System Response by different inputs in MATLAB and Simulink

LAB # 02

Fall 2024

CSE-310L Control Systems Lab

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Class Section: **C**

"On my honor, as student of University of Engineering and Technology, I have neither given nor received unauthorized assistance on this academic work."

Submitted to:

Dr. Muniba Ashfaq

Date:

20th **October 2024**

Department of Computer Systems Engineering

University of Engineering and Technology, Peshawar

Objectives:

The objective of this lab is to learn about:

- Step and Impulse Response of the system
- Simulating Response of the system using sinusoidal as input

Task 1:

Find an impulse and step response of the following system by using MATLAB. Use Simulink to find both responses and compare them with MATLAB results. (Hint: impulse, step,

Impulse is the derivative of the step)

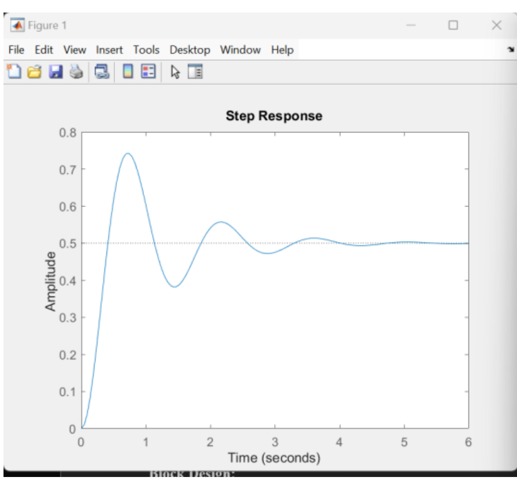
$$G(s) = \frac{10}{s^2 + 2s + 20}$$

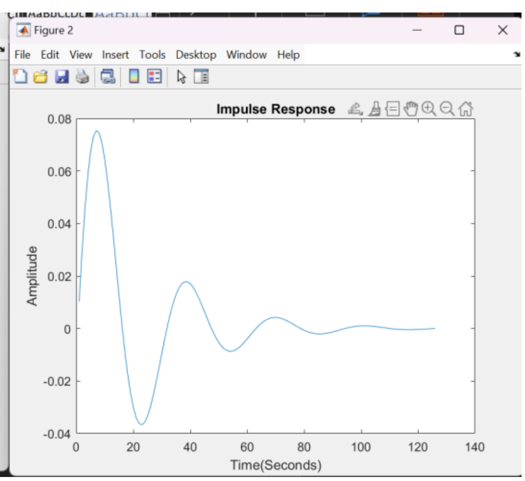
MATLAB:

Code:

```
C1 = [10];
C2 = [1, 2, 20];
transferFunction = tf(C1, C2);

figure(1)
step(transferFunction)

figure(2)
plot (diff(step(transferFunction)))
title("Impulse Response")
xlabel("Time(Seconds)")
ylabel("Amplitude")
```

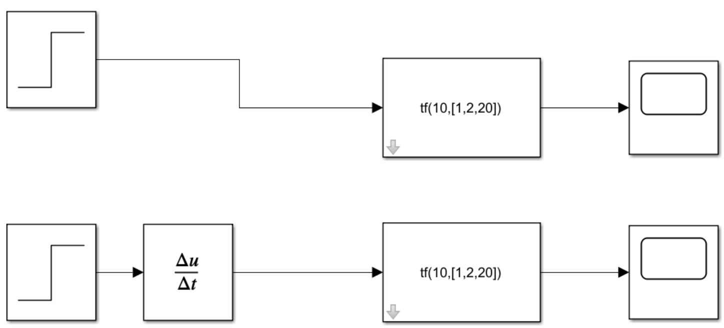
Output:



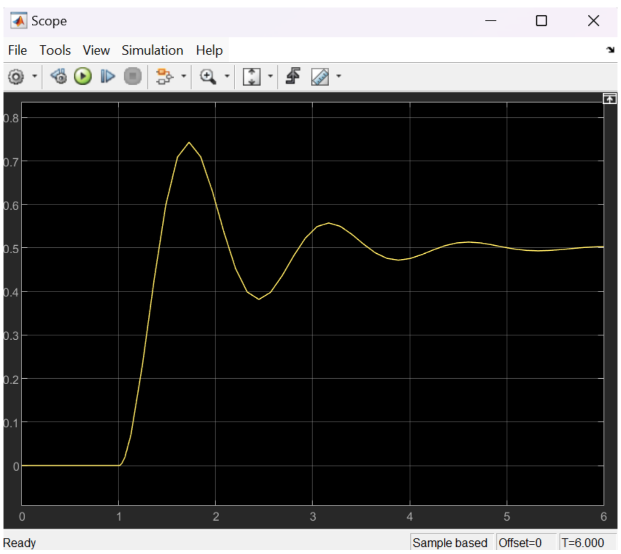


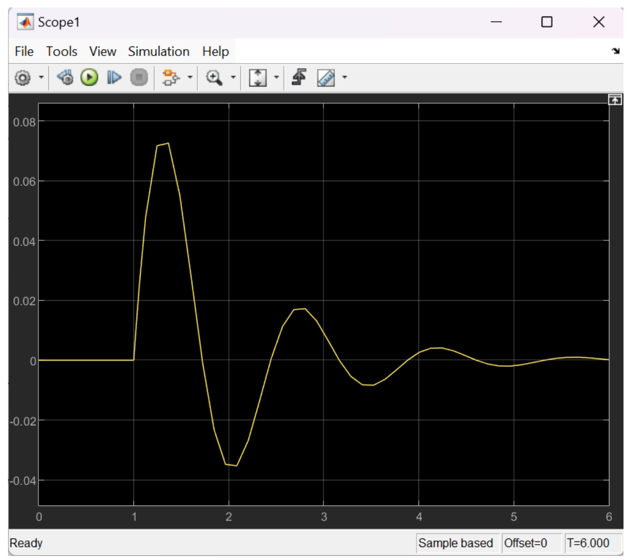
Simulink:

Block Design:



Output:





Step response

Impulse response

Task 2:

Apply the sinusoidal input to the above mentioned system in both MATLAB and Simulink. Compare both the results too. Also plot output vs input in both. (Hint:lsim)

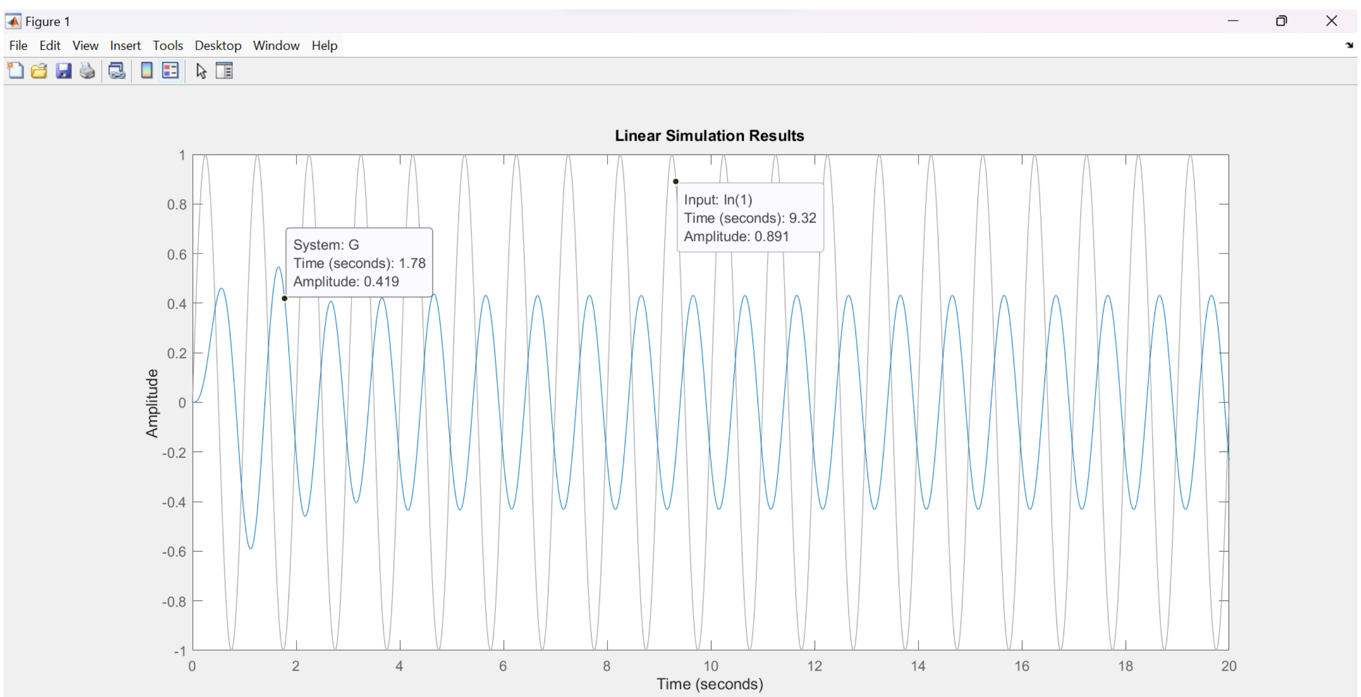
MATLAB:

Code:

Task1.m Task2.m Task3.m

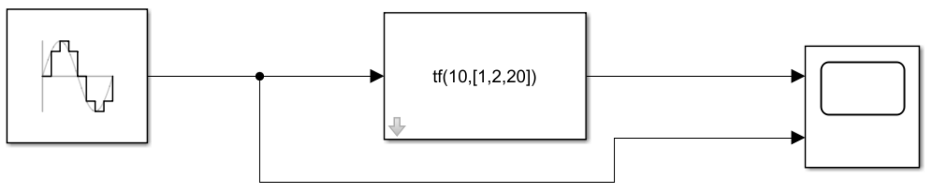
```
C1 = [10];
C2 = [1, 2, 20];

G = tf(C1, C2);
t = 0:1/100:20;
f = 1;

y = sin(2*pi*f*t);
lsim(G, y, t)

```

Output:

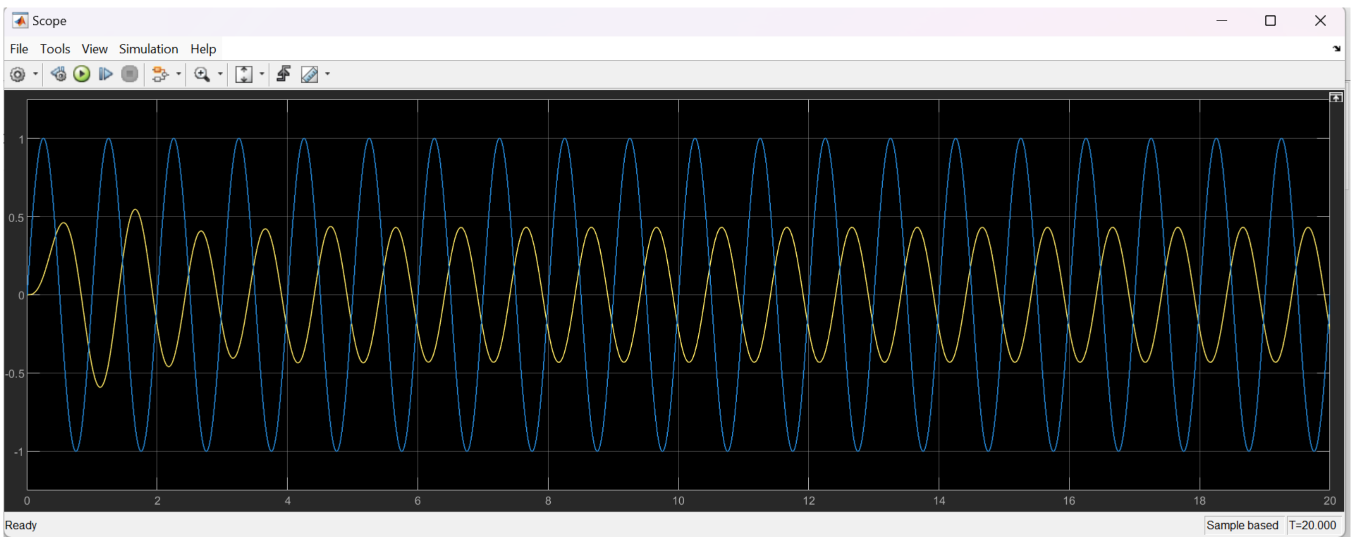


Simulink:

Block Design:



Output:



Task 3:

Apply the following input to the system in both Simulink and MATLAB.

$\sin(2\pi t) + u(t) + 2u(t-5)$

MATLAB:

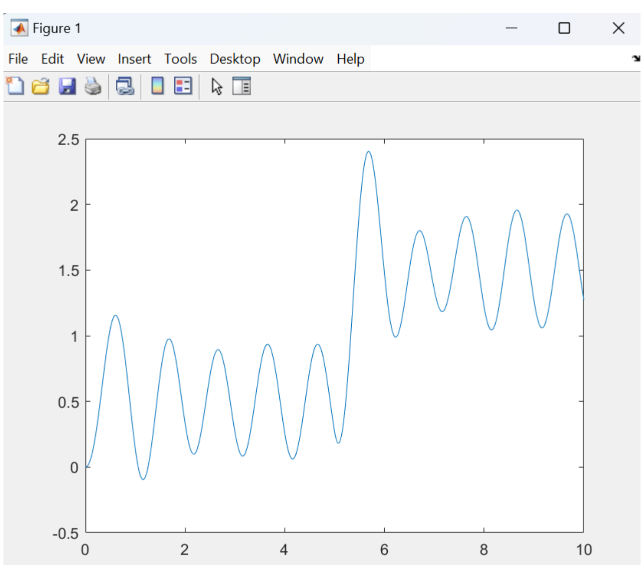
Code:

Editor - U:\Uni\Control Systems Lab\ControlSystemLab2\MATLAB\Task3.m

Task1.m Task2.m Task3.m

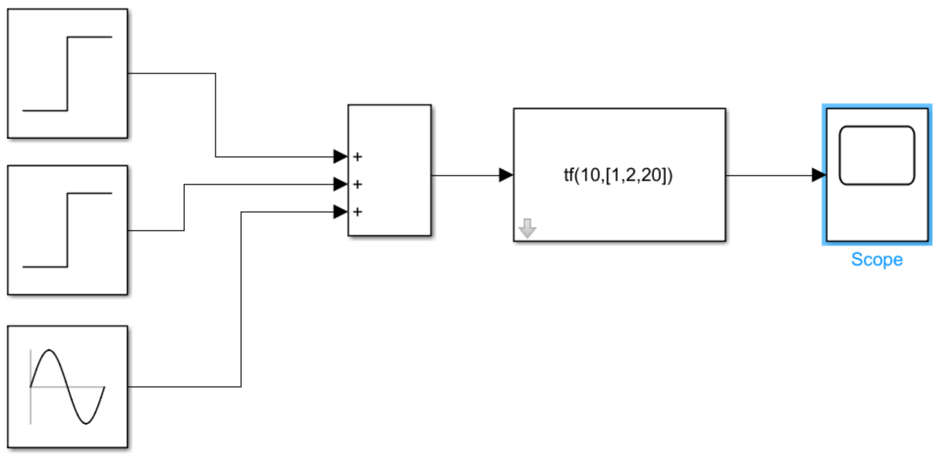
```
C1 = [10];
C2 = [1, 2, 20];

G = tf (C1, C2);

t = 0:1/100:10;
f = 1;
u = sin(2*pi*f*t);
y1=lsim (G, u, t);
y2=step (G, 0:0.01:10);
y3=step (G, 5:0.01:10);
temp=zeros(500, 1);
y3= [temp; y3];
y=y1+y2+2*y3;
plot (t,y)
```

Output:

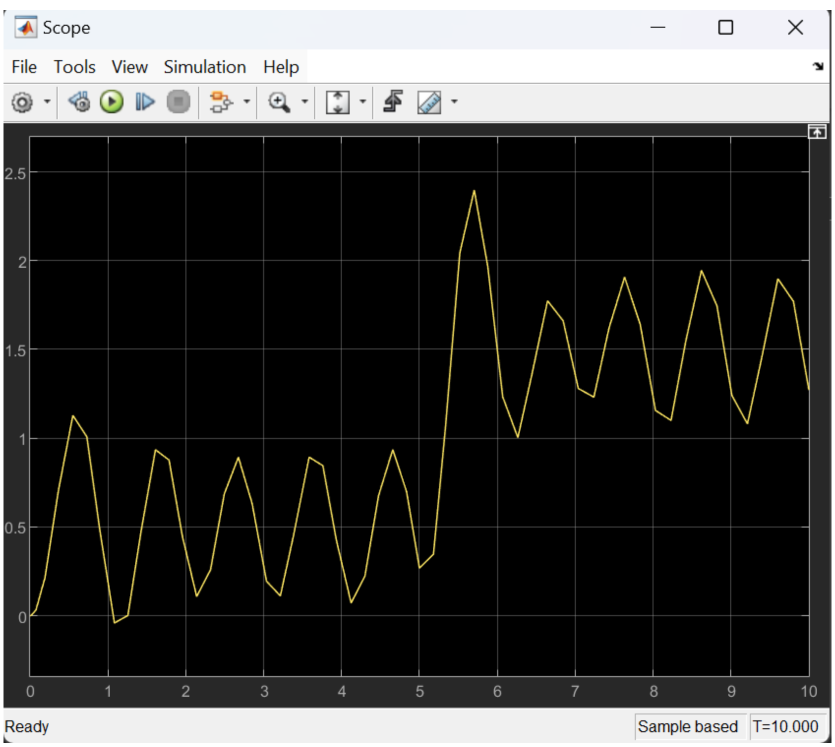


Simulink:

Block Design:



Output:



Task 4:

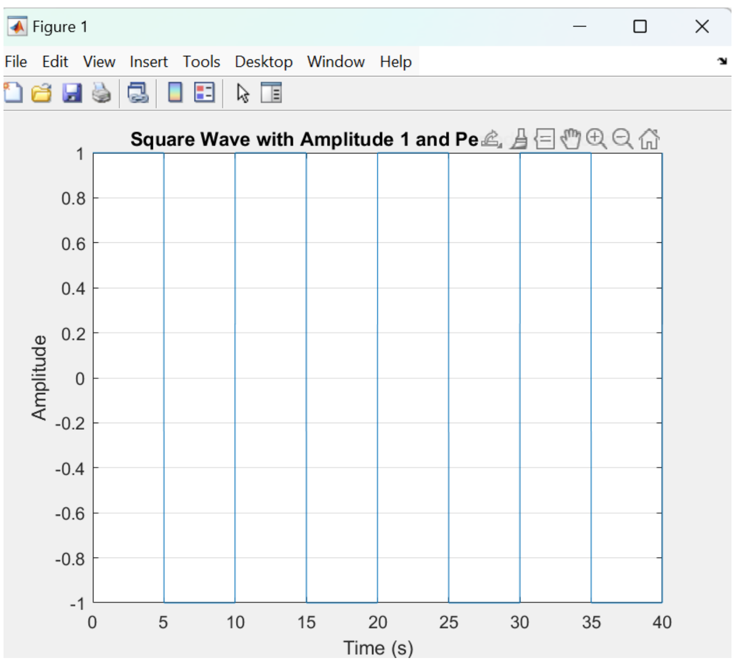
Square input with amplitude equal to 1 and time period equal to 10 seconds. Simulate the system for at least 40 seconds.

MATLAB:

Code:

```
% Parameters
amplitude = 1;  % Amplitude of the square wave
period = 10;    % Time period in seconds
simulation_time = 40;  % Total simulation time in secon

% Time vector
t = 0:0.01:simulation_time;  % Time from 0 to 40 second

% Generate square wave
square_wave = amplitude * square(2 * pi * (1/period) *
```

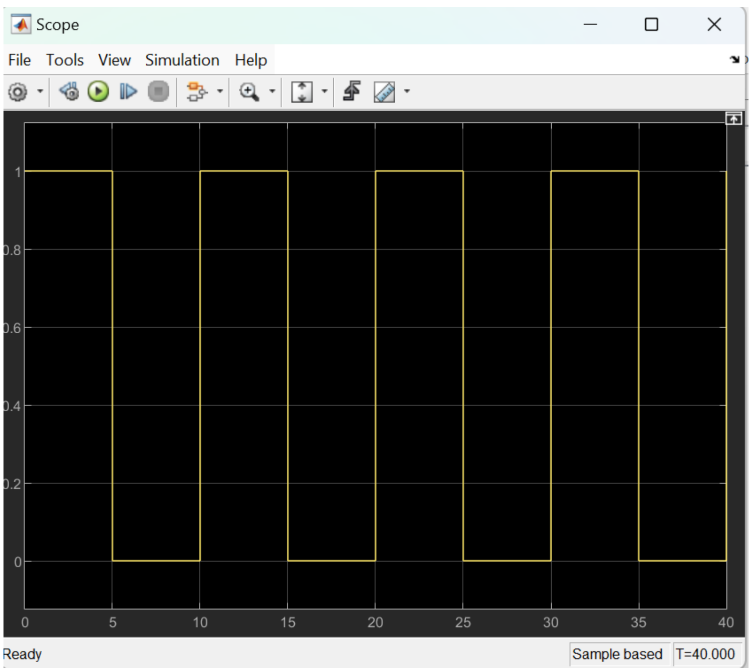
Output:



Simulink:

Block Design:

Output:



Task 5:

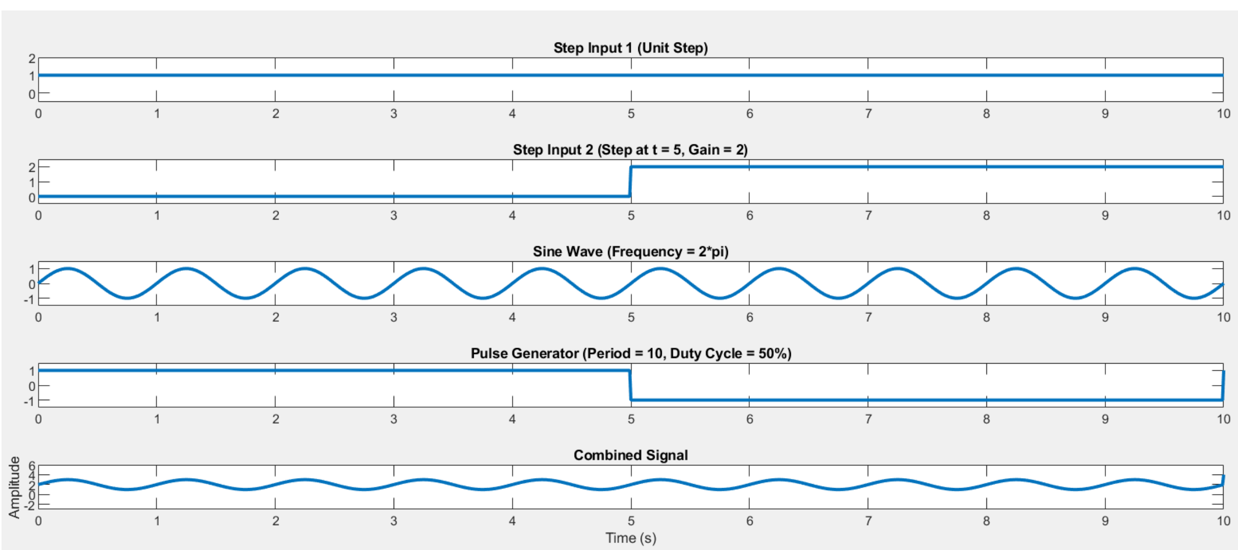
Combine both of the inputs of Q#3 and Q#4.

MATLAB:

Code:

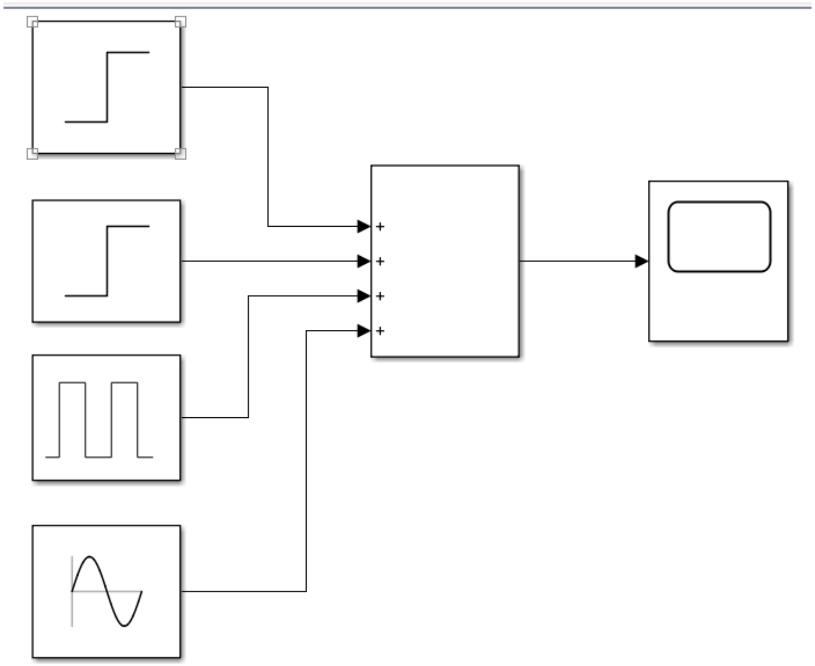
```
% Define the time vector
t = 0:0.01:10;  % time from 0 to 10 with a step of 0.01

% Step input 1: Step function at time = 0
step1 = ones(size(t));  % unit step input

% Step input 2: Step function with step time of 5 and gain of 2
step2 = 2 * (t >= 5);  % step at t = 5 with gain 2

% Sine function with frequency of 2*pi (1 Hz sine wave)
sine_wave = sin(2*pi*t);

% Pulse generator with period of 10 and duty cycle of 50%
pulse_generator = square(2*pi*(1/10)*t, 50);  % period = 10, duty

% Sum the signals
combined_signal = step1 + step2 + sine_wave + pulse_generator;

% Plot the signals
figure;
```

Output:



Simulink:

Block Design:



Output: