

Automatic Control – EEE 2002 Tutorial Exercise III

A first order system is given by $G(s) = \frac{k}{s+a}$.

1. Write the transfer function as: $G(s) = \frac{k'}{\tau s + 1}$ and hence find the value of the DC gain (k') and of the system's time constant (τ).
2. For $k=1$ and $a=5$ repeat the previous step.
3. Based on the previous answer predict the behaviour of the system for a (unit) step input.
4. Find the step response of that system using Matlab **AND** Simulink and hence crosscheck your previous answer.
5. Using the appropriate Matlab commands find (exactly) the steady state value and the time constant of the system and hence further crosscheck your previous results.
6. Using the appropriate Matlab commands find and plot the error.
7. Using the appropriate Matlab commands find the exact value of the steady state error.
8. Repeat the previous steps and comment on your results for:
 - a. $k=0.1$ and $k=10$ (keep a fixed to 5).
 - b. $a=0.5$ and $a=50$ (keep k fixed to 1).
9. Plot the responses of step 7 in one figure, add axes labels and graph title. Each response must be with a different colour.
10. For the original system ($k=1$ and $a=5$) find and plot the ramp response and the error when the slope of the input signal is 5.
11. Using the appropriate Matlab commands find the exact steady state error.
12. Using the final value theorem crosscheck your previous answer (for both steady state response and the steady state error).