SINUSOIDAL WAVE

AC CIRCUITS

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TOPIC OUTLINE

Sinusoidal Wave Parameters

- **Instantaneous Voltage**

- **Peak Voltage**

- **Root-Mean-Square Voltage**
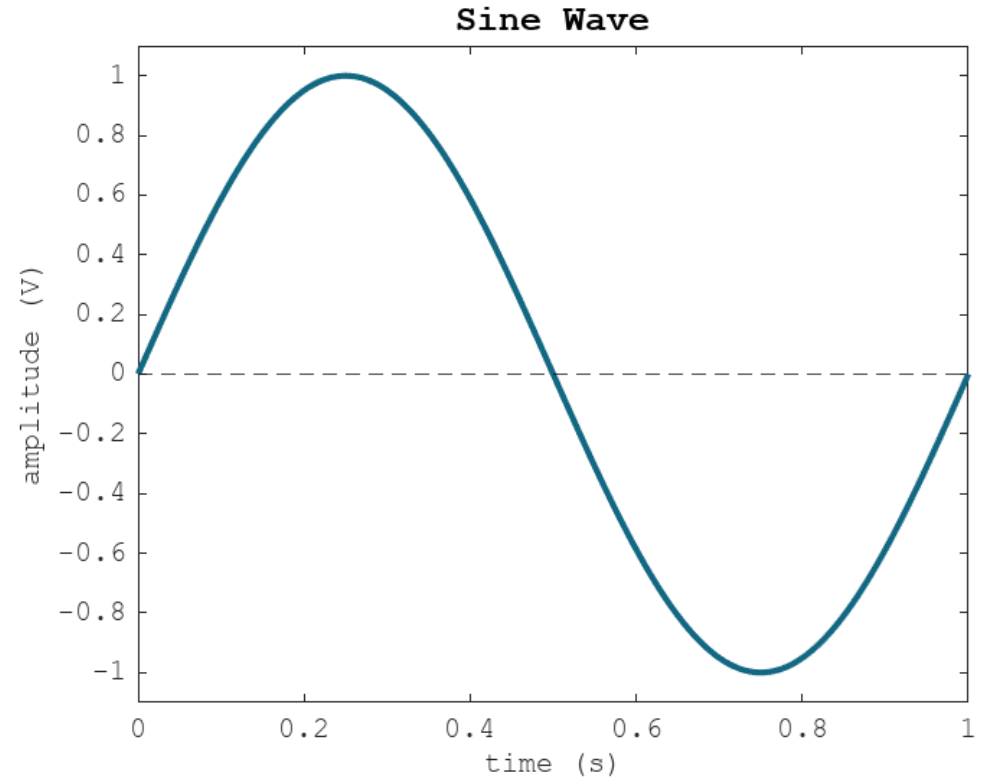
- **Period and Frequency**

SINUSOIDAL WAVE PARAMETERS

SINUSOIDAL WAVE

A **sinusoidal wave** is a periodic oscillation described mathematically by the **sine** or **cosine function**. It is the foundation for analyzing alternating current (AC) circuits, which are essential in power systems, communication systems, and signal processing.

Sine Wave

INSTANTANEOUS VOLTAGE

Instantaneous voltage ($v(t)$) refers to the value of voltage at a specific instant in time during the cycle of a sinusoidal (AC) waveform.

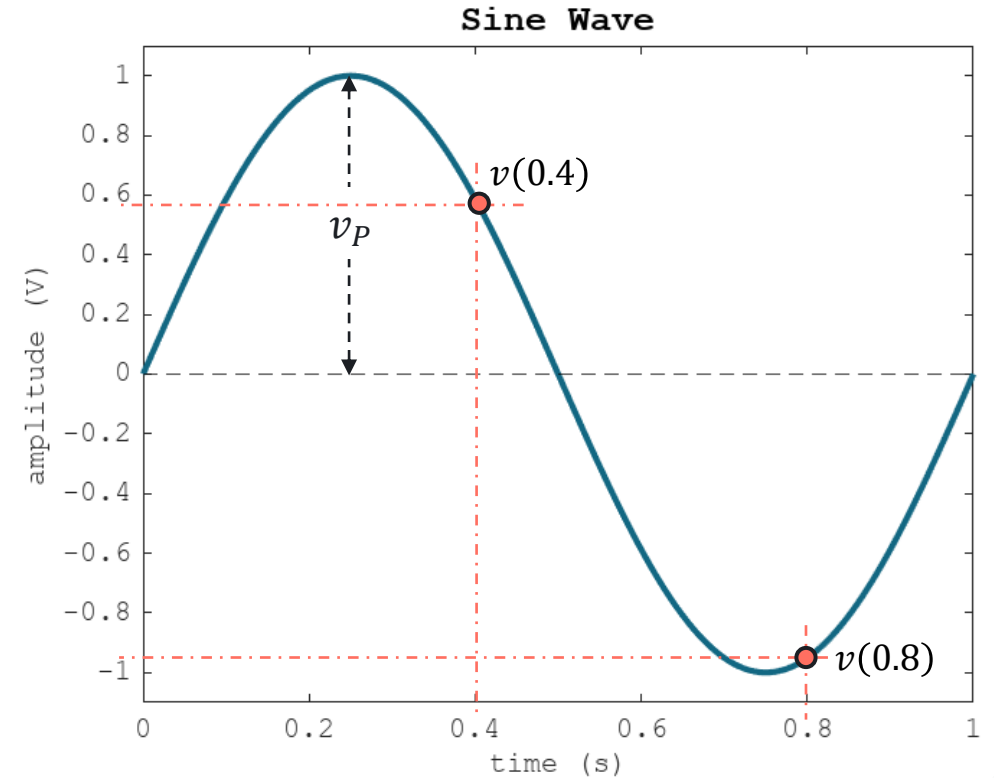Formula

$$v(t) = v_p \sin \omega t$$

where:

$v(t)$ = instantaneous voltage (V)

v_P = peak/maximum voltage (V)

$\omega = 2\pi f$ = angular speed (rad/s)
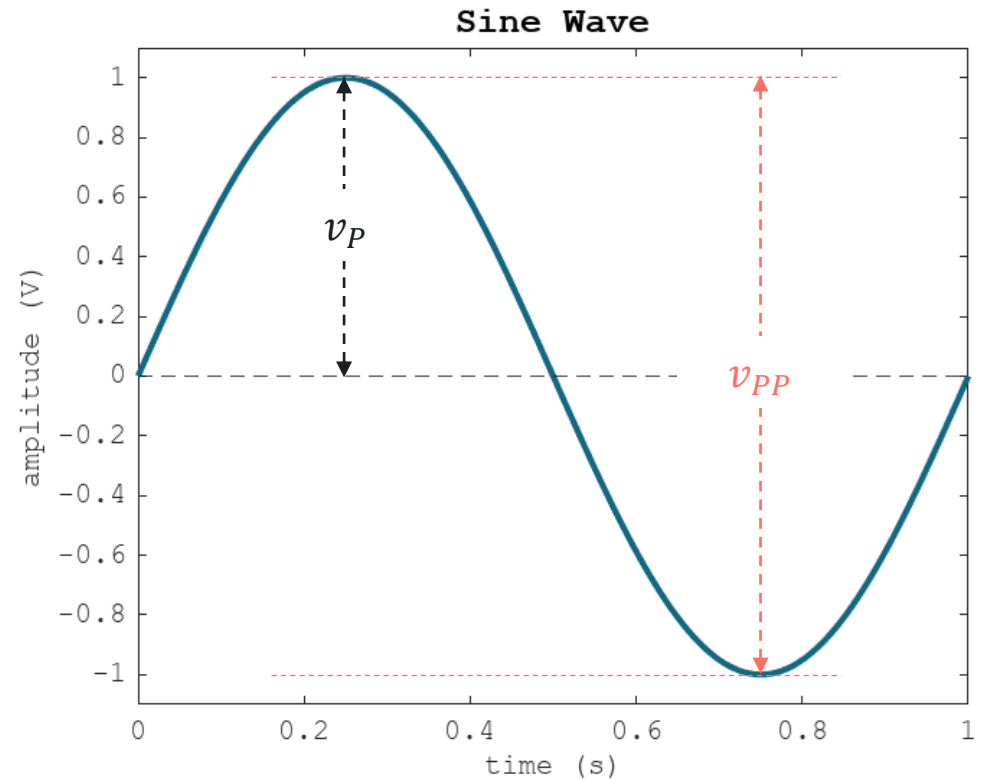
f = frequency (Hz)

t = time (s)

Sine Wave

PEAK-TO-PEAK VOLTAGE

Peak-to-peak voltage (v_{PP}) is the total voltage range of an AC waveform. It is the difference between the highest positive point ($+v_P$) and the lowest negative point ($-v_P$) of the wave.
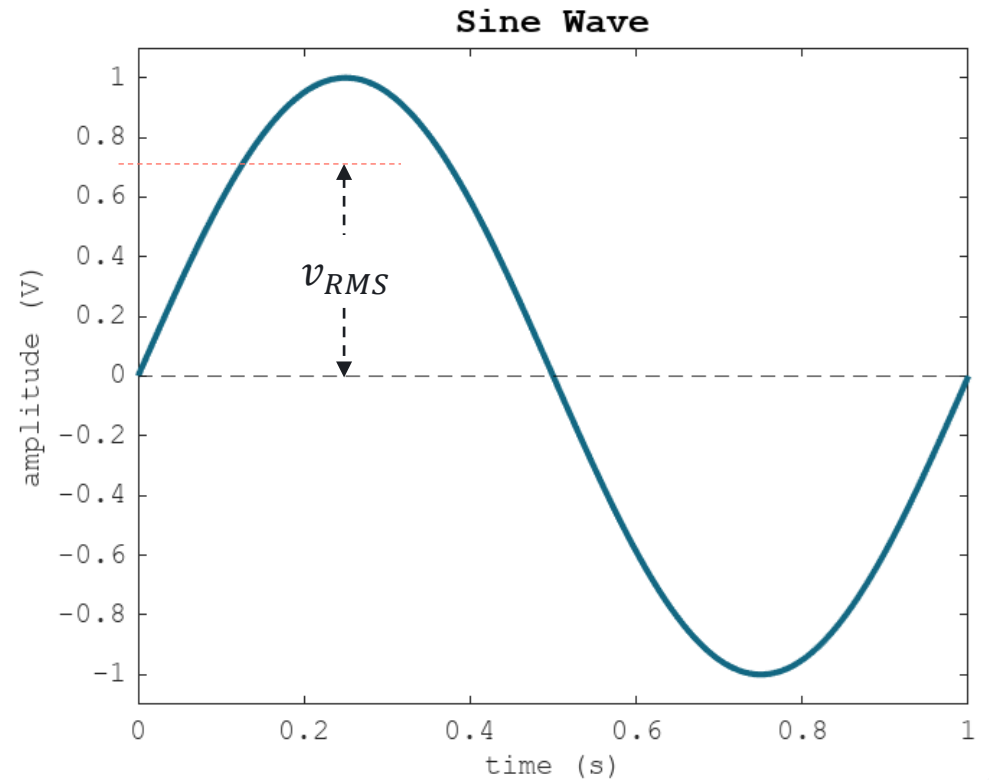
Formula

$$v_{PP} = 2v_P$$

ROOT-MEAN-SQUARE VOLTAGE

The **root-mean-square voltage** (v_{RMS}) is a measure of the **effective voltage** of an AC signal. When you measure an AC voltage using a multimeter, the displayed value is the RMS voltage.
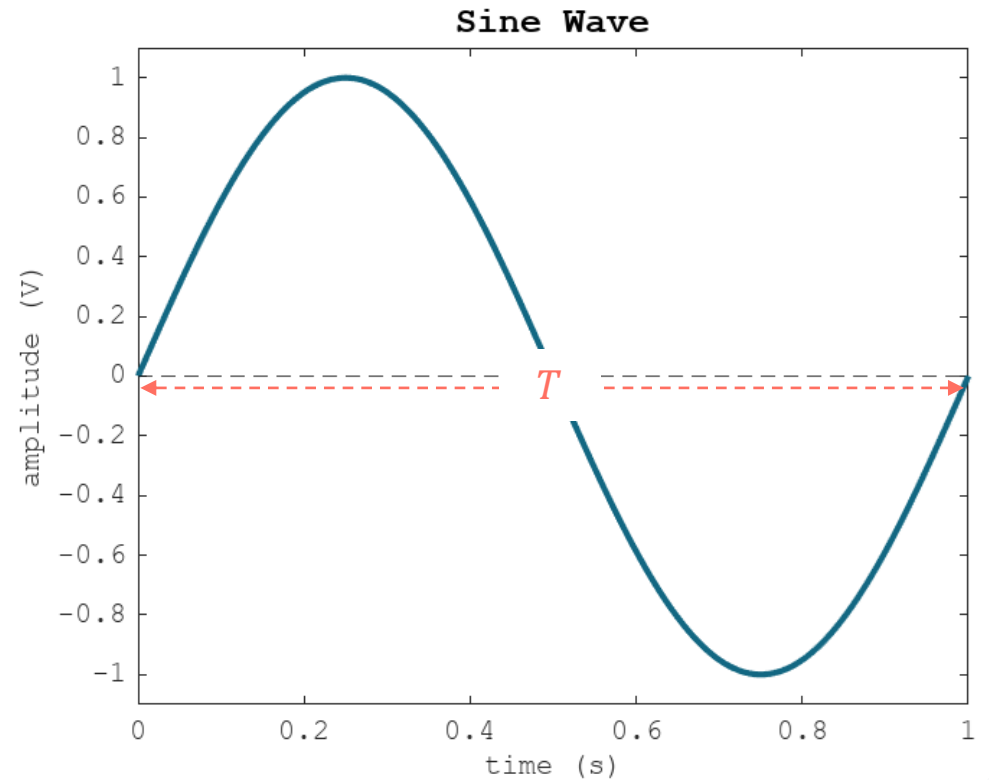
Formula

$$v_{RMS} = \frac{v_p}{\sqrt{2}}$$

Sine Wave

PERIOD AND FREQUENCY

The **period** (**T**) of a waveform describes the time it takes for **one complete cycle** of the waveform to occur. It is the inverse of the **frequency** (**f**), which is the **number of cycles** that the occur per second.

Formula

$$T = \frac{1}{f}$$

Sine Wave

EXERCISE

The rms value of the voltage in a 60-cycle circuit is 115 volts. Write the equation for the sinusoidal wave.

Solution

EXERCISE

A sinusoidal voltage waveform is described by the equation:

$$v(t) = 120 \sin 377t$$

Determine the following:

a. Frequency (f)

b. Period (T)

c. RMS voltage (v_{RMS})

d. Peak-to-peak voltage (v_{PP})

e. If this voltage is applied across a 10Ω resistor, what is the average power dissipated in the resistor?

Solution

LABORATORY