Lab # 12

Basic implementation of Simulink

Objective:

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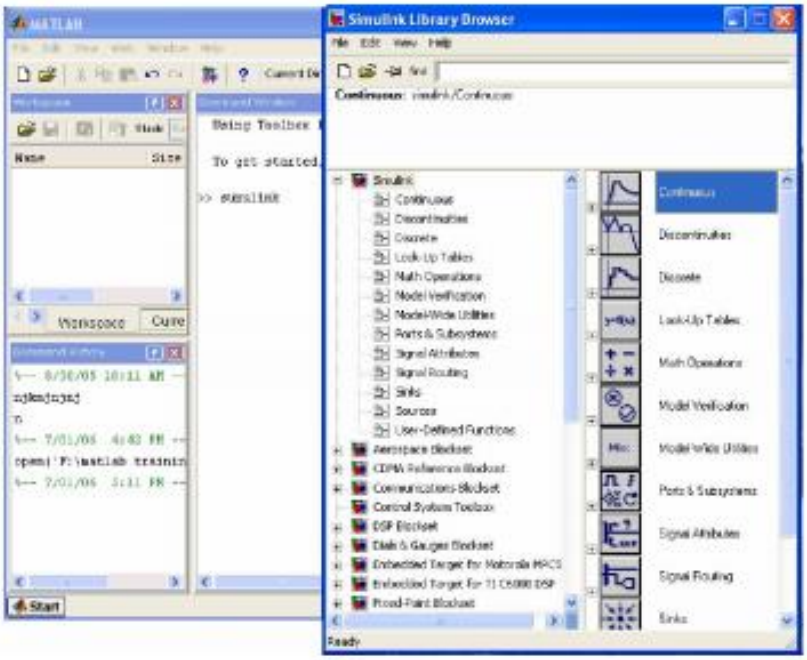
Simulink:

Simulink is a software package for modeling, simulation, and analyzing dynamic systems. For modeling, Simulink provides a graphical user interface (GUI) for building models as block diagrams using click-and-drag mouse operation. Simulink includes a comprehensive block library of sinks, sources, linear and nonlinear components, and connectors.

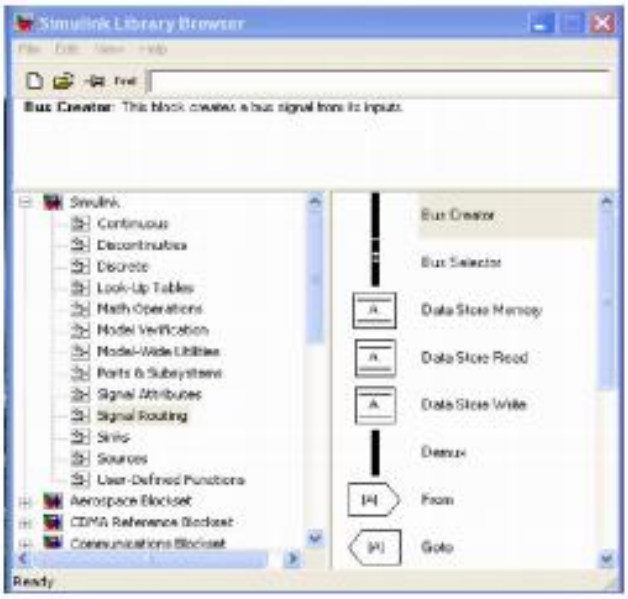
Starting Simulink:

To start Simulink, click the Start button on the MATLAB desktop and select Simulink Library Browser. This opens the Simulink Library Browser.You can also click the icon on the MATLAB toolbar or type simulink in the command wimdow.



Introduction the Simulink Library Browser:

In the Simulink Library Browser, to see the blocks contained in a library, select the library name. The blocks inside the library are listed in the right column. A library contains a number of sub libraries appears with a "+" next to it. You can expand the library by double-clicking the library name or by clicking the "+". Clicking the"-" next to an expanded library collapse it. In the Library Browser, right-click a block to · Insert the bock into the current block diagram · Acces the help information of the block · Go up one level in the library · View the parameters dialog of the block.



Basic Elements:

There are two major classes of items in Simulink:

Blocks and **Lines**:

- Blocks are used to generate, modify, combine, output, and display signals.
- Lines are used to transfer signals from one block to another.

Simulink Libraries:

Simulink has 16 libraries that contain the basic building units of a system:

- Commonly Used Blocks – A library of common blocks ·
- Continuous – Blocks that model linear function ·
- Discontinuities – Blocks whose outputs are discontinuous functions of their input ·
- Discrete – Blocks that are represent discrete-time functions ·
- Logic and Bit operations – Blocks that are perform logic or bit operations.
- Look – Up Tables – Data interpolations, blocks that use look –up tables to determine outputs from inputs ·
- Math Operations – Mathematical and logical operators ·
- Model Verification – Blocks that enable you to create self-validating models
- Model-Wide Utilities – Information Containers ·
- Port & Subsystems – Blocks for creating various types of subsystems
- Signal Attributes – Blocks that modify or output attributes of signals · Signal
- Routing – Blocks that route signals from one point in a block diagram to another
- Sinks – Blocks that display or write block output ·
- Source – Blocks that generate signals, system input
- User – Defined Functions – Blocks that allow you to define the function that relates input to outputs
- Additional Math & Discrete – Miscellaneous math and discrete blocks

Building a System:

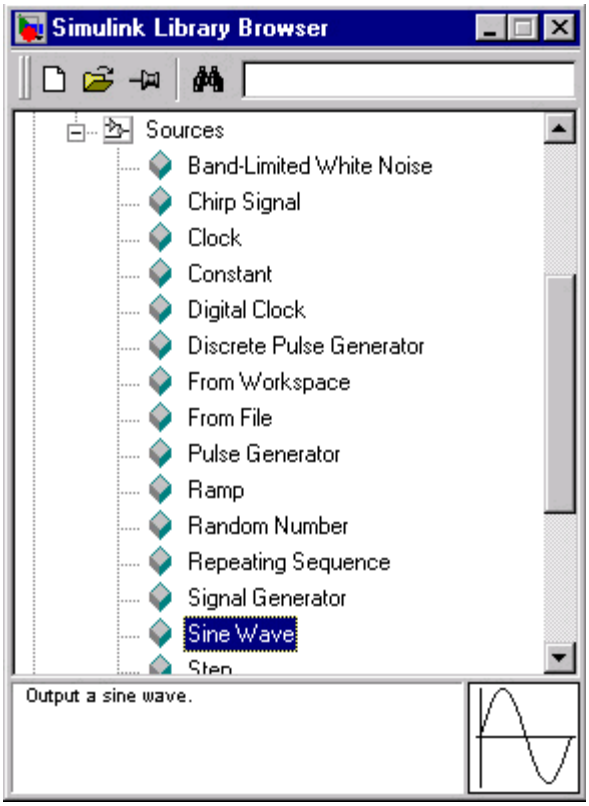
Building the system model is then accomplished through a series of steps:

1. The necessary blocks are gathered from the Library Browser and placed in the model window.
2. The parameters of the blocks are then modified to correspond with the system we are modelling.
3. Finally, the blocks are connected with lines to complete the model.

Gathering Blocks:

Each of the blocks we will use in our example model will be taken from the Simulink Library Browser. To place the Sine Wave block into the model window, follow these steps:

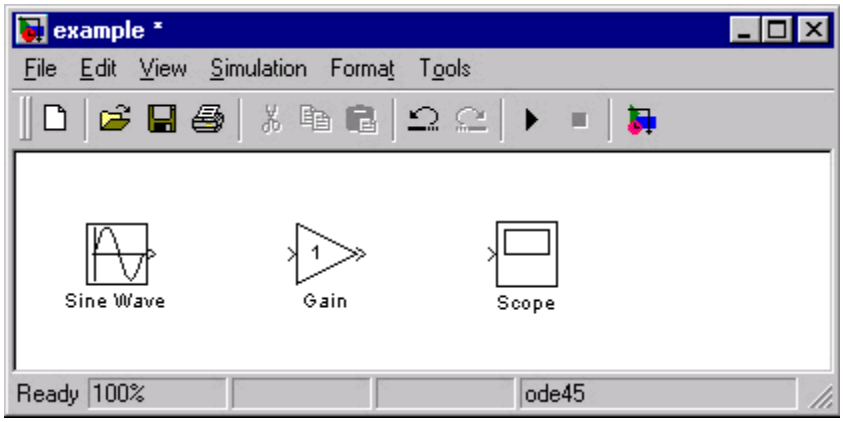
1. Click on the "+" in front of "Sources" (this is a subfolder beneath the "Simulink" folder) to display the various source blocks available for us to use.
2. Scroll down until you see the "Sine Wave" block. Clicking on this will display a short explanation of what that block does in the space below the folder list:



3. To insert a Sine Wave block into your model window, click on it in the Library Browser and drag the block into your workspace.

The same method can be used to place the Gain and Scope blocks in the model window. The "Gain" block can be found in the "Math" subfolder and the "Scope" block is located in the "Sink" subfolder. Arrange the three blocks in the workspace

(done by selecting and dragging an individual block to a new location) so that they look similar to the following:



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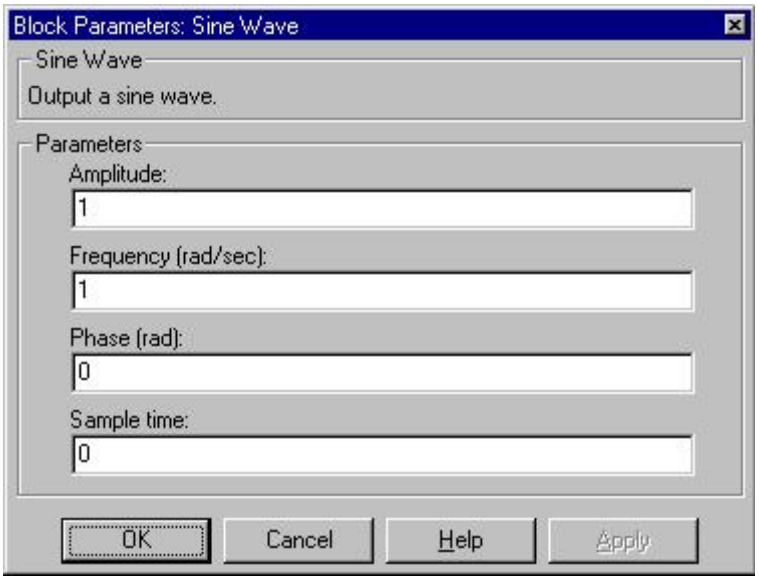
Simulink allows us to modify the blocks in our model so that they accurately reflect the characteristics of the system we are analyzing. For example, we can modify the Sine Wave block by double-clicking on it. Doing so will cause the following window to appear:

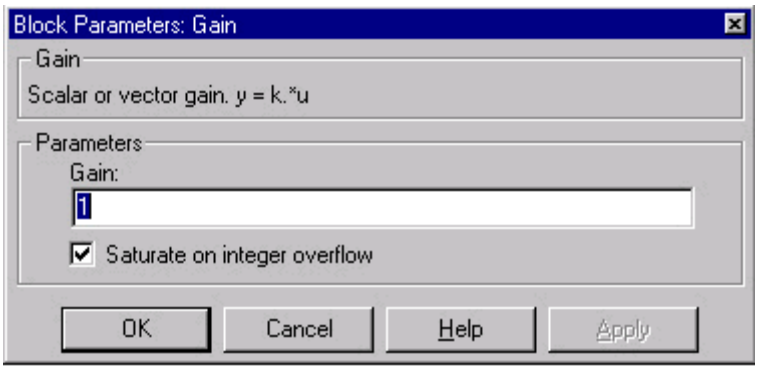


This window allows us to adjust the amplitude, frequency, and phase shift of the sinusoidal input. The "Sample time" value indicates the time interval between successive readings of the signal. Setting this value to 0 indicates the signal is sampled continuously.

Let us assume that our system's sinusoidal input has:

- Amplitude = 2
- Frequency = pi
- Phase = pi/2

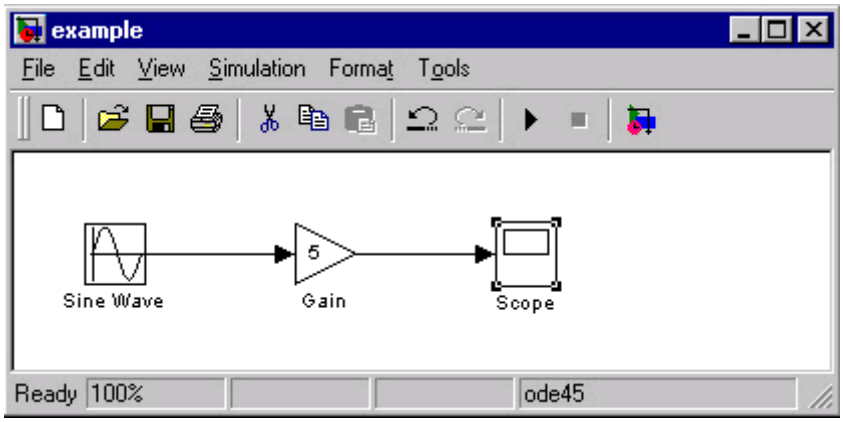
Next, we modify the Gain block by double-clicking on it in the model window. The following window will then appear:

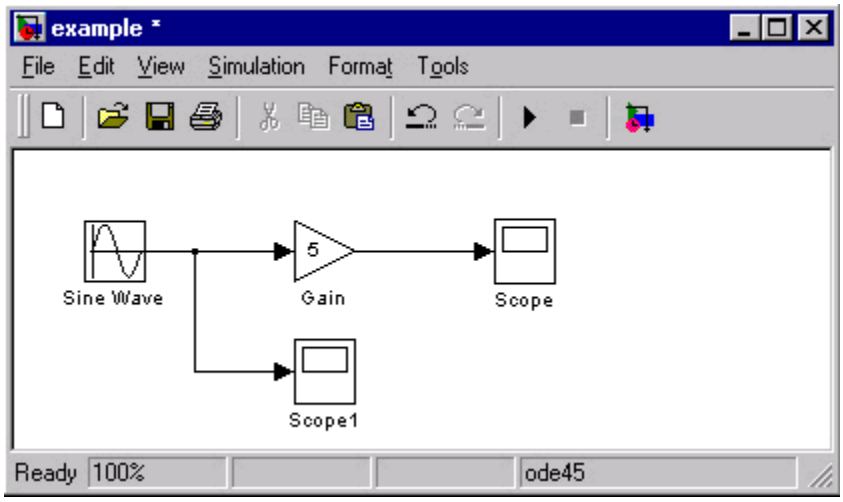


For our system, we will let k = 5. Enter this value in the "Gain" field, and click "OK" to close the window.

Connecting the Blocks:

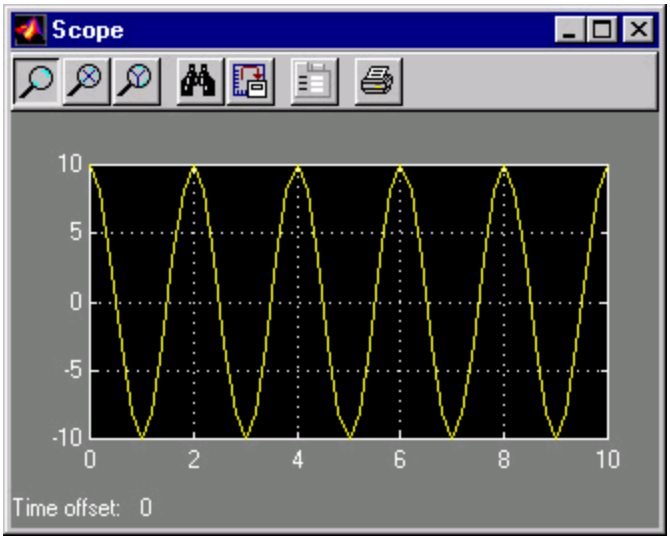
Lines are drawn by dragging the mouse from where a signal starts (output terminal of a block) to where it ends (input terminal of another block). When drawing lines, it is important to make sure that the signal reaches each of its intended terminals. A signal is properly connected if its arrowhead is filled in. If the arrowhead is open, it means the signal is not connected to both blocks.





Running the Simulation:

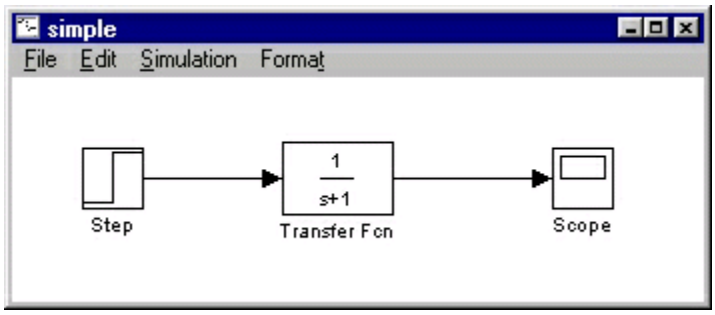
Now that our model has been constructed, we are ready to simulate the system. To do this, go to the **Simulation** menu and click on **Start**, or just click on the "Start/Pause Simulation" button in the model window toolbar. Double-click the Scope block to view the output of the Gain block for the simulation as a function of time. Once the Scope window appears, click the "Autoscale" button in its toolbar (looks like a pair of binoculars) to scale the graph to better fit the window. Having done this, you should see the following



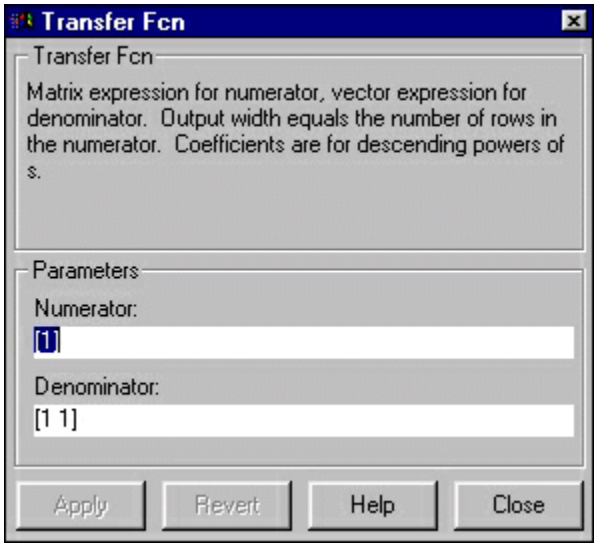
Model for Transfer Function:

The second model consists of three blocks: Step, Transfer Function, and Scope. The Step is a **source block** from which a step input signal originates. This signal is transfered through the **line** in the direction indicated by the arrow to the Transfer Function **linear block**.

The Transfer Function modifies its input signal and outputs a new signal on a line to the Scope. The Scope is a **sink block** used to display a signal much like an oscilloscope.



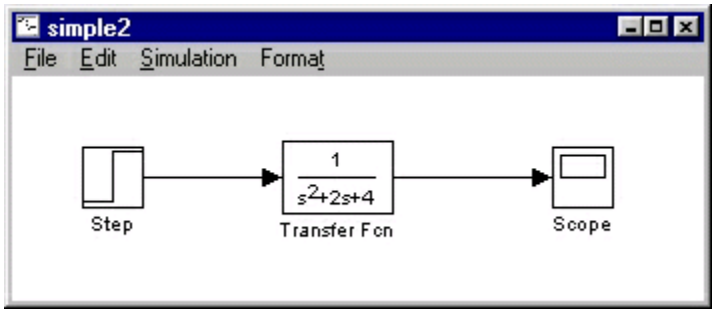
A block can be modified by double-clicking on it. For example, if you double-click on the "Transfer Fcn" block in the second model, you will see the following dialog box.



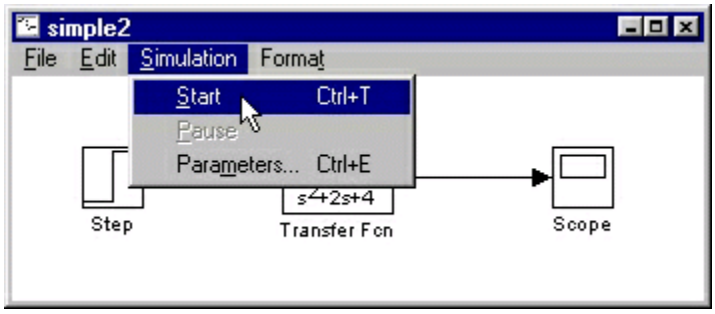
This dialog box contains fields for the numerator and the denominator of the block's transfer function. By entering a vector containing the coefficients of the desired numerator or denominator polynomial, the desired transfer function can be entered. For example, to change the denominator to s^2+2s+1, enter the following into the denominator field:

[1 2 1]

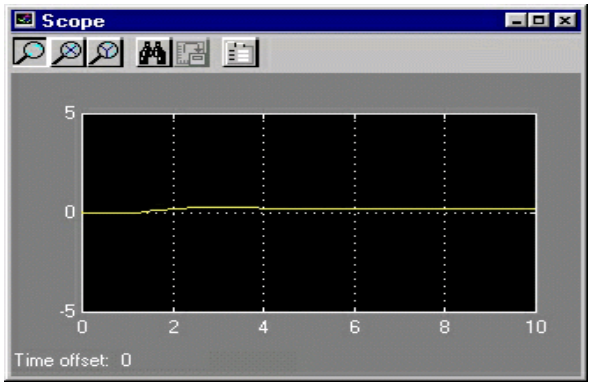
and hit the close button, the model window will change to the following,



Then, to start the simulation, either select **Start** from the **Simulation** menu (as shown below)



The scope window will appear as shown below.



Post Lab Questions

a) **What is Simulink?**

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b) **What are the important components of ”Sink” library.**

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c) **What is function block? Explain with example**.

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d) **What is ‘scope’ used for during simulation?**

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Lab Tasks

Task 1

a) Show the output of following in Simulink
   i. 230+200
   ii. Sin Wave
   iii. Unit Step
   iv. $\frac{1}{2s+4}$

Task 2

a) Draw the following circuit on Simulink. Perform Modulation and Demodulation of message signal using Simulink.