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### Total: \_\_\_\_/50

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Section: AB2

## Part I. \_\_\_/8

### State Space Model Representation of H1(s) \_\_\_/8

*Compare the plots of y\_dot and y obtained in Part 1 of the lab with the plots previously made for the prelab. Why are they identical? Attach plots – if your prelab plot was wrong, fix it and attach the corrected plot.*

They are identical, because they correspond to the same differential equation, .

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## Part II. \_\_\_/22

### Effects of a Zero on Mp, tr, and ts. \_\_\_/2

*Fill the table and attach plot for part II.*

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Property** | **No Zero**  **H1(s)** | **H2(s) with Zero at s = -30** | **H2(s) with Zero at s = -3** | **H2(s) with Zero at s = -1.5** | **H2(s) with Zero at s = 1.8** | **H2(s) with Zero at s = 18** |
| M­p % | 9.84% | 9.64% | 41.08% | 114.82% | 19.52% | 9.78% |
| t­r (s) | 0.43 | 0.43 | 0.23 | 0.18 | 0.30 | 0.42 |
| t­s (s) | 1.05 | 1.01 | 0.85 | 1.38 | 1.34 | 1.10 |

Table 1: Effects of Zero

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### Discuss the Effects of a LHP Zero \_\_\_/4

*Explain how Mp, tr, and ts are affected by the zero’s location. When can the zero be ignored?*

When the zero is closer to the origin, Mp is larger, tr is smaller, and ts is larger.

When the absolute value of zero is very large, it can be ignored.

### Effects of a Non-minimum Phase (RHP) Zero \_\_\_/2

*What is unique in this situation?*

RHP zeros would cause inverse response, which make the system hard to control.

### Decomposition of H2(s) \_\_/14

*Take H2(s), set ζ to the value found in the prelab, and separate the numerator into two terms so that H2(s) is a sum of 2 fractions. Discuss how this decomposition helps to explain the effect of the zero location. In particular, discuss what each term represents. Also discuss α’s effect. Which term dominates as α approaches 0? As α approaches ∞? What happens when α is negative?*

The first part is the same as the original transfer function. The second part adds a term to the output, which is proportional to the derivative of the original output. When approaches zero, the second part dominates, and vice versa. When is negative, it causes an inverse response, which make the system harder to stabilize.

## Part III. \_\_\_/20

### Effects of an Extra Pole on Mp, tr, and ts. \_\_\_/2

*Fill the table and attach plot for part III. Attach Plots.*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Property** | **No Pole**  **H1(s)** | **H3(s) with Pole at s = -30** | **H3(s) with Pole at s = -3** | **H3(s) with Pole at s = -1.5** |
| M­p % | 9.48% | 9.33% | 0.00% | 0.00% |
| t­r (s) | 0.43 | 0.44 | 0.69 | 1.34 |
| t­s (s) | 1.05 | 1.08 | 1.05 | 2.05 |

Table 2: Effects of Extra Pole

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### Discuss the Effects of an Extra Pole \_\_\_/4

*Explain how Mp, tr, and ts are affected by the location of the additional pole. When can the extra pole be ignored?*

When the pole is closer to the origin, the Mp is smaller, the tr is larger, and ts is larger.

### Decomposition of H3(s) \_\_\_/14

*Take H3(s), set ζ to the value found in the prelab, and perform a partial fraction expansion to make three terms in the form of the expansion on page 18 in the lab manual. Determine the values of k1, k2, and k3. Discuss how this decomposition helps to explain the effect of the location of an additional pole. In particular, discuss what each term represents. Also discuss α’s effect. Which term dominates as α approaches 0? As α approaches ∞?*

The term represents a transfer function whose pole is at . The second term adds a term to the output, which is proportional to the derivative of the original output. The last term is proportional to the original transfer function. When approaches infinity, the second term dominates, and vice versa.

## Attachments (4)

* Plot from PreLab
* Plots for Part I, II and III.

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