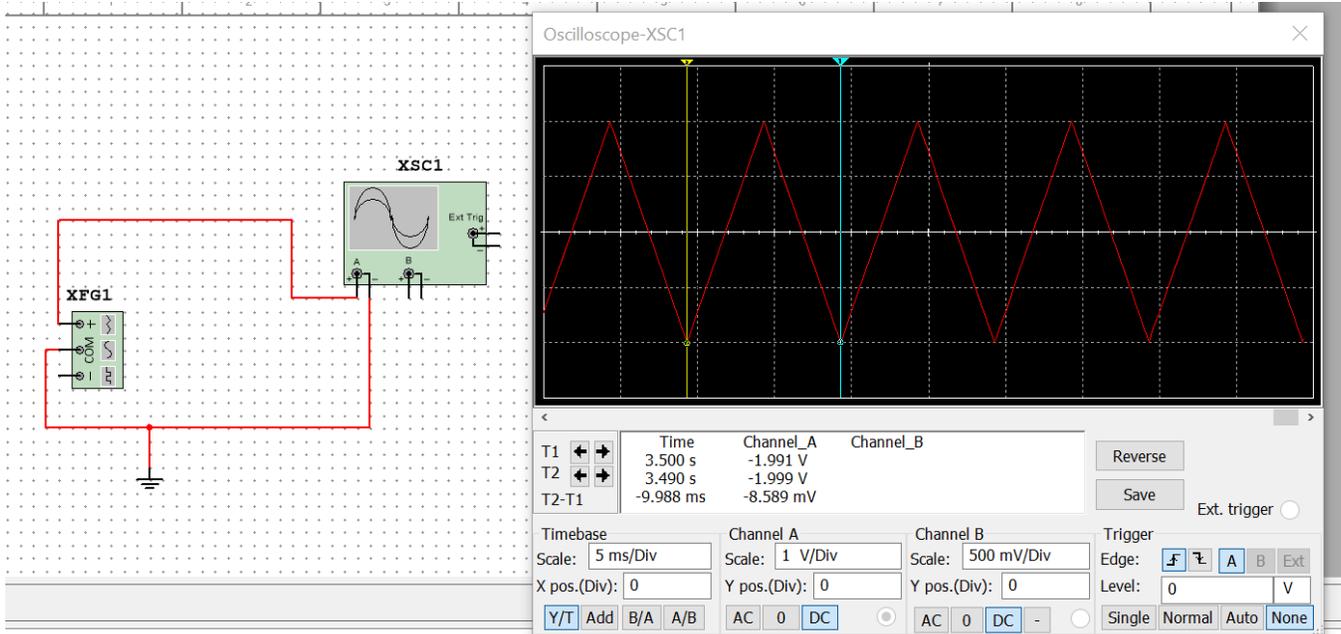
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## 2. SQUARE



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## 3. TRIANGLE



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### TO MEASURE RMS VALUE OF VOLTAGE

1. Apply the sinusoidal wave as input from the Function Generator.
2. Observe the output waveform in the CRO.
3. Note down the peak value of the output wave, from the CRO.
4. Calculate the RMS value and compare with the measured value.

$$V_{RMS} = \frac{V_P}{\sqrt{2}} \text{ (Sine Wave)}$$

$$V_{RMS} = \frac{V_P}{\sqrt{3}} \text{ (Triangle Wave)}$$

$$V_{RMS} = V_p \text{ (Square Wave)}$$

$$V_{RMS} = \frac{V_P}{\sqrt{3}} \text{ (Sawtooth Wave)}$$

**OBSERVATION TABLE 8.1:**

Waveform	P/P Voltage set by Function Generator, V	P/P Voltage measured by oscilloscope V	Frequency set by Function Generator Hz	Period measured by oscilloscope sec	Calculated frequency, Hz F=1/T	Calculated RMS value (V)	Measured RMS value (V)
Sine	4	4	100	9.988m	100.12	1.41	1.41
Triangle	4	4	100	9.988m	100.12	1.15	1.15
Square	4	4	100	10.050m	99.5	2	2

## PHASE DIFFERENCE MEASUREMENT

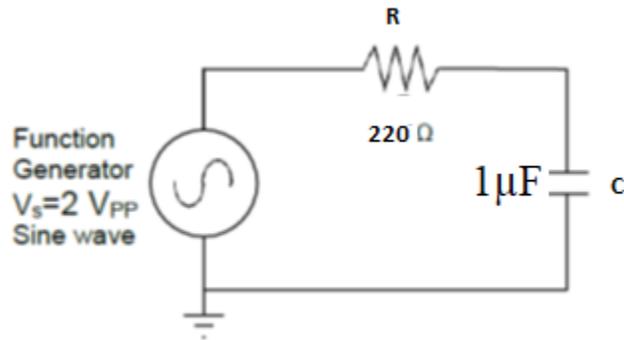


Figure 8. Series RC circuit

## PROCEDURE

1. Using the resistor **R** and capacitor **C** connect the series RC circuit shown in Figure 8.
2. Switch ON the function generator and select sine wave as the input signal.
3. Set the amplitude  $V_s$  of the wave to 2.0 V peak-to-peak at a frequency of 500 Hz.
4. Connect the output of the function generator to the oscilloscope CHANNEL 1.
5. Connect the output from across capacitor **C** to CHANNEL 2 of the oscilloscope.
6. Run the simulator and observe the waveform in the oscilloscope in YT MODE.
7. The waveform should appear as shown in figure 9 below.

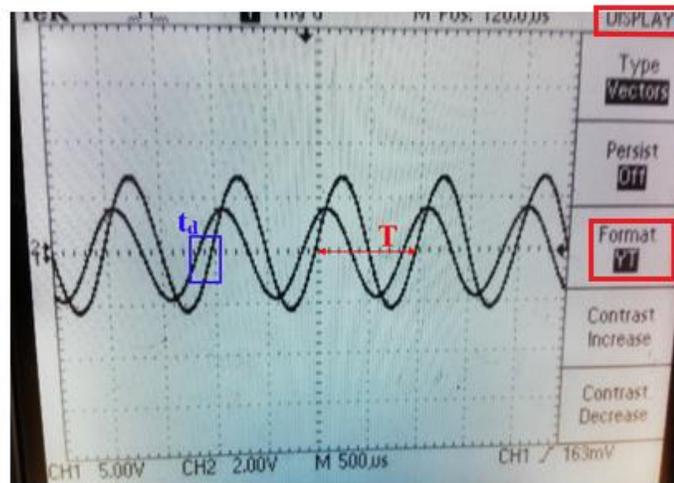


Figure 9. Phase shifted signal on oscilloscope

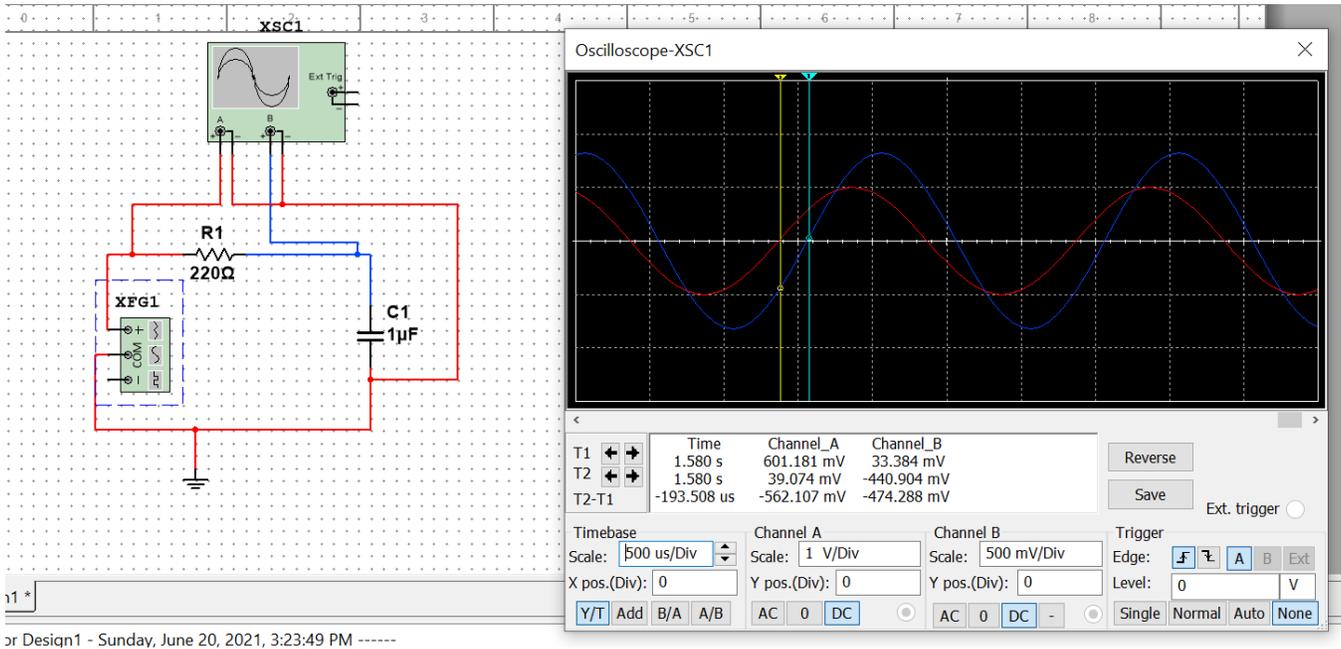
8. Note the shift " $t_d$ " between the signal and the time period " $T$ " of the input signal and record these reading in table 8.2.

9. Using expression (1) calculate the phase " $\phi$ "

$$\phi_{Measurement} = 360 \times \left(\frac{t_d}{T}\right) \dots\dots\dots(1)$$

10. This method of phase measurement is called as the TIME DELAY method.

**ADD SIMULATION RESULT HERE (TIME DELAY)**

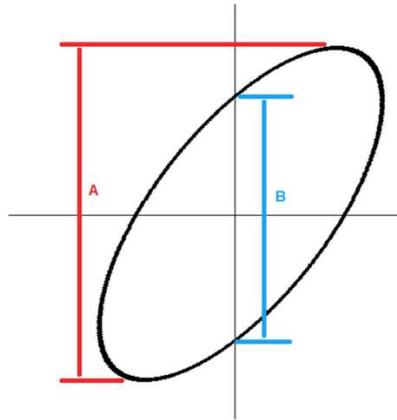


11. Phase difference using the lissajous method can be done in the following way;

12. Setup the two signals in the oscilloscope in XY MODE in the oscilloscope to obtain the **Lissajous Figures** as shown below.

13. Note the value of A and B as shown in the figure.

14. Calculate the value of " $\phi$ " using the formula.

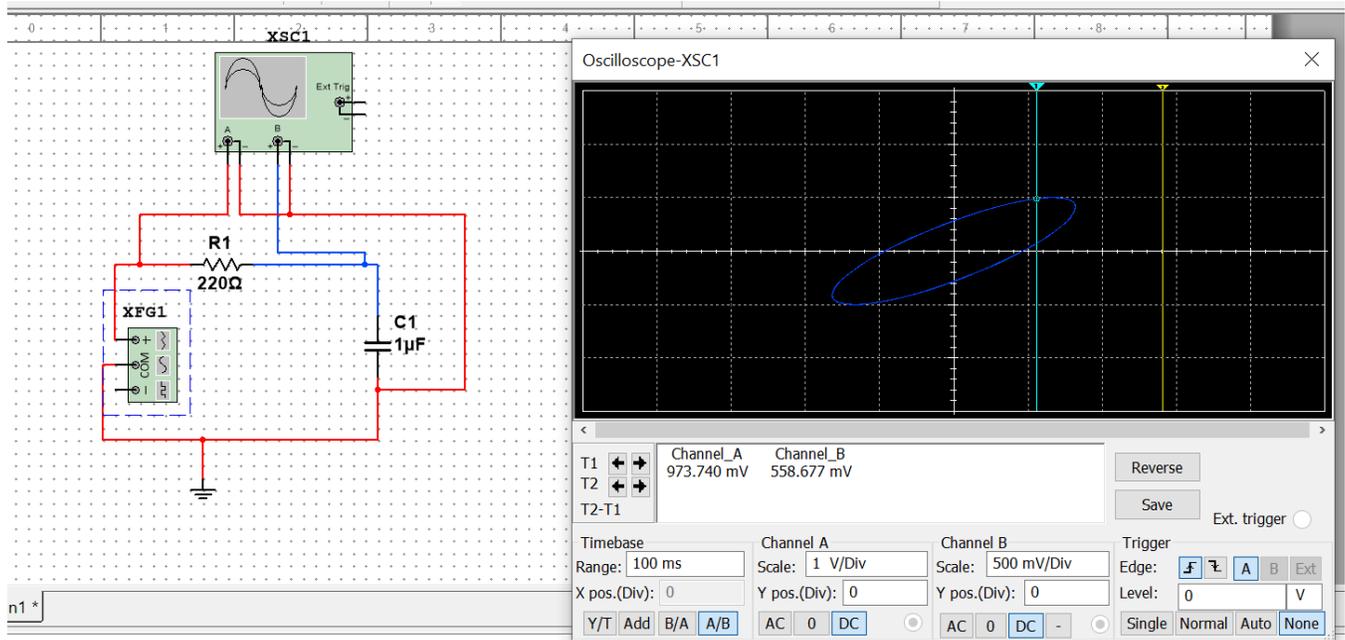


$$\sin \Phi = \frac{B}{A}$$

$\Phi = \text{Phase Angle}$

Figure 10. Lissajous Figures

**ADD SIMULATION RESULT HERE (LISSAJOUS METHOD)**



**OBSERVATION TABLE 8.2**

Frequency set from FG (Hz)	$t_d$ sec	T sec	$\phi$ (measd) (°)	B	A	$\phi$ (measd) (°)
500	193.508 micro	0.002	34.83	1.140424	1.94748	35.844

