EXPERIMENT 1
Basic Signal Measurement Using Oscilloscope and Function Generator

OBJECTIVE

The objectives of this experiment are:

- To learn the basic operation and use of the oscilloscope and function generator.
- To generate sinusoidal, square, and triangular waveforms with specified amplitude and frequency using a function generator.
- To observe and measure signal parameters such as peak-to-peak voltage and frequency using an oscilloscope.
- To measure the RMS voltage of different waveforms using a Digital Multimeter (DMM).
- To compare the theoretical RMS values calculated in the preliminary work with the experimentally measured values.
- To develop skills in waveform observation, measurement, and signal interpretation.

EQUIPMENT

- Oscilloscope
- Function Generator
- Digital Multimeter (DMM)
- Oscilloscope Probe
- 1 kΩ resistor
- Connecting wires

PRELIMINARY WORK

P1 Calculate the RMS values of the following waveforms using the formula

$$V_{RMS} = \sqrt{\frac{1}{T}\int_0^T v(t)^2 dt}$$

a) Sinusoidal waveform

$$v(t) = V_m \sin\left(\frac{2\pi}{T}t\right) \quad for \quad 0 \le t \le T$$

b) Square waveform

$$v(t) = \quad V_m \quad for \quad 0 \le t \le \frac{T}{2}$$

$$v(t) = -V_m \quad for \quad \frac{T}{2} \le t \le T$$

c) Triangular waveform

$$v(t) = \frac{4V_m t}{T} \qquad for \quad 0 \le t \le \frac{T}{4}$$

$$v(t) = 2V_M - \frac{4V_m t}{T} \qquad for \quad \frac{T}{4} \le t \le \frac{3T}{4}$$

$$v(t) = -4V_M + \frac{4V_m t}{T} \qquad for \quad \frac{3T}{4} \le t \le T$$

EXPERIMENTAL WORK

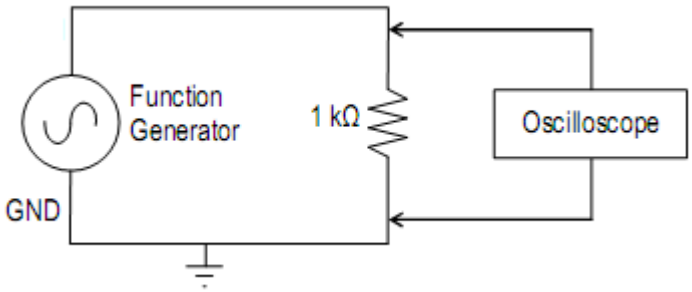

Figure 1.1

E1 Setup the circuit given in Figure 1.1.

a) Generate a sine wave with Vpp = 10V and f = 1kHz.
   I. Measure and **record** the RMS voltage across the 1kΩ resistor.
   II. Measure the voltage across 1kΩ resistor using oscilloscope. **Draw** the waveform.
b) Generate a triangular wave with Vpp = 10V and f = 1kHz.
   I. Measure and **record** the RMS voltage across the 1kΩ resistor.
   II. Measure the voltage across 1kΩ resistor using oscilloscope. **Draw** the waveform.
c) Generate a square wave with Vpp = 10V and f = 1kHz.
   I. Measure and **record** the RMS voltage across the 1kΩ resistor.
   II. Measure the voltage across 1kΩ resistor using oscilloscope. **Draw** the waveform.

When drawing the waveform in your report:

- Draw the waveform using a grid similar to the oscilloscope screen.
- Indicate the oscilloscope settings:
  - Vertical scale: VOLTS/DIV
  - Horizontal scale: SEC/DIV
- The number of divisions in your drawing must match the oscilloscope display.
- Clearly label Vm and T on the waveform.

CONCLUSION

C1 Calculate the RMS values using the formulas that you obtained in preliminary work by taking $V_m = 5V$. Compare the results that you obtained in the experiments. If there are any differences, explain why?