EE5351: CONTROL SYSTEM DESIGN

LABORATORY 02

NAME : BANDARA LRTD

REG No. : EG/ 2021/ 4433

GROUP NO: CE07

DATE : 24/01 /2025

Table : Summative Laboratory Form

|  |  |
| --- | --- |
| Semester | 05 |
| Module Code | EE5351 |
| Module Name | Control System Design |
| Lab Number | 02 |
| Lab Name | Laboratory Section 2 |
| Lab conduction date | 2024.11.05 |
| Report Submission date | 2025.01.24 |

**Contents**

[1 OBSERVATION 6](#_Toc192007513)

[2 CALCULATION 7](#_Toc192007514)

[3 REFERENCES 12](#_Toc192007515)

**List of Tables**

Table : Summative Laboratory Form

[Table 2: Observations 6](#_Toc188653612)

**List of Figures**

[Figure 1: Simplified Simulink 8](#_Toc192007528)

[Figure 2: Closed Loop T/f 8](#_Toc192007529)

[Figure 3: O/p diagram 9](#_Toc192007530)

[Figure 4:output from closed loop transfer function 9](#_Toc192007531)

[Figure 5:Time domain response of the closed loop function 11](#_Toc192007532)

[Figure 6: Design a PD Controller 11](#_Toc192007533)

[Figure 7: Overshoot is reduced by 30% 11](#_Toc192007534)

# OBSERVATION

Table : Observations

|  |  |  |
| --- | --- | --- |
| Terminal Resistance (Rm) | 8.4 | Ω |
| Rotor inductance (Lm) | 1.16 | mH |
| Equivalent(Jen) | 2.09×10⁻⁵ | kgm² |
| Torque constant (Kt) | 0.042 | Nm/A |
| Voltage constant (Km) | 0.042 | Nm/A |

# CALCULATION

Q1.

1. .
2. Voltage equation:

2. Back EMF equation:

3. Torque equation:

4. Motor torque relationship:

1. Transfer function

By using equations (1), (2), (3), and (4):

Due to the negligible rotor inductance the simplified version is:-

1. H

A computer screen shot of a computer program

AI-generated content may be incorrect.

Figure : Simplified Simulink

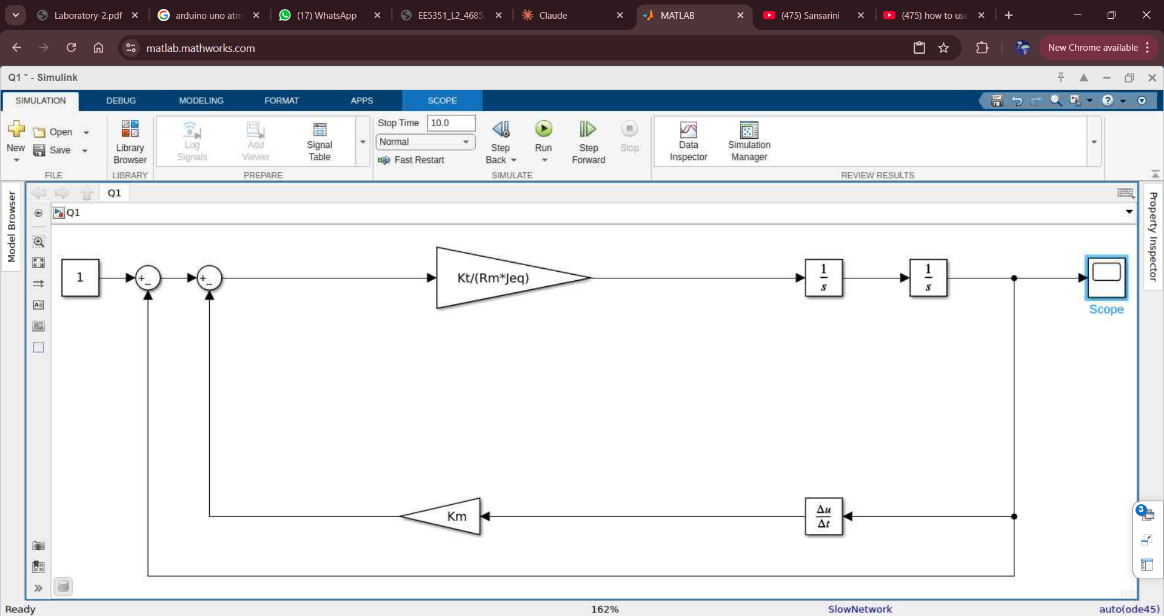
1. By considering the closed loop transfer function
2. 

Figure : Closed Loop T/f

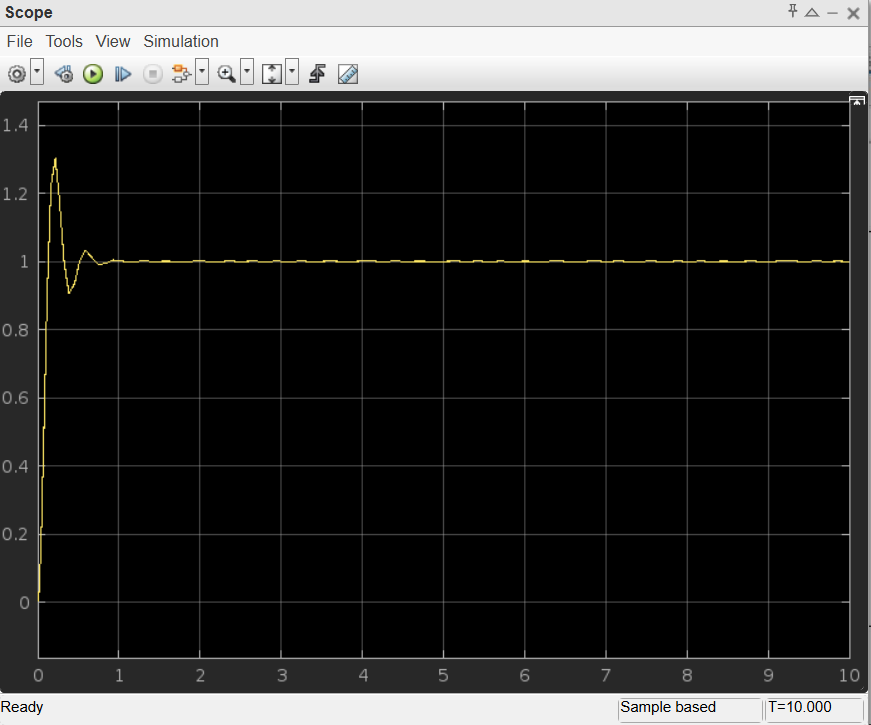


Figure : O/p diagram

Figure :output from closed loop transfer function

Overshoot given as =

= 33%

Q2.

1. Characteristic equation given as :

=0

1. By considering ;

2єɷ = 10.047

= 239.23

Є = 0.3248

= 15.47rad/s

Overshoot = 100%

= 100%

= 33.99%

1. = 100%

= 0.415

< 2

< 2

According to that to maintain < 2

The PD characteristics equation is given as

=0

Considering that can replace by .

From that given as:

< 2

>0.01762

From that can consider as 1.

According to that

=

0.415=

= 0.011635

Q3)

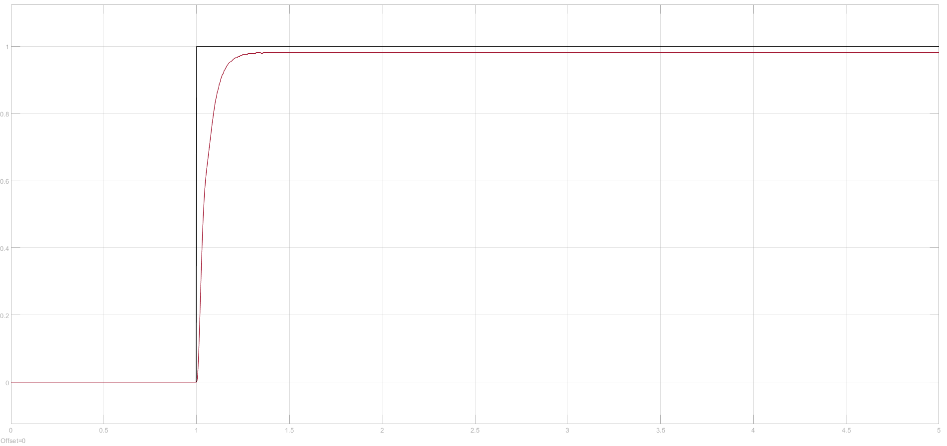


Figure :Time domain response of the closed loop function

1. The overshoot is given by:

:40.0717%

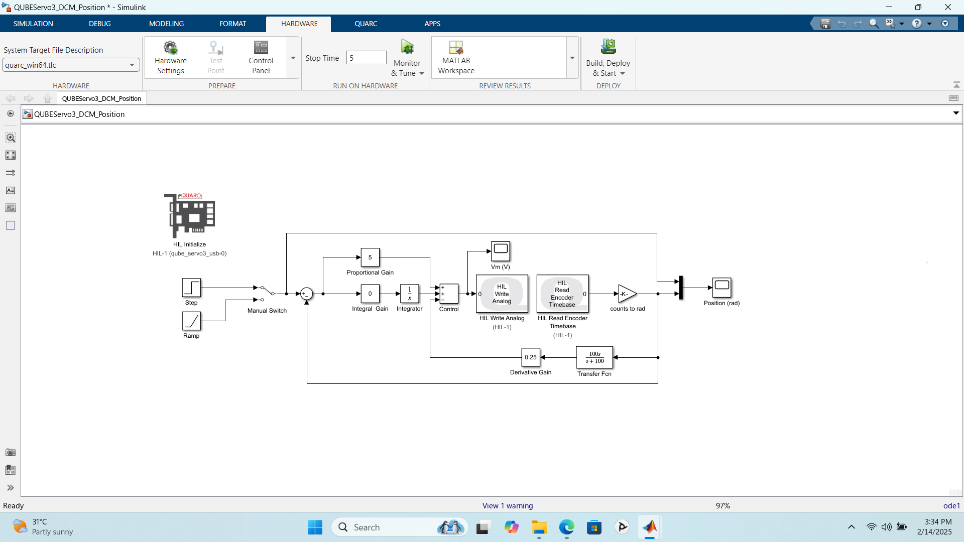
1. 

Figure : Design a PD Controller

A graph with a red line

Description automatically generated

Figure : Overshoot is reduced by 30%

# REFERENCES

|  |  |
| --- | --- |
| [1] | M. H. Center. [Online]. Available: https://www.mathworks.com/help/slcontrol/ug/create-i-pd-and-pi-d-controllers.html. |
| [2] | MEDIUM. [Online]. Available: https://medium.com/@mmwong920/a-brief-introductino-to-pd-controller-bac79c4f3fef. |
| [3] | GREEKFOGGREEK. [Online]. Available: https://www.geeksforgeeks.org/compensators/. |