PRAG 304L: Electrical Diagnostics for Farm Machinery Lab
Instructor: Dr. Pappu Kumar Yadav
Spring 2025

Lab 3: Getting Used to MATLAB/Simulink Environment

1. Overview

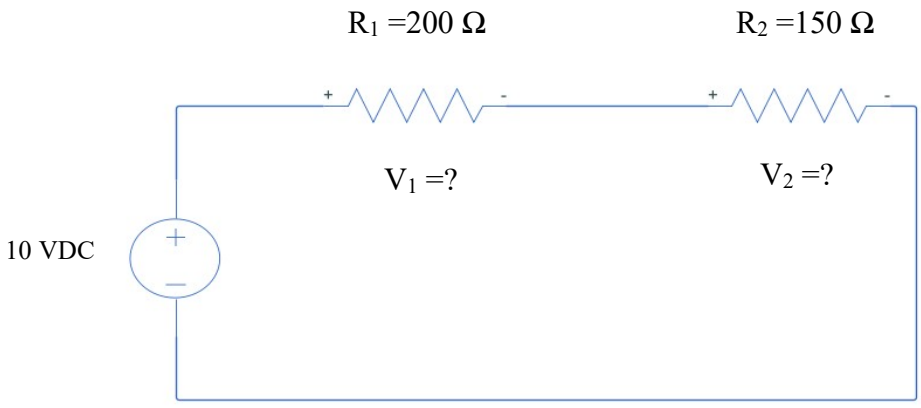
MATLAB (Matrix Laboratory) is a high-level language and interactive environment used for numerical computation, visualization, and programming. It allows matrix manipulations, plotting of functions and data, implementation of algorithms, and creation of user interfaces.
Simulink is a block diagram environment for multi-domain simulation and Model-Based Design. It supports simulation, automatic code generation, and continuous test and verification of embedded systems.
In this and all the following labs we will be using Simulink to design electrical/electronic circuits and visualize their outputs graphically and numerically.

2. Objectives

i. To become familiar with the MATLAB and Simulink environments.
ii. To learn how to create resistive circuit models in Simulink using Simscape Electrical toolbox.
iii. To learn how to simulate resistive circuit models in Simulink using Simscape Electrical toolbox.

3. Experiment

In this experiment, we will create a simple circuit with a 10 VDC power supply, two resistors in series with R_1 =200 Ω and R_2 = 150 Ω. The goal is to measure voltage drops across both the resistors.

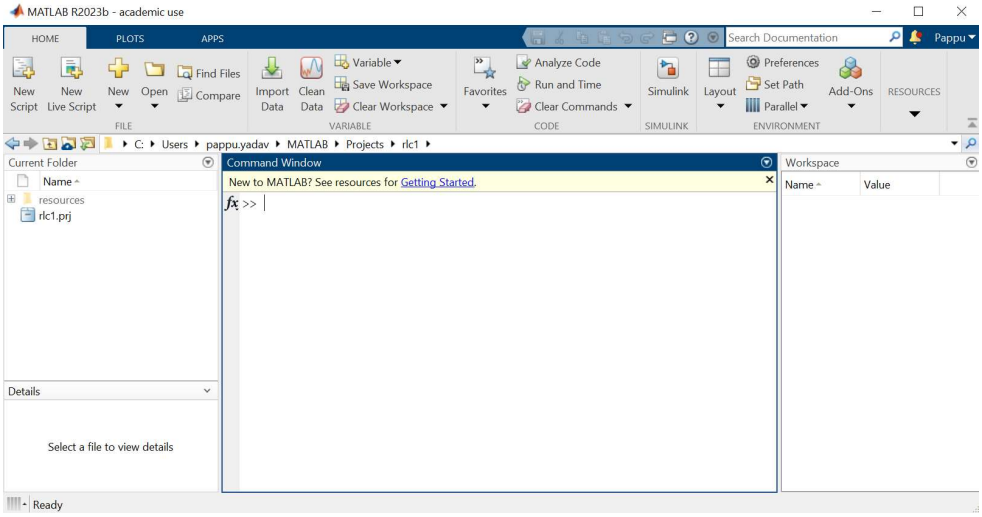


4. Procedure

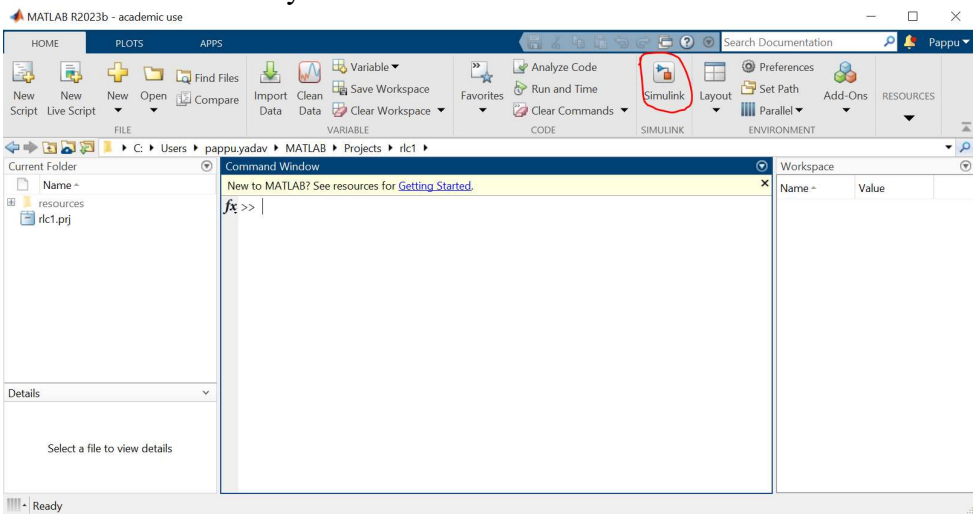
i. Open MATLAB Software on your lab computer. The symbol should appear like this.

ii. When opening the first time, make sure to create an account with MATLAB using your South Dakota State University email address.

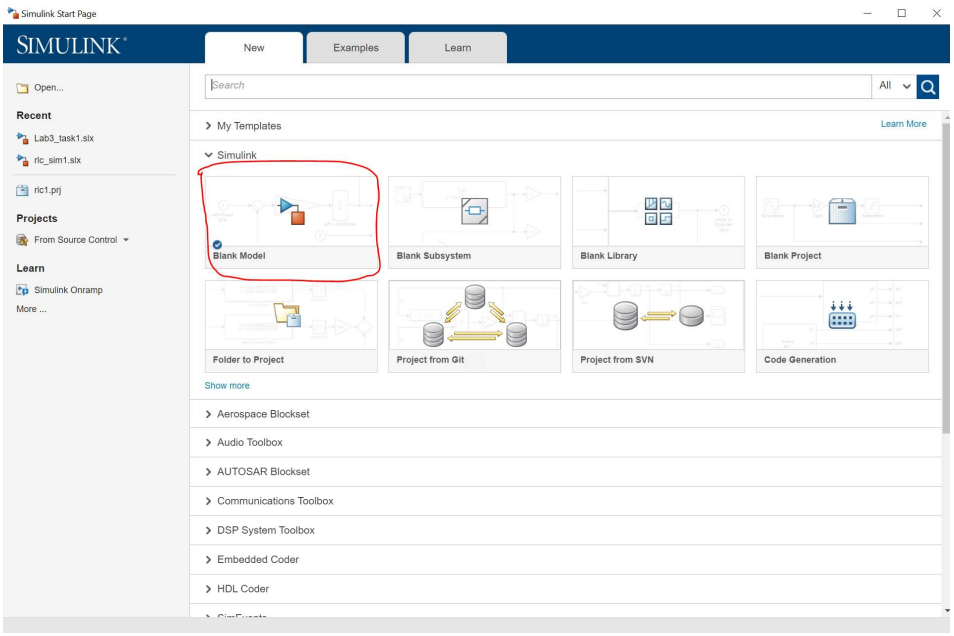
iii. You will see a window like this when MATLAB opens successfully.



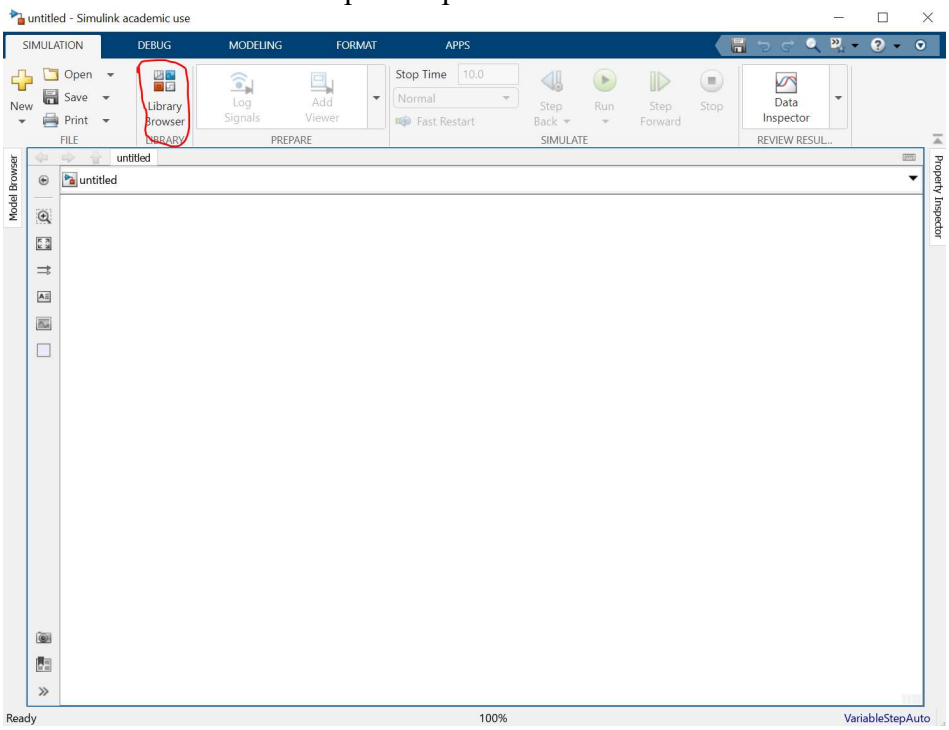
iv. Click on “Simulink” symbol within the software environment.



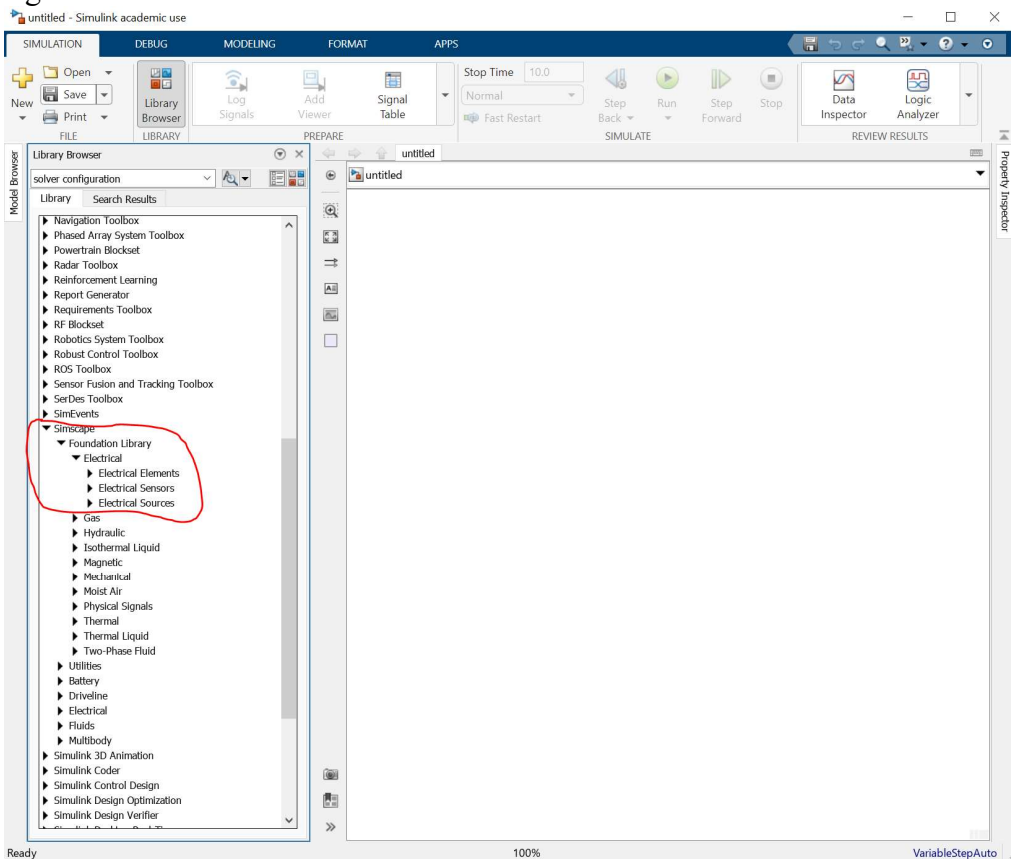
v. This will open a new window of Simulink and then hover your cursor over “Blank Model” and then click “Create Model”.



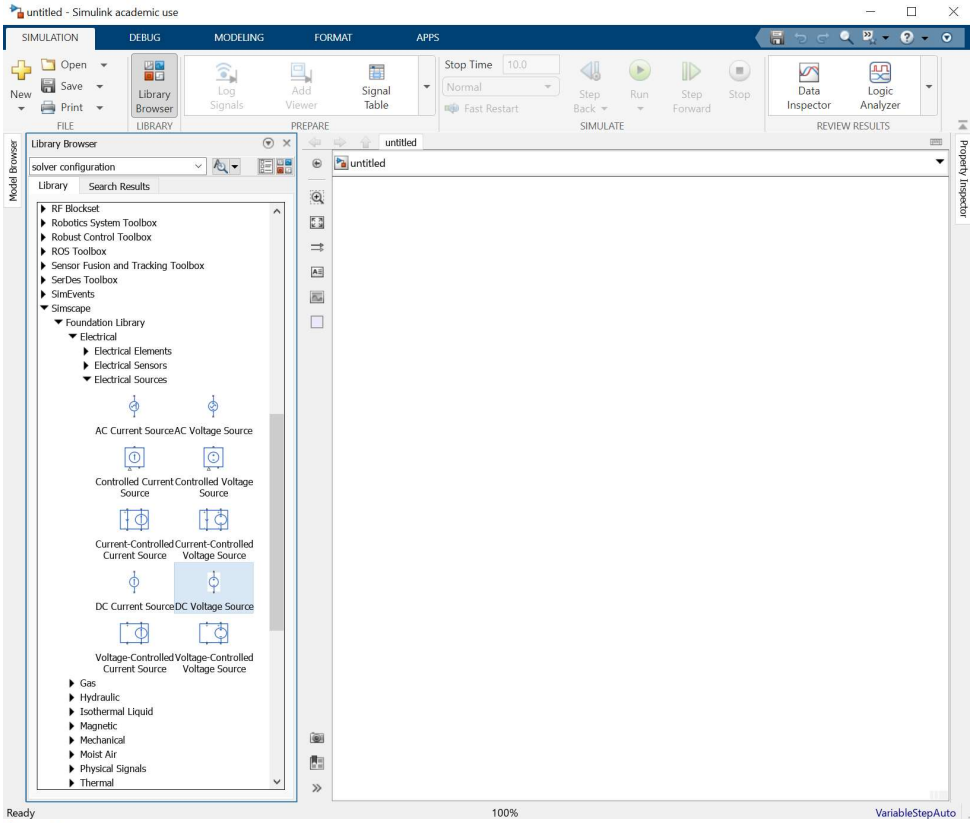
vi. Then a new window will open. Expand the window and then click “Library Browser”.



vii. This will open list of libraries available on the left side of the window. Scroll all the way down to “Simscape→Foundation Library→Electrical as shown below. This has three important groups which we will be using often through the labs.



viii. We will start by first expanding “Electrical Sources” and select “DC Voltage Source” as shown below. Then right click and select “Add block to model untitled”. This will add the block in the workspace on the right.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Robust Control Toolbox
ROS Toolbox
Sensor Fusion and Tracking Toolbox
SerDes Toolbox
SimEvents
Simscape
Foundation Library
Electrical
Electrical Elements
Electrical Sensors
Electrical Sources
AC Current Source
AC Voltage Source
Controlled Current Source
Controlled Voltage Source
Current-Controlled Current Source
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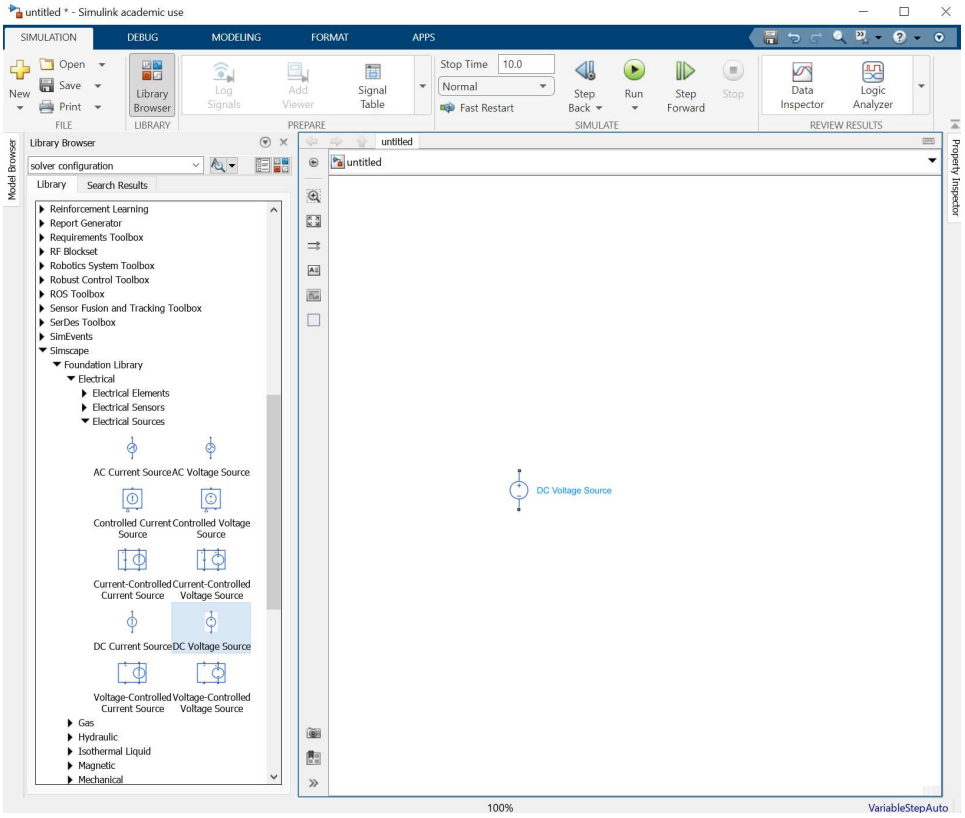
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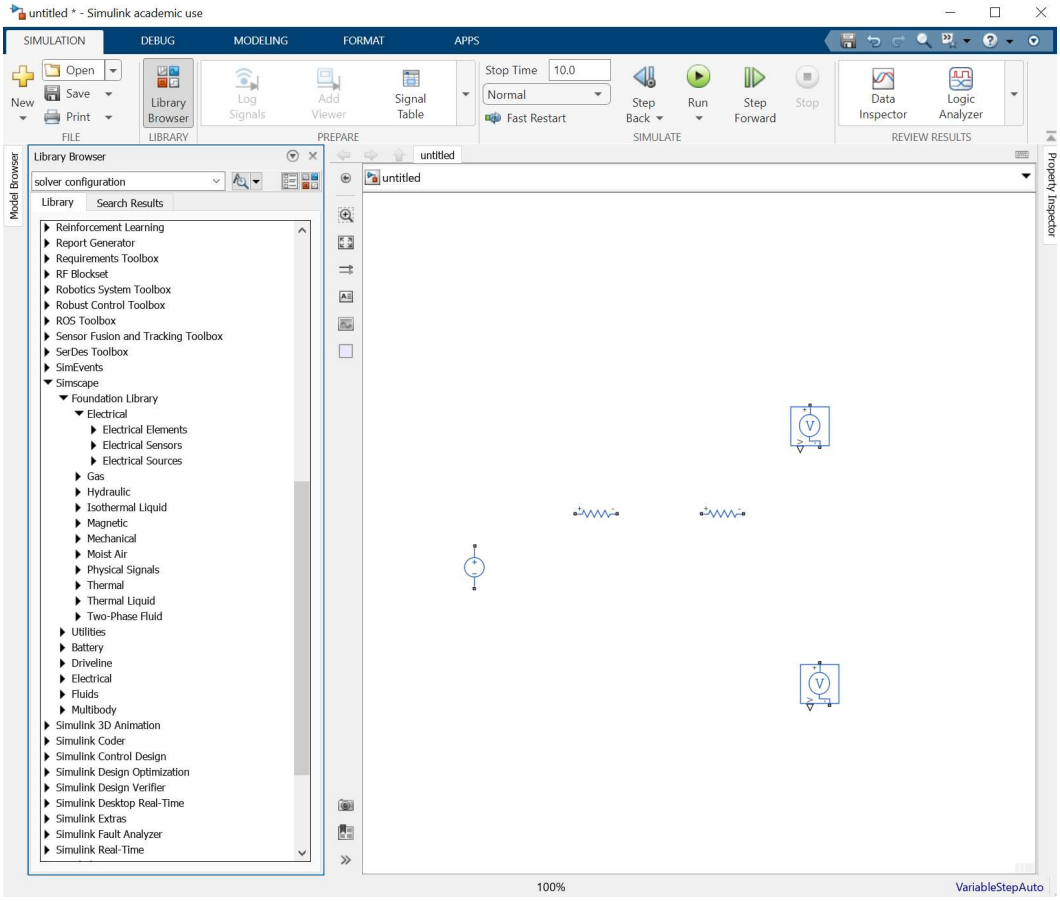
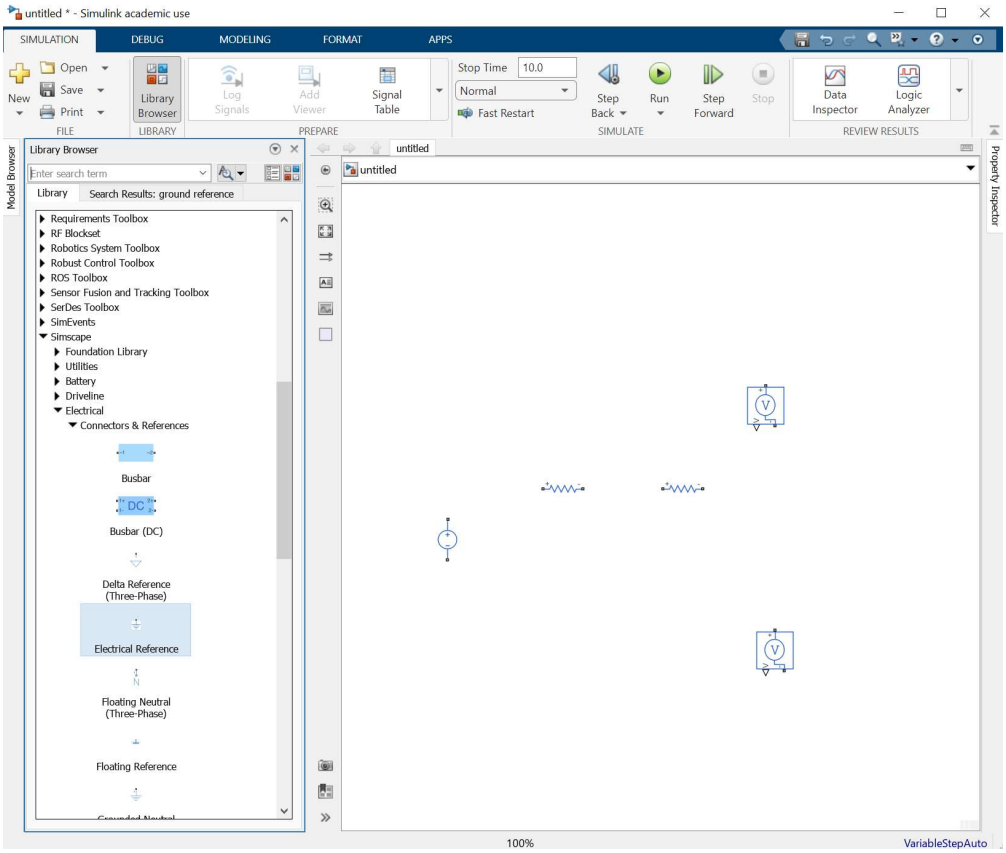
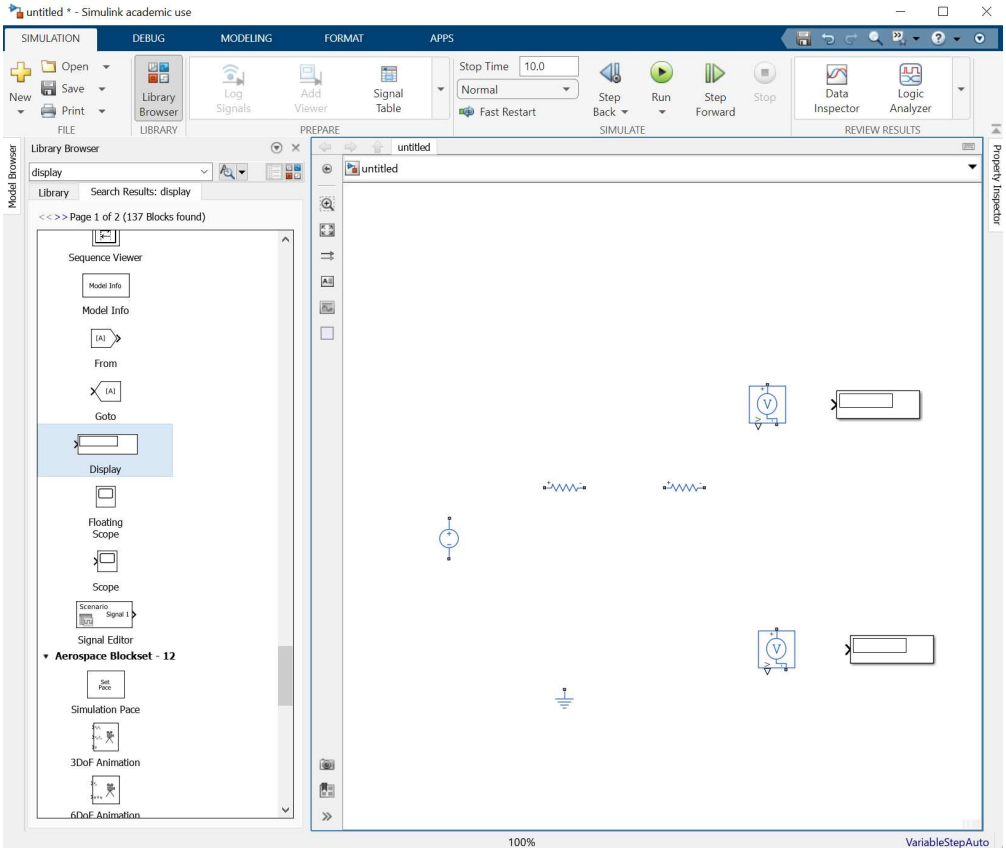
ix. In the same way, under "Electrical Elements" choose "Resistor" and under "Electric sensor" choose "Voltage sensor" and add them to the workspace. We will need two Resistors and two Voltage sensors. To do this, simply select the block and right click your mouse. Then use copy and paste. By now, you should see something like this.



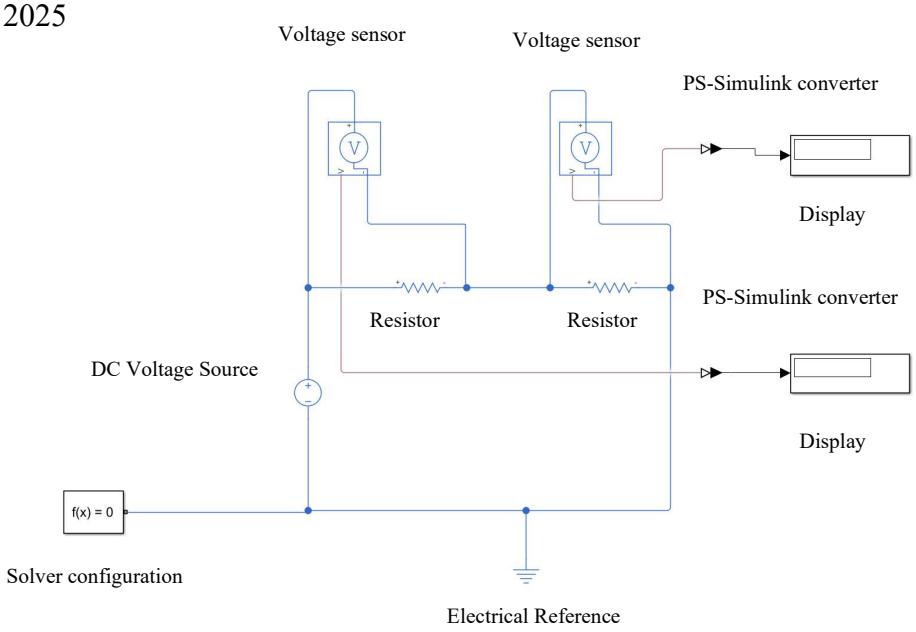
x. Besides these, we will also need two important components: Ground reference and Display. For ground reference, add this within "Simscape→Electrical→Connectors & References" as shown below. Please note that this "Electrical" is different than the previous one.



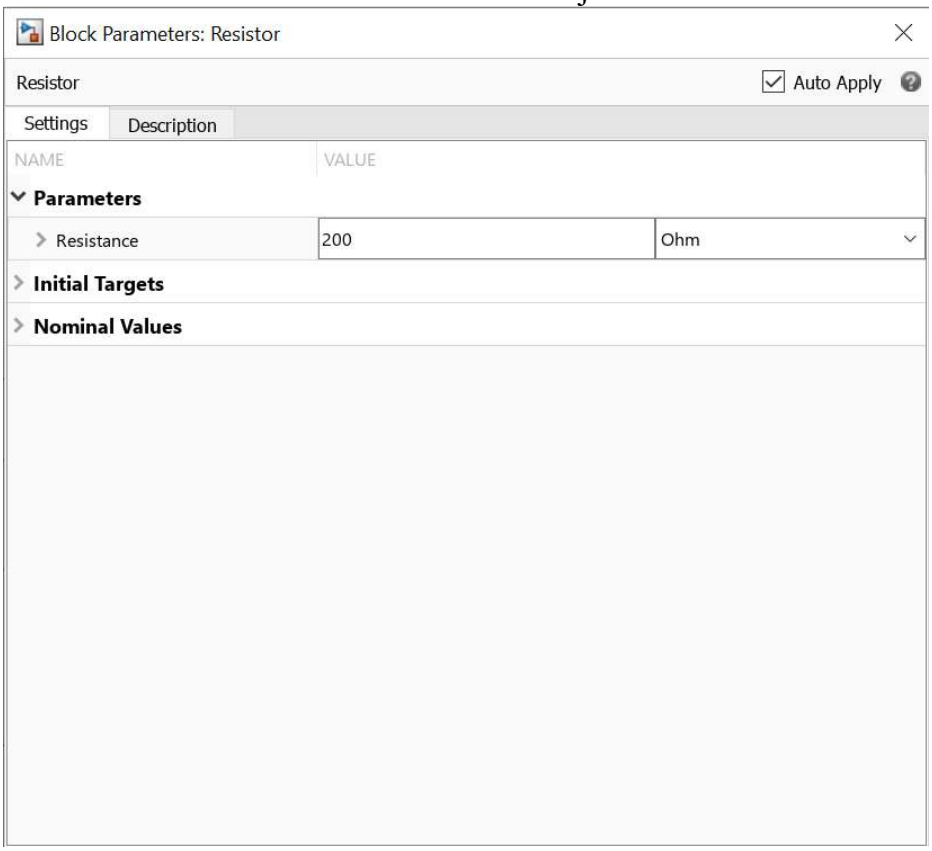
xi. To add “Display” simply type” Display” in the search box and press enter. Then scroll all the way down to add it as shown below. Use copy and paste to add two of these.



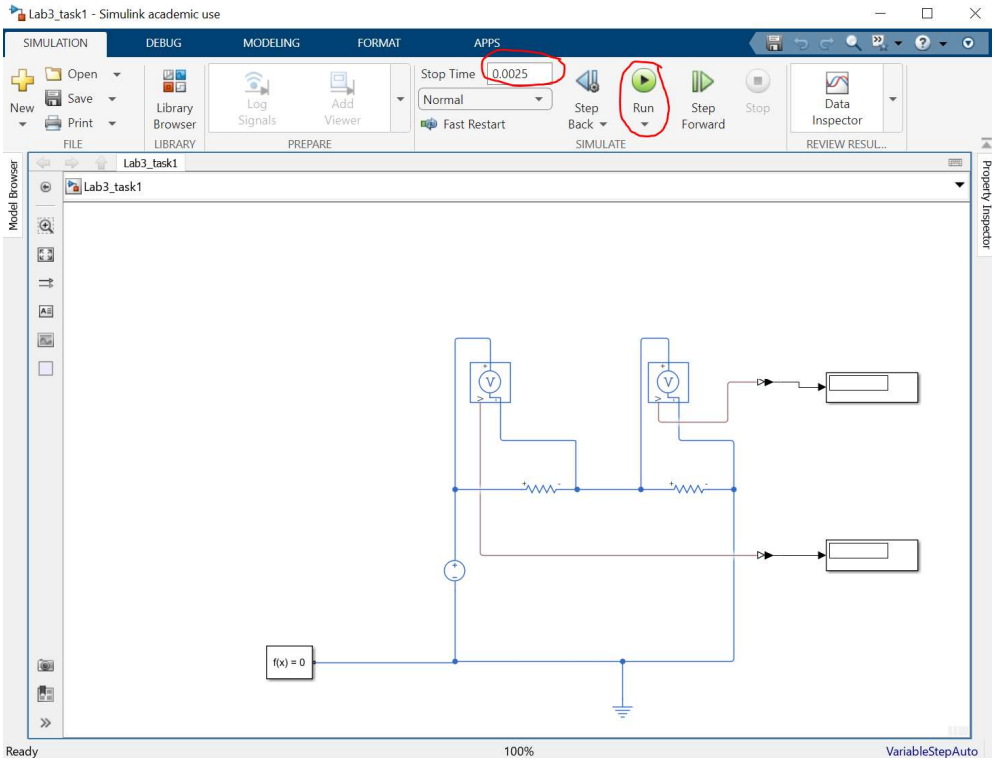
xii. Apart from all these we need two important blocks for "Simscape" components. They are "Solver Configuration" and "PS-Simulink Converter". Please do not worry about these. Just remember that "PS-Simulink Converter" block converts physical signals like voltages and currents to be displayable by Simulink software. "Solver Configuration" is almost always used for "Simscape" components and is always connected to the ground as shown. Add these by typing in the search box. Then start connecting all the blocks and you should see a complete circuit model as shown.



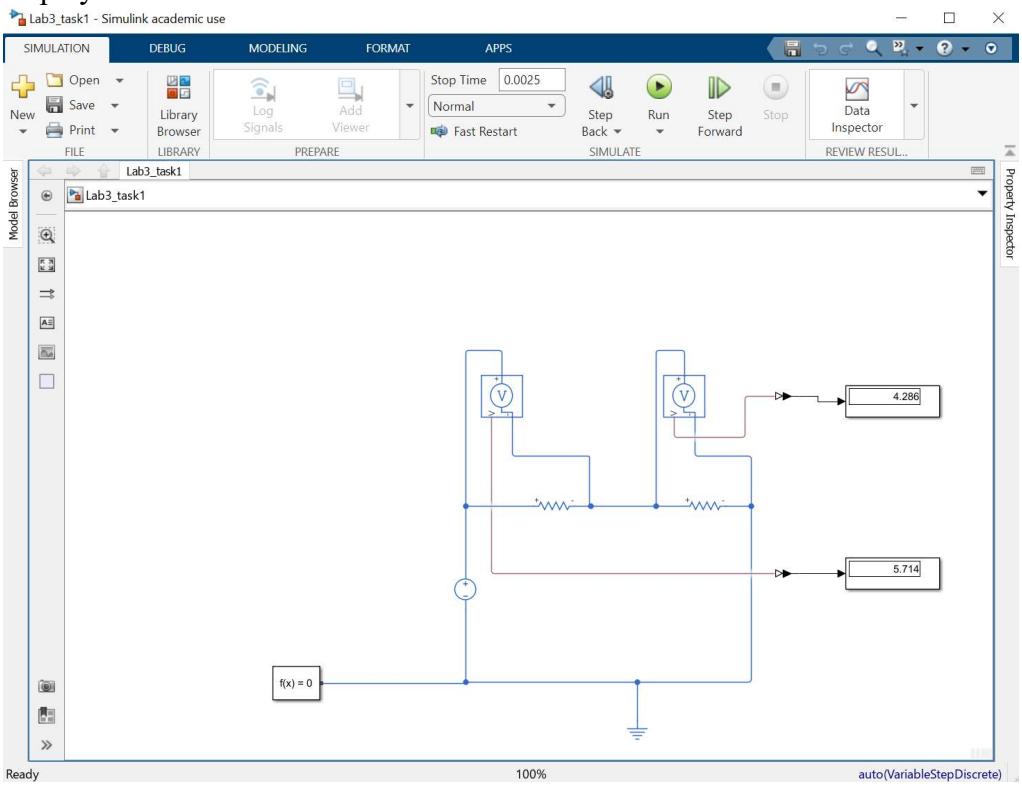
xiii. Now double click each Resistor block and adjust the values as shown below.



xiv. When this circuit model is ready, you can click the "Run" button to run the simulation. You can set up the time duration for how long you want to run the simulation. For now, you can keep the time as 1 second or 0.0025 seconds or any time of your choice. This will matter in other lab exercises. For now, you shouldn't worry about it.



xv. When you run, you should see the values of voltage drops across each resistor in the display blocks as shown below.



Please note these drops are in Volts. When you have successfully run this simulation. Please use the following values of Resistors as per your group and note down the values of voltage drops and include these in your lab report.

Lab Section	Lab Group	R_1 (Ω)	R_2 (Ω)
I	I	200	300
	II	150	250
	III	300	150
	IV	400	150
II	I	150	200
	II	250	150
	III	100	350
	IV	350	450

5. Now build the above circuit on a breadboard and check voltage drops across each resistor using multimeter provided in your lab.
6. Submit lab report including pictures of experiment and results. Use the report template provided on D2L.