EE5351: CONTROL SYSTEM DESIGN

LABORATORY 03

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 | 03 |
| Lab Name | Laboratory Section 3 |
| Lab conduction date | 2024.11.05 |
| Report Submission date | 2025.01.24 |

**Contents**

[1 OBSERVATION 6](#_Toc192004675)

[2 CALCULATION 7](#_Toc192004676)

[3 REFERENCES 13](#_Toc192004677)

**List of Tables**

Table : Summative Laboratory Form

[Table 2: Observations 6](#_Toc188653612)

**List of Figures**

[Figure 1: Simplified t/f Simulink Model 8](#_Toc192004688)

[Figure 2: By creating closed loop function giving input as 1 8](#_Toc192004689)

[Figure 3: Output from the closed loop function 9](#_Toc192004690)

[Figure 4: Root Locus of DC Motor Position Control System 9](#_Toc192004691)

[Figure 5: Math Lab code for increase the Omega by 10% 10](#_Toc192004692)

[Figure 6: Root Locus for By increasing the omega 10](#_Toc192004693)

[Figure 7: MathLab code for implement Step response 11](#_Toc192004694)

[Figure 8: Time response before and after changing the omega 11](#_Toc192004695)

[Figure 9: Time Domain Response [θm(t)] of the closed loop 12](#_Toc192004696)

[Figure 10: Design a compensator **for** the DC motor position control system 12](#_Toc192004697)

# 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:

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

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

1. A computer screen shot of a computer program

   AI-generated content may be incorrect.

Figure : Simplified t/f Simulink Model

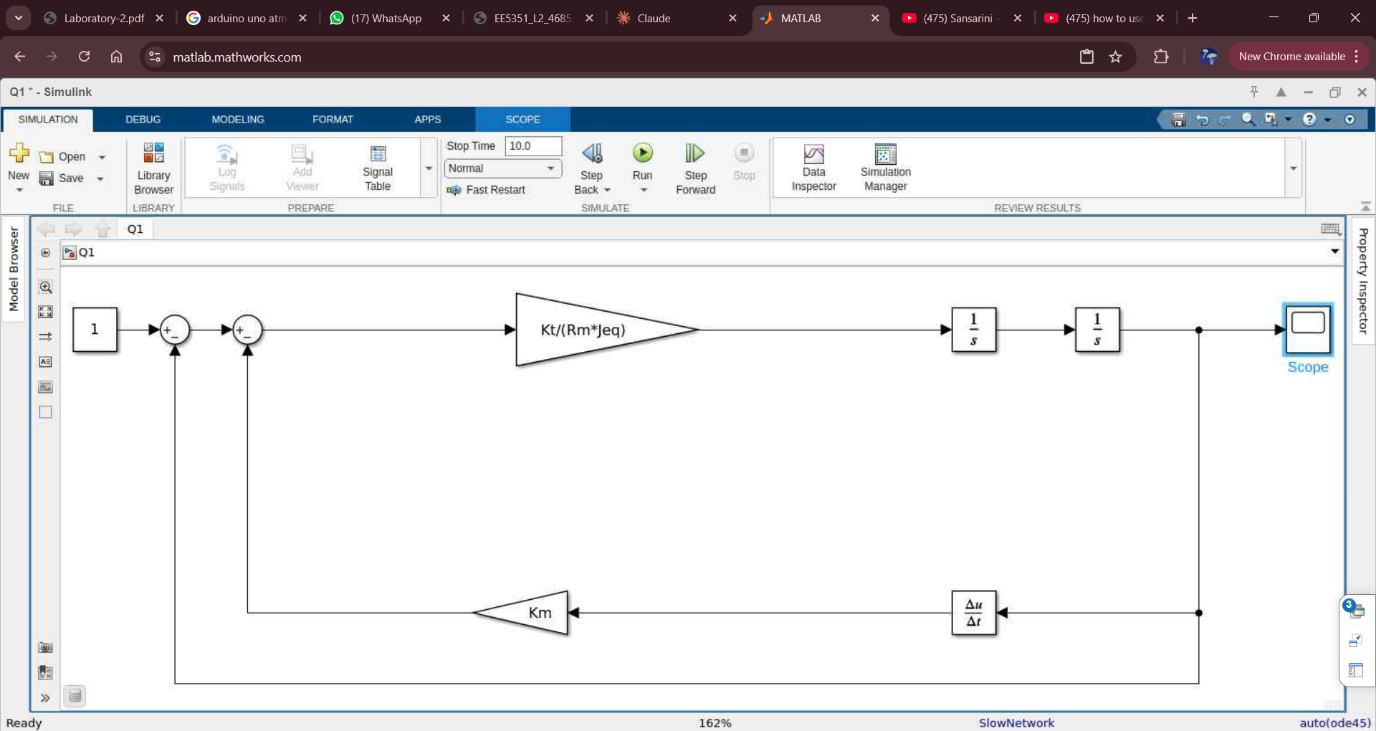
1. By considering the closed loop transfer function
2. 

Figure : By creating closed loop function giving input as 1

A screenshot of a graph

AI-generated content may be incorrect.

Q2.

Figure : Output from the closed loop function

% Define numerator and denominator of the transfer function

num = 0.042;

den = [17.556e-5, 1.764e-3, 0.042];

% Create the transfer function

G = tf(num, den);

% Plot the root locus

rlocus(G);

title('Root Locus of DC Motor Position Control System');

grid on;

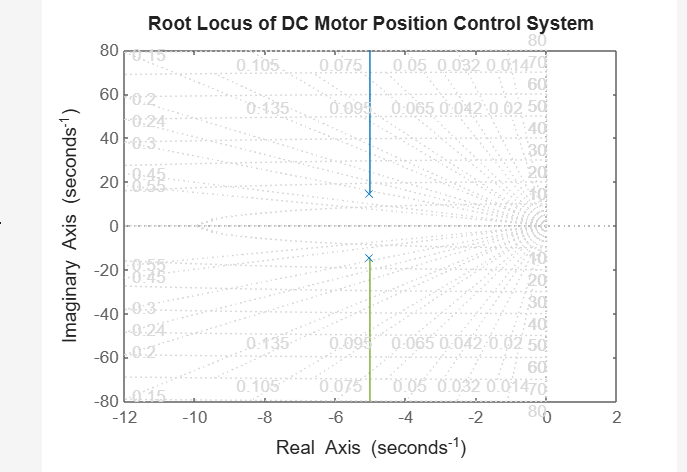


Figure : Root Locus of DC Motor Position Control System

Characteristic equation given as ;

=0

By calculating the given as

2 = 10.0455

= 10.05

A screenshot of a computer

AI-generated content may be incorrect.

Figure : Math Lab code for increase the Omega by 10%

A screenshot of a graph

AI-generated content may be incorrect.

Figure : Root Locus for By increasing the omega

A screen shot of a computer

AI-generated content may be incorrect.

Figure : MathLab code for implement Step response

A graph with a red line

AI-generated content may be incorrect.

Figure : Time response before and after changing the omega

Q3)

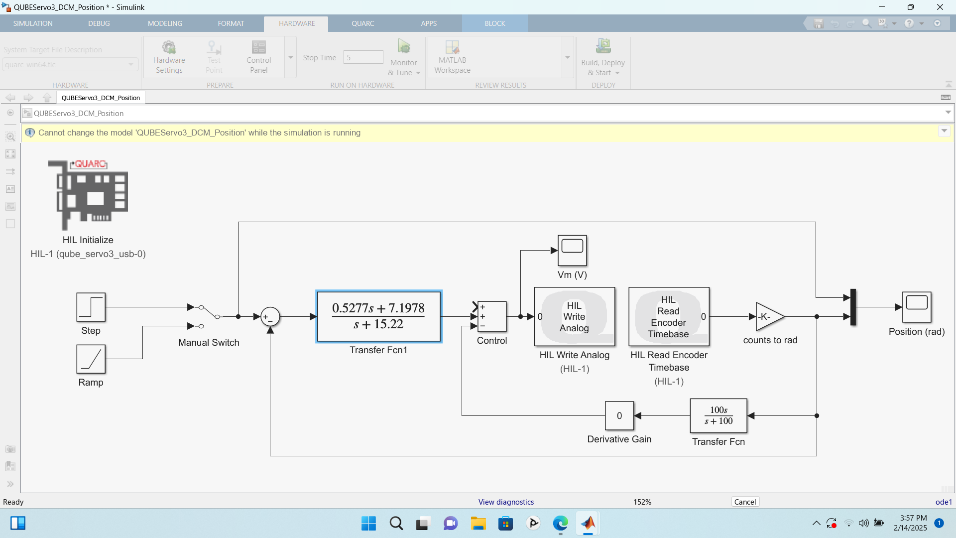


Figure 9: Time Domain Response [θm(t)] of the closed loop

Figure 10: Design a compensator **for** the DC motor position control system

# REFERENCES

|  |  |
| --- | --- |
| [1] | "Control Tutorial," [Online]. Available: https://ctms.engin.umich.edu/CTMS/index.php?example=Introduction&section=ControlRootLocus. |
| [2] | [Online]. Available: https://medium.com/@csoham358/a-hackers-guide-to-understanding-controllers-62fb26bed952. |
| [3] | "LibreTexts," [Online]. Available: https://eng.libretexts.org/Bookshelves/Industrial\_and\_Systems\_Engineering/Chemical\_Process\_Dynamics\_and\_Controls\_(Woolf)/09%3A\_Proportional-Integral-Derivative\_(PID)\_Control/9.02%3A\_P\_I\_D\_PI\_PD\_and\_PID\_control. |