Report By:

### Total: \_\_\_\_/40

Lab Partner:

Lab TA:

Section:

## Question 1. \_\_\_/15

### Theoretical/Experimental Results \_\_\_/5

*Mp = (MaxValue – SteadyState)/SteadyState \* 100*

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| ζ | M­p Theory % | M­p Expmt % | t­r Theory (s) | t­r Expmt (s) | t­s Theory (s) | t­s Expmt (s) |
| 2.0 |  |  |  |  |  |  |
| 1.5 |  |  |  |  |  |  |
| 1.0 |  |  |  |  |  |  |
| 0.8 |  |  |  |  |  |  |
| 0.7 |  |  |  |  |  |  |
| 0.5 |  |  |  |  |  |  |
| 0.3 |  |  |  |  |  |  |
| 0.2 |  |  |  |  |  |  |

Table 1: Theoretical/Experimental Results

*Attach one sample plot from your StepResponseMetrics file that shows how you obtained the experimental results for one of the values of ζ.*

### Comparison of Theoretical vs. Experimental Results \_\_\_/5

Hint: Does it look like the theoretical equations on page 11 of the lab manual match the experimental values?

*Put Discussion Here*

### Discussion of variation with ζ of Mp, ts, tr \_\_\_/5

*Put Discussion Here*

## Question 2. \_\_\_/15

### Effect of ζ on Pole Locations (Derive Equation and Explain) \_\_\_/5

*Put Discussion of ζ’s Effect Here. Include the equation of the two pole locations in terms of ζ (you may assume ωn = 1). Include either a sketch/graph of the pole locations as ζ increases, or a description of what this graph would look like.*

### Effect of Pole Locations on Mp, ts, tr for an Underdamped System \_\_\_/5

*Hint: An underdamped system has ζ \_\_\_\_*

*As ζ increases, the poles do\_\_\_\_ which makes Mp, ts, tr do \_\_\_\_\_\_\_*

*(Double Hint: moving the poles causes two different effects on ts)*

### Effect of Pole Locations on Mp, ts, tr for an Overdamped/Critically Damped System \_\_\_/5

*Hint: An over-damped system has ζ \_\_\_\_*

*A critically damped system has ζ \_\_\_\_*

*As ζ increases, the poles do\_\_\_\_ which makes Mp, ts, tr do \_\_\_\_\_\_\_*

## Question 3. \_\_\_/10

*Investigate the effects of approximating an overdamped 2nd order system with a 1st order system. The approximation will be done by using a transfer function with only the pole that is closer to the origin, pmin.*



### Similarities/Differences on Overdamped 2nd-Order system to a 1st-Order System with the less negative of the 2nd-Order’s poles \_\_\_/6

*Plot the step responses for the 2nd order systems and their 1st order approximations for ζ = 1.5, ζ = 5, and ζ = 40. Assume ωn = 1. How are the step responses of the 1st order approximations similar to and different from the step responses of the original 2nd order systems?*

### Effect of magnitude of ζ on the accuracy of the approximations \_\_\_/4

*How does ζ affect the accuracy of the 1st order approximations?*

## Attachments (3)

* Plots obtained during lab
* Sample response with relevant points for calculating Mp, ts and tr marked
* Step Responses comparing 2nd order systems and 1st order approximations