

EE2111A Activity Sheet - Week 2 Studio 1

Start	Duration	Activity
0:10	20 mins	Briefing
0:30	60 mins	Activity #1: Understanding sinusoidal waveforms
1:30	70 mins	Activity #2: Finding phase-shift using CircuitLab

Learning Objectives

To be able to

- explain different parameters used for describing a sinusoidal waveform, and
- explain the concept of phase lead/lag in AC circuits.

Phase lead and phase lag

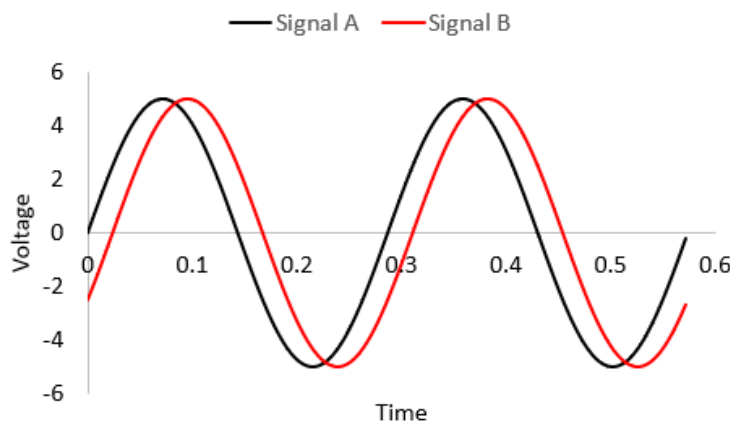


Figure 1: Between the two sine waves shown, Signal A (black) leads Signal B (red) or Signal B lags Signal A

Activity #1 : Understanding sinusoidal waveform

Group size: This is an individual activity.

For waveforms shown in Figure 2 to Figure 5, determine the amplitude A , radian frequency ω , and phase ϕ so as to describe each one of them using the function:

$$v(t) = A \sin(\omega t + \phi).$$

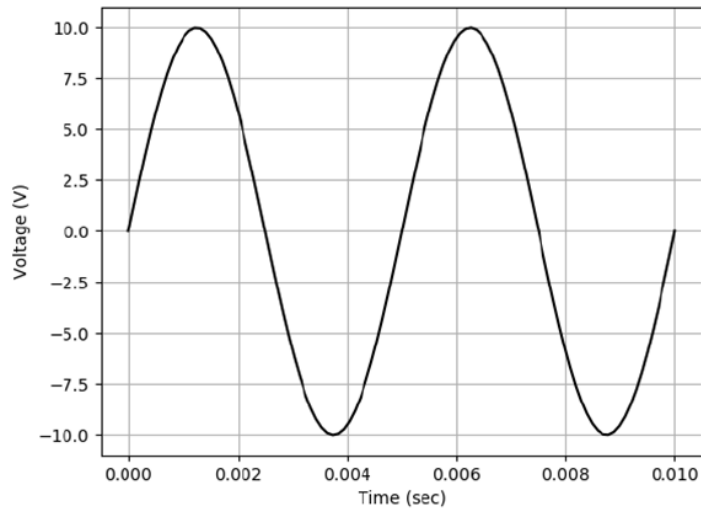


Figure 2: Sinusoidal A

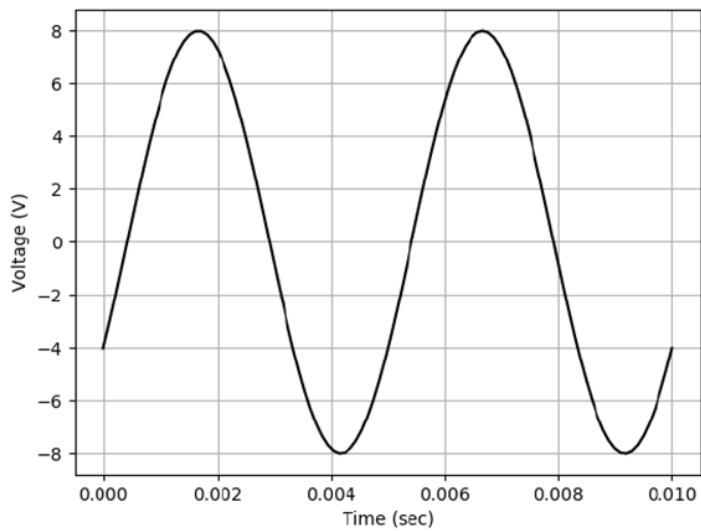


Figure 3: Sinusoidal B

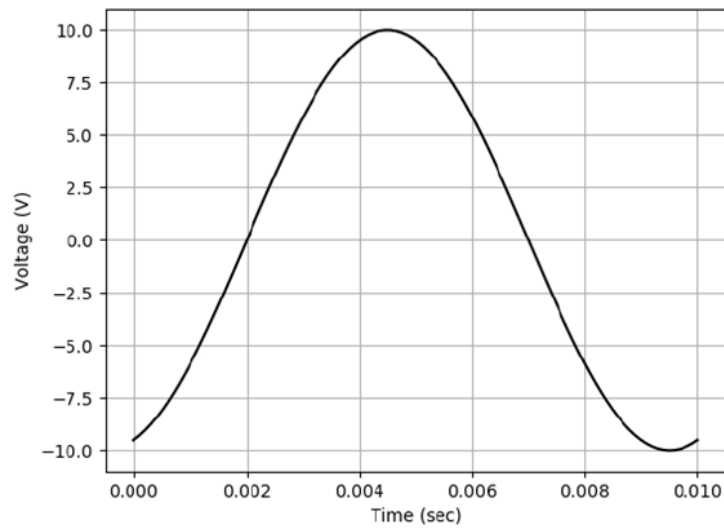


Figure 4: Sinusoidal C

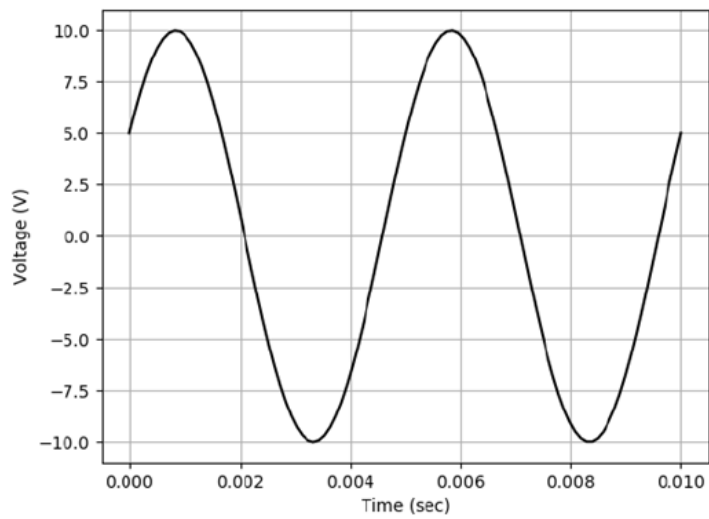


Figure 5: Sinusoidal D

Activity #2 : Find phase-shift using CircuitLab

Group size: This is an individual activity

In this activity, you will find phase difference between voltage and current in (a) series R-R, (b) series C-R and (c) series L-R circuits using CircuitLab simulator.

- You will simulate the circuit shown in Figure 6 using **CircuitLab** for three different components in place of the rectangular box:
 - Resistor: $120\ \Omega$
 - Capacitor: $0.1\ \mu\text{F}$, and
 - Inductor: $1\ \text{mH}$
- $V_s(t)$ is a 5 V, 10 kHz sinusoidal voltage source.
- Set time-domain simulation parameters. A sample is shown in Figure 7.
- Observe the input voltage $V_s(t)$ and the current $I(t)$ as output of the simulation.
- Determine the phase shift of $I(t)$ with respect to $V_s(t)$.

E-logbook:

A. Activity #1: Write the expression

$$A \sin(\omega t + \phi)$$

for all four cases.

B. Activity #2: For each of the three cases,

- Show simulation waveform: $V_s(t)$ and $I(t)$.
- What is the phase shift of $I(t)$ with respect to $V_s(t)$ (including sign)?
- Mention whether current I leads or lags the source voltage $V_s(t)$?

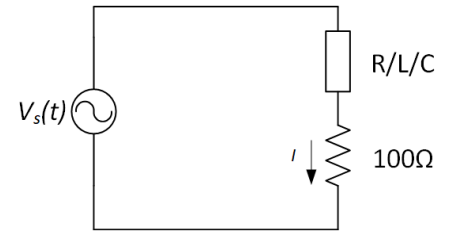


Figure 6: You can make this circuit an R-R, C-R, and L-R, respectively, by using R, C, and L in place of the rectangular box.

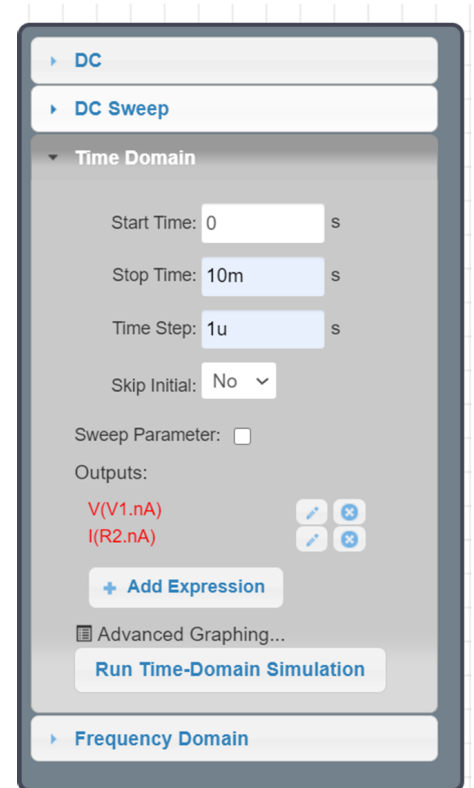


Figure 7: CircuitLab simulation setting

Appendix

- CircuitLab is a web-based simulator that can be used for schematic design, simulation of circuit, and viewing the waveform.
 - Circuit simulation allows us to predict, replicate or model the behaviour of actual circuits using mathematical models.
 - The waveform viewer allows us to graph electrical voltages and currents thus making it easy to observe trends and relationships between variables.
1. Go to <https://www.circuitlab.com/> and sign up for an account using your **NUS Email Account**.
 2. You will receive an email verification link via your NUS email account. Click on the link to verify your account.
 3. Once the account has been verified, visit the url below to activate the license! <https://www.circuitlab.com/accounts/eduverify/>
 4. For a quick start guide on how to create and simulate a circuit in CircuitLab, watch the introduction video at [this link](#). The CircuitLab YouTube channel provides many other easy to follow video tutorials on circuit simulation.