# Short Summary Report: Lab #2

## Cover Page

Title: Linear Quadratic Regulator Design and Evaluation

Name(s): [Insert Names]

Section: [Insert Section]

Instructor: Dr. Rob Brown

Date: [Insert Date]

## Introduction

Objectives:  
The objective of this lab is to design and evaluate a Linear Quadratic Regulator (LQR) and Linear Quadratic Controller (LQC) for a single-axis spacecraft attitude control system.

Approach:  
The lab implements two tasks: designing and implementing an LQR with full state feedback and an LQC with a specified end time. The designs were tested using Simulink models.

## Main Body

Assumptions:  
The system assumes linear dynamics with known parameters. Measurement noise and modeling inaccuracies were considered negligible.

Brief Math Technique:  
The Riccati equation was used to solve for the optimal feedback gain. The gains were then implemented in Simulink models for step response simulations.

Theoretical Predictions:  
The LQR is expected to stabilize the system quickly with minimal overshoot. The LQC should achieve similar results with additional tuning for the terminal state.

Experimental Results:  
Simulations for both LQR and LQC were conducted. Plots of state responses and control inputs are included.

## Discussion/Conclusions/Recommendations

Discussion:  
The LQR design achieved stability with fast convergence. The LQC provided additional control precision for the terminal state. Plots indicate minimal oscillations and adherence to design criteria.

Conclusions:  
Both LQR and LQC designs met the stability and performance requirements. LQR was simpler to implement, while LQC offered terminal state accuracy.

Recommendations:  
Future designs could explore varying Q and R matrices to optimize performance further.

## Appendices

Appendix A: Simulink Models  
[Include diagrams or descriptions here]

Appendix B: MATLAB Code  
[Include snippets of relevant code here]

Appendix C: Plots  
[Insert plots of state responses and control inputs here]