**Department of Electrical Engineering and   
Computer Science**

**Faculty Member:** Dr. Salman Ghafoor  **Dated:** 4/12/2022

**Semester:** 5th **Section:** BEE 12C

**EE-232: Signals and Systems**

Lab 10: Linearity in Simulink MATLAB

Group Members

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  | **PLO4 – CLO3** | **PLO5 - CLO3** | **PLO8 -CLO4** | **PLO9 -CLO4** |
| **Name** | **Reg. No** | **Viva / Quiz / Lab Performance** | **Analysis of data in Lab Report** | **Modern Tool Usage** | **Ethics and Safety** |
|  |  | **5 Marks** | **5 Marks** | **5 Marks** | **5 Marks** |
| Danial Ahmad | 331388 |  |  |  |  |
| Muhammad Umer | 345834 |  |  |  |  |
| Syeda Fatima Zahra | 334379 |  |  |  |  |
|  |  |  |  |  |  |

**Table of Contents**

[2 MATLAB Simulink 3](#_Toc121072983)

[2.1 Objectives 3](#_Toc121072984)

[2.2 Equipment 3](#_Toc121072985)

[2.3 Lab Instructions 3](#_Toc121072986)

[3 Lab Tasks 4](#_Toc121072987)

[3.1 Testing Linearity 4](#_Toc121072988)

[3.2 Exercise 5](#_Toc121072989)

[3.2.1 Task 1 5](#_Toc121072990)

[3.2.2 Task 2 6](#_Toc121072991)

[4 Conclusion 7](#_Toc121072992)

# MATLAB Simulink

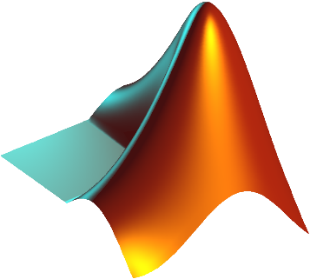
## Objectives

This Lab experiment has been designed to familiarize students with MATLAB Simulink; students are required to prove linearity of a system using Simulink.

## Equipment

Software

* *MATLAB*



## Lab Instructions

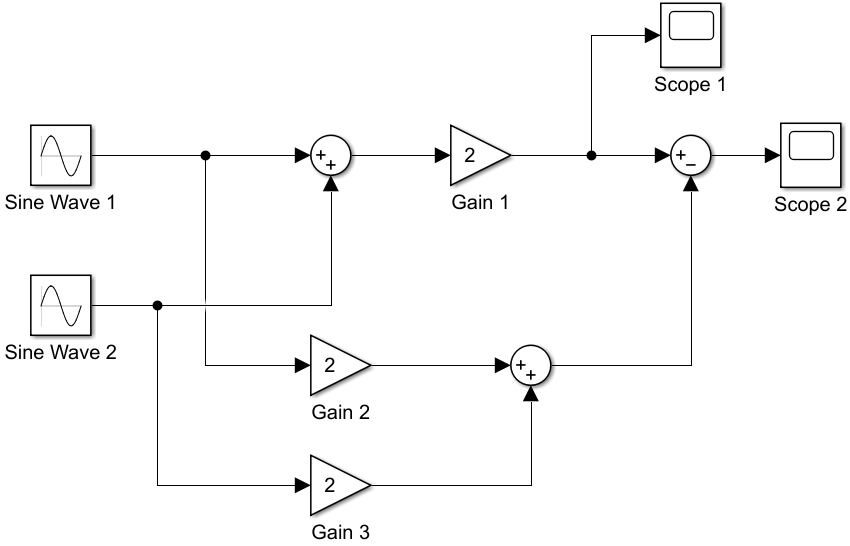
All questions should be answered precisely to get maximum credit. Lab report must ensure following items:

* Lab objectives
* MATLAB codes
* Results (Graphs/Tables) duly commented and discussed
* Conclusion

# Lab Tasks

## Testing Linearity

To test the linearity of the gain block, build the system in the following Figure 1.



Figure

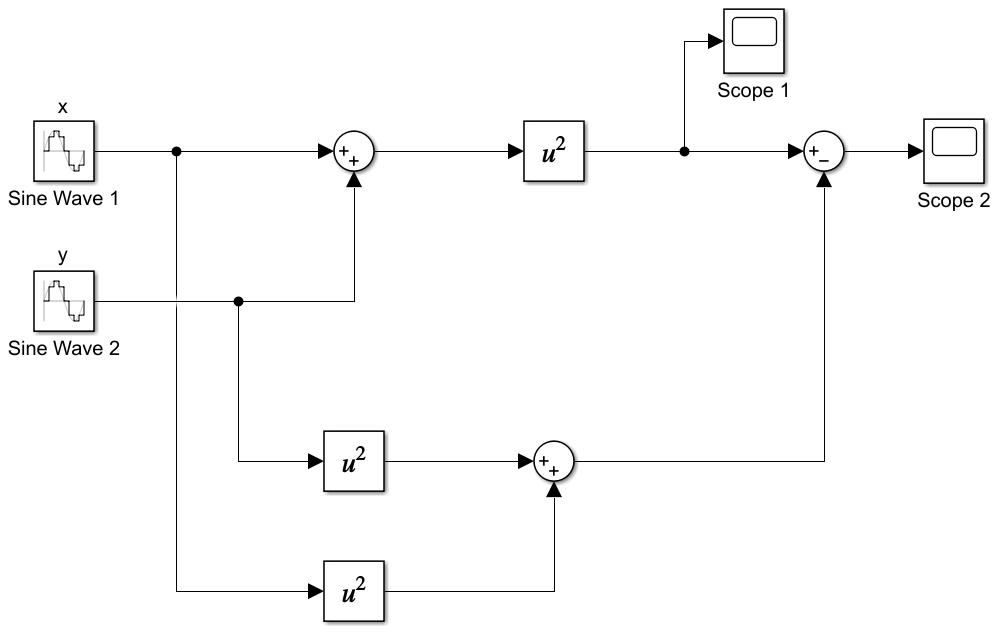
|  |  |
| --- | --- |
|  |  |
| Scope 1: (Sine Wave 1 + Sine Wave 2)2 | Scope 2: ((Sine Wave 1 + Sine Wave 2)2)  (2Sine Wave 1) + (2Sine Wave 2) |

As scope 2 displays: , we can deduce that the system is indeed linear, due to a constant zero output.

## Exercise

### Task 1

Use Simulink to design a non-linear system and show that the system is non-linear by showing that the principle of superposition does not hold.



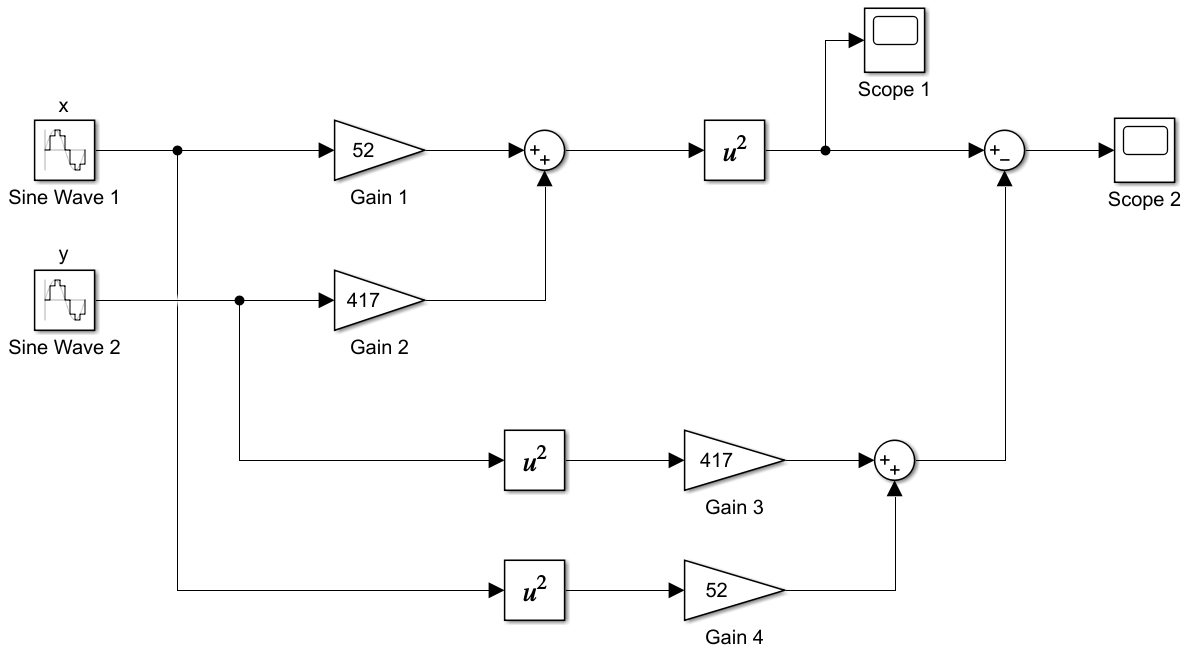
Figure

|  |  |
| --- | --- |
|  |  |
| Scope 1: (x + y) ^ 2 | Scope 2: (x + y) ^ 2  ((x) ^ 2 + (y) ^ 2) |

As scope 2 displays: we can deduce that the system is not linear, due to a non-zero constant output.

### Task 2

Use the symbolic toolbox to show that the squaring operation is not linear. That is, use the symbolic toolbox to show that:



Figure

In Figure 3, x and y are sine waves of different frequencies. is a gain of 52 and is a gain of 417.

|  |  |
| --- | --- |
|  |  |
| Scope 1: (52x + 417y) ^ 2 | Scope 2: (52x + 417y) ^ 2  ((52x) ^ 2 + (417y) ^ 2) |

As scope 2 displays: we can deduce that the system is not linear, due to a non-zero constant output.

# Conclusion

In this lab, MATLAB® Simulink was used to show the linearity and non-linearity of different systems, mainly the squaring operation. We deduce that Simulink is a useful and versatile MATLAB “add-on” used as a graphical programming environment for modelling systems.