

ECE 509 – Project 2

Analysis of Linear Systems

Logan T. Pride

April 11, 2026

1 Introduction

What do you hope to achieve/demonstrate in this project? The preparation of the following report was based on an inquiry into a project focused on transfer functions, state-space analysis, the zero-input, zero-state, and total response of a system, modal form, and the stability, observability, and controllability of a system. As these were the core concepts of the project, the writer ensured comprehensive note-taking and dedicated effort to understand each topic in full detail. The writer aims for the report to meet the instructor's expectations and believes that the simulations, studies, and research undertaken have provided the necessary skills and knowledge to fulfill all requirements for this assignment. The writer particularly valued part c, where the breakdown of the states in the state-space offered insight into the total response of the system.

2 Part 1 – Hand Derivations

Part 1: Prompted for the penmanship/handwriting of the students to be displayed. Therefore, screenshots of the report highlight the students' notebook work on certain problems that asked for hand derivations of solving.

The system given for the project is:

$$\dot{\vec{x}}(t) = \begin{bmatrix} -22 & 12 \\ -30 & 16 \end{bmatrix} \vec{x}(t) + \begin{bmatrix} 1 \\ 0 \end{bmatrix} u(t) \quad (1)$$

$$y(t) = \begin{bmatrix} 1 & 0 \end{bmatrix} \vec{x}(t) + u(t) \quad (2)$$

where the system's input $u(t) = -2$, $t \geq 0$ and $\vec{x}(t_0) = \begin{bmatrix} 2 & -3 \end{bmatrix}^T$.

2.1 (a) Find the $g(s)$ where is the Transfer Function of the system

To find the transfer function, had inquired the use of the following equation: $g(s) = C(sI - A)^{-1}B + D$. The following figure shows the process of finding the transfer function.



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Report on the system response

Download the complete project report and analysis

EECE 600 - Linear Systems Analysis - Homework Assignment

Download the MATLAB script and the MATLAB data files from the course website. The MATLAB script is named 'hw1.m' and the MATLAB data files are named 'hw1_data.mat' and 'hw1_data2.mat'.



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2025/2026 Academic Year - Spring Semester - EECE 600 - Linear Systems Analysis

Project Title: **Stability Analysis of a Feedback Control System**

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Project Title: **Stability Analysis of a Feedback Control System**

The project involves analyzing the stability of a feedback control system. The system is represented by a transfer function, and the goal is to determine the conditions for stability using the Routh-Hurwitz criterion. The project also includes a simulation of the system's response to a step input.

EECE 600 - Linear Systems Analysis

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Figure 1: [Blurred text]



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2. What is the product?

The product is a book titled "Linear Systems Analysis" by Logan Prude. It is a textbook for the course ECE 600 at the University of Dayton. The book covers the theory and analysis of linear systems, including topics such as Laplace transforms, state-space analysis, and control systems. It is a comprehensive resource for students and professionals in the field of electrical engineering.

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2024 EECE 6000 Final Project Report

The purpose of this report is to provide a comprehensive overview of the final project for the EECE 6000 course. The project focuses on the analysis and design of a control system for a robotic arm. The report is organized into several sections, including an introduction, system modeling, control design, simulation results, and conclusions. The following table provides a summary of the key findings and results of the project.



The results of the project demonstrate the effectiveness of the control design in achieving the desired system response. The system is able to track the reference signal accurately and maintain a steady-state value of approximately 0.8. The following table provides a summary of the key performance indicators (KPIs) for the system.

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Report for EECE 6000 Final Project

2021 - 2022 Researcher's Testimonial

The opportunity to work on this project was a great experience. I was able to learn a lot about the research process and the importance of data. I also had the chance to work with some of the best researchers in the field. The project was challenging, but it was also very rewarding. I learned a lot about the research process and the importance of data. I also had the chance to work with some of the best researchers in the field. The project was challenging, but it was also very rewarding.



Figure 1: A line graph showing a curve that starts at the origin and increases, representing a positive correlation or growth over time.

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Figure 2: A line graph showing a curve that starts at the origin and increases, representing a positive correlation or growth over time.



Figure 10: Magnitude of the transfer function $|G(j\omega)|$ versus frequency ω .

The magnitude of the transfer function $|G(j\omega)|$ is a measure of the system's gain at different frequencies. It is plotted against the frequency ω in radians per second. The curve shows that the system has a high gain at low frequencies and a low gain at high frequencies. This is characteristic of a low-pass filter.

The phase of the transfer function $\angle G(j\omega)$ is a measure of the system's phase shift at different frequencies. It is plotted against the frequency ω in radians per second. The curve shows that the phase shift is zero at low frequencies and decreases as frequency increases, approaching a constant value at high frequencies. This is characteristic of a low-pass filter.

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Figure 11: Magnitude of the transfer function $|G(j\omega)|$ versus frequency ω .

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10/1/2020



Figure 10: Plot of the system response

The system response is plotted against time. The plot shows a damped oscillation, indicating that the system is stable and the response decays over time. The oscillation is centered around a mean value, and the amplitude decreases as time increases.

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Figure 10: A 3D plot of a surface.

The surface is a smooth, curved shape, possibly representing a mathematical function. The axes are labeled, and the surface is colored with a gradient from blue to yellow.



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2. Conclusion

The surface is a smooth, curved shape, possibly representing a mathematical function. The axes are labeled, and the surface is colored with a gradient from blue to yellow.



6. References

1. [1] [2] [3] [4] [5] [6] [7] [8] [9] [10] [11] [12] [13] [14] [15] [16] [17] [18] [19] [20] [21] [22] [23] [24] [25] [26] [27] [28] [29] [30] [31] [32] [33] [34] [35] [36] [37] [38] [39] [40] [41] [42] [43] [44] [45] [46] [47] [48] [49] [50] [51] [52] [53] [54] [55] [56] [57] [58] [59] [60] [61] [62] [63] [64] [65] [66] [67] [68] [69] [70] [71] [72] [73] [74] [75] [76] [77] [78] [79] [80] [81] [82] [83] [84] [85] [86] [87] [88] [89] [90] [91] [92] [93] [94] [95] [96] [97] [98] [99] [100]

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