# ELEN3016: CONTROL LAB 1

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$$G(s) = \frac{1}{s(s+4)(s+6)}$$

## 1 Matlab Simulations

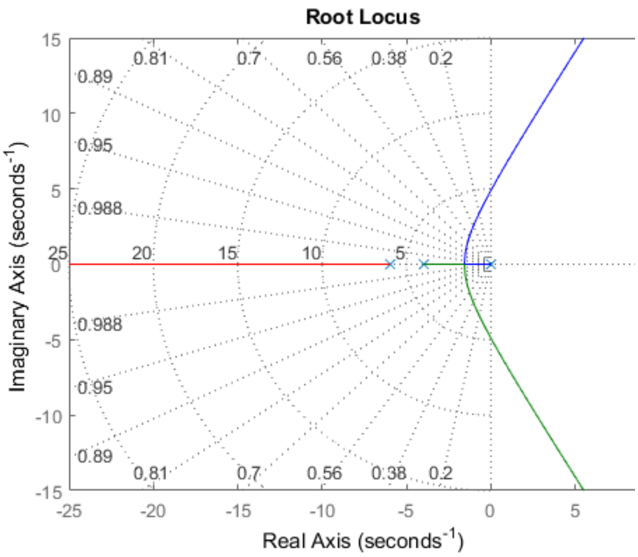


Figure 1: Root-Locus Plot of Plant Transfer Function

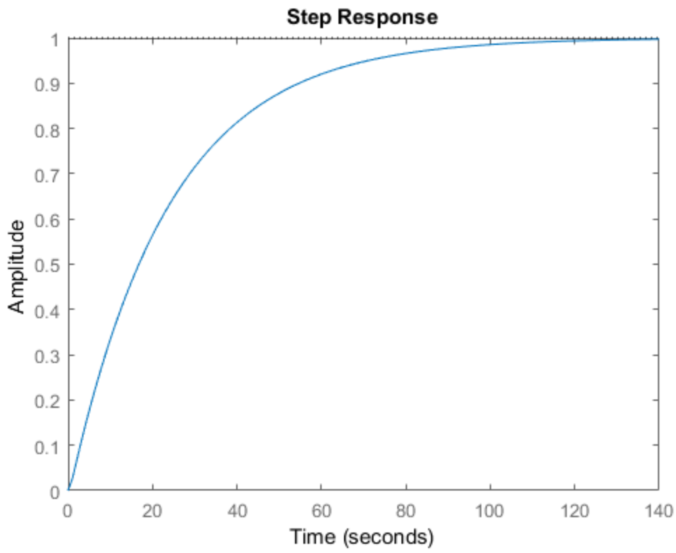


Figure 3: Step Response of Plant with Unity Feedback

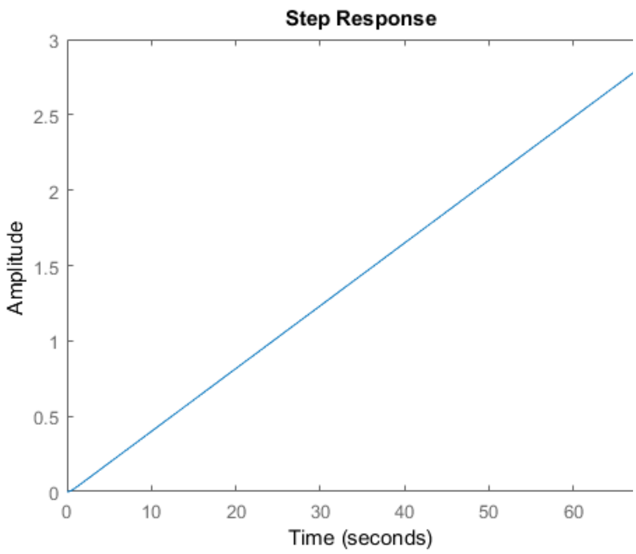


Figure 2: Step Response of Plant (with no Feedback)

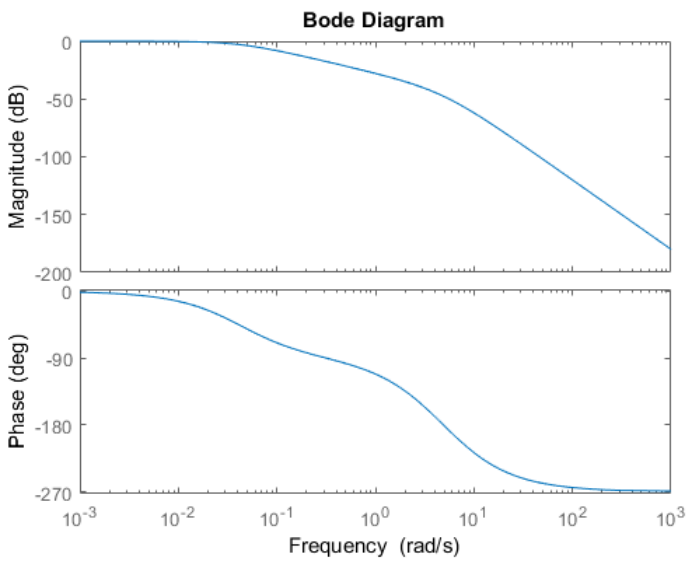


Figure 4: Bode Plot of Plant with Unity Feedback

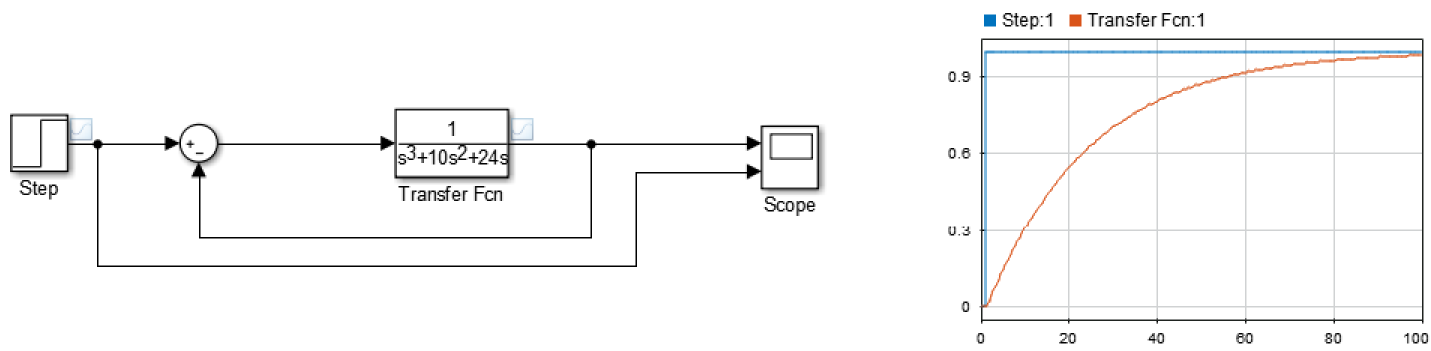


Figure 5: Simulink Simulation

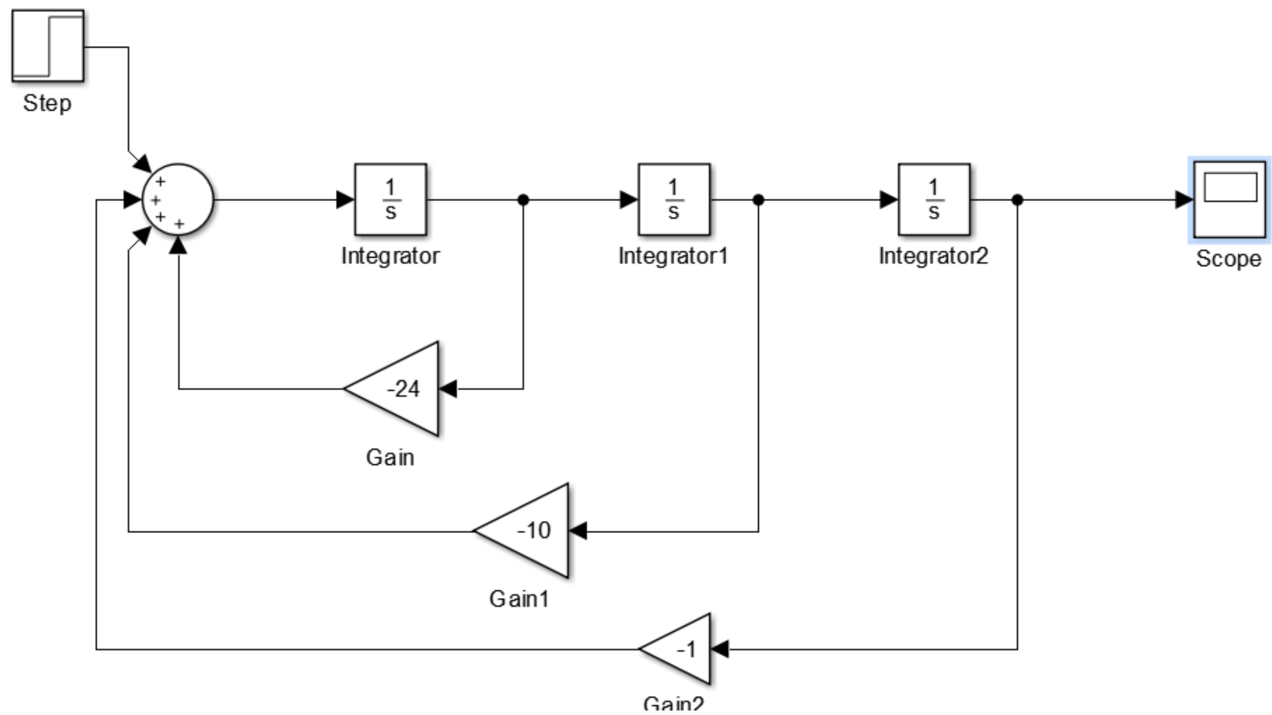


Figure 6: Simulink State Diagram Simulation

Table 1: Matlab Simulated Characteristics

| **Property** | |
|---|---|
| Rise Time (s) | 51.8 |
| Settling Time (s) | 92.7 |
| Overshoot (%) | 0 |
| Undershoot (%) | 0 |
| Peak | 0.9993 |

For a closed loop transfer function with unity negative feedback, the steady state error ($e_{ss}$) can be expressed as;

$$e_{ss} = \lim_{s \to 0} sE(s) \tag{1}$$

$$= \lim_{s \to 0} \frac{sR(s)}{1 + G(s)} \tag{2}$$

For a step input (i.e R(s) $=\frac{1}{s}$). $e_{ss} = \frac{1}{1+K_p}$ where $K_p = \lim_{s \to 0} G(s)$.

## 2 Dominant Pole Theory Reduction

$$G_1(s) = \frac{\frac{1}{6.08}}{s(s+3.921)} \tag{3}$$

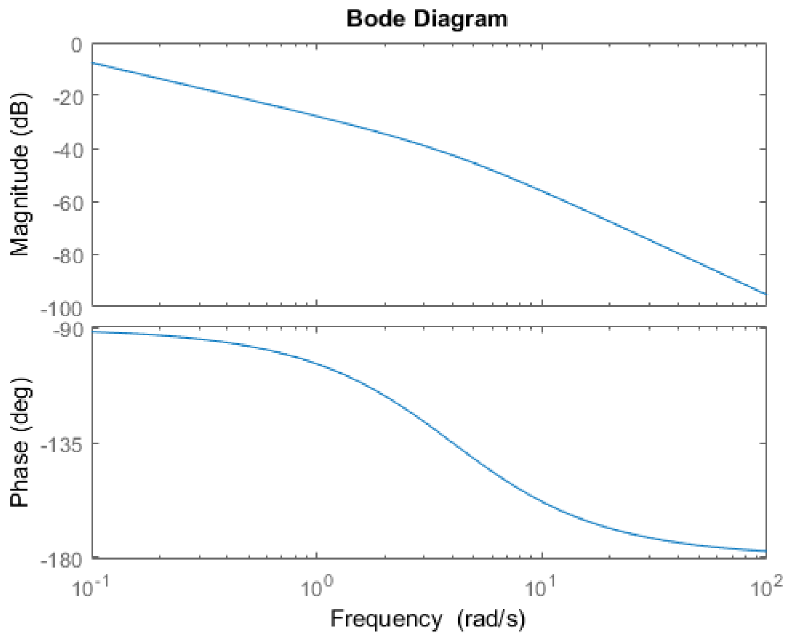


Figure 7: $G_1(s)$ Frequency Response

$$G_2(s) = \frac{\frac{1}{6}}{s(s+4)} \tag{4}$$

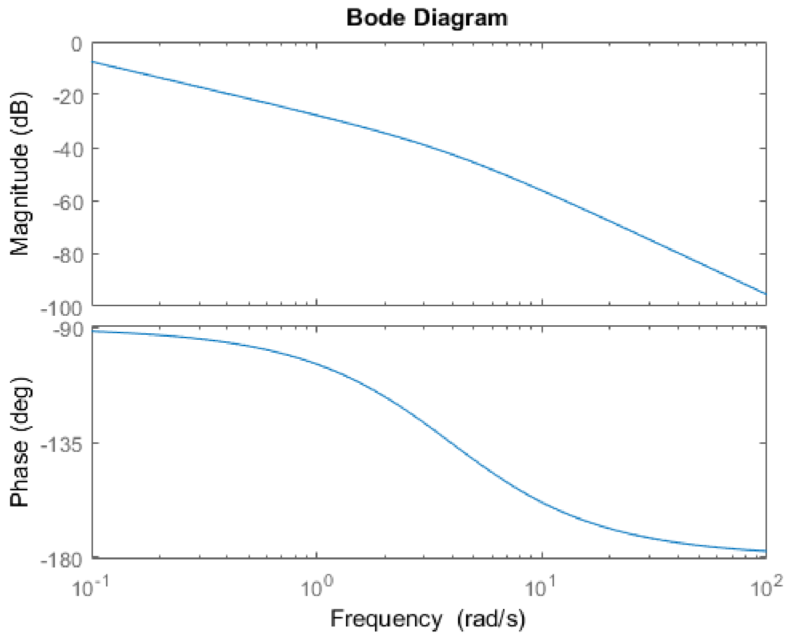


Figure 8: $G_2(s)$ Frequency Response

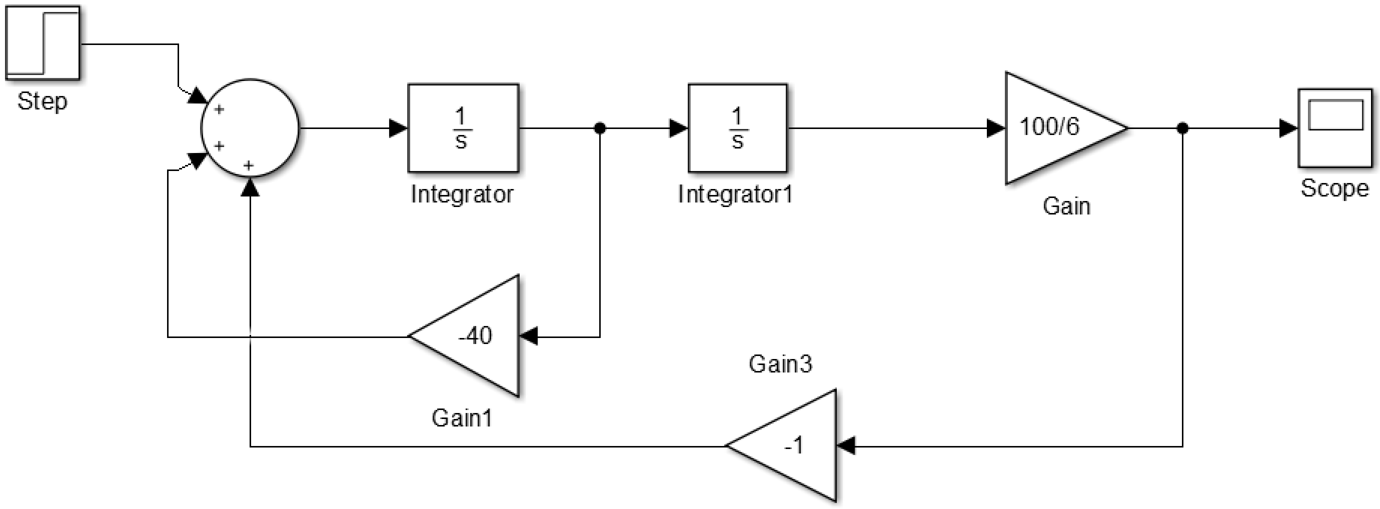


Figure 9: State Diagram With Time Scaling and Dominant Pole Theory Reduction

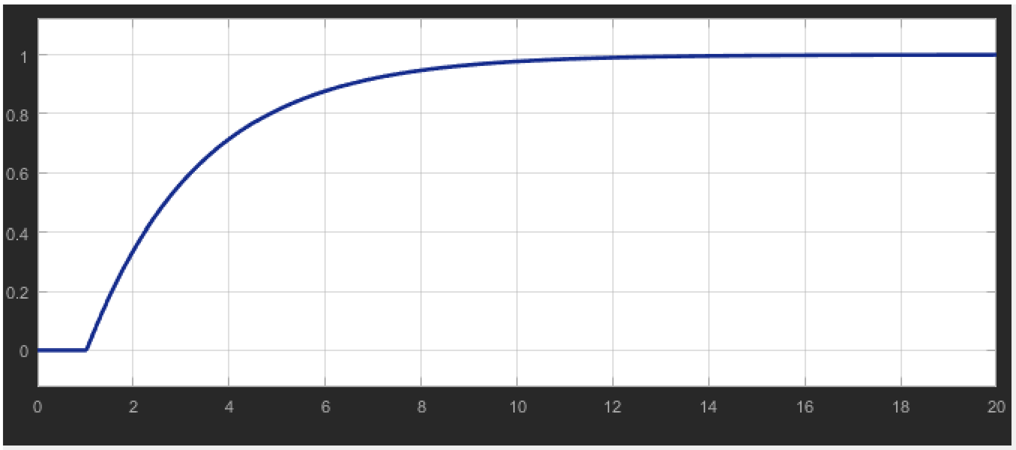


Figure 10: Step Response of Time Scaled and Dominant Pole Theory Reduced System