



Course #: 804465 – Automatic Control Lab #5

TRANSIENT AND STEADY STATE RESPONSES USING MATLAB

**Objective** Simulation of transient and steady state responses of systems due to step and impulse input functions

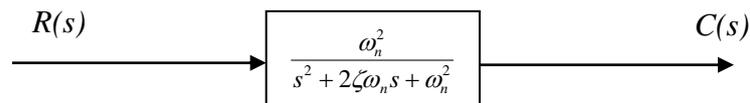


Figure 1. Block Diagram of a System

**Introduction**

Figure 1 shows the transfer function of a second order system in the standard form. The performance parameters of a second order system are related to the modal properties/parameters (natural frequency  $\omega_n$  and damping ratio  $\zeta$ ) which depend on the mass, damping and stiffness of a mechanical system. Some of the performance parameters for transient and steady state response (time domain response) are:

Peak time  $t_p = \pi/\omega_d$

Maximum overshoot  $M_p = e^{-(\zeta\pi/\sqrt{1-\zeta^2})}$

Settling time (2 % criterion)  $t_s = 4/\zeta\omega_n$

**Lab Assignment**

- Calculate the peak time, maximum overshoot and settling time of the response of the system with transfer function  $\frac{C(s)}{R(s)} = \frac{25}{s^2 + 6s + 25}$  due to a unit step input.
- Write MATLAB m-file to get the plot of the responses of the system due to unit step and impulse inputs. For the unit step input, plot the responses for  $\frac{C(s)}{R(s)} = \frac{1}{s^2 + 6s + 25}$  and the transfer function given in (a) above for comparisons. Make sure your program contains comments so that a reader can understand every step in the m-file. Save the file as your first name\_student ID, e.g. Munshi\_43201100.
- Estimate the peak time, maximum overshoot and settling time from the



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response of the system expressed in standard transfer function and compare with your answers obtained in step (a).

Hints:

1. **For unit step input responses,**  
n1=1;n2=25; den = [1 6 25];  
step(n1,den);  
title('Transfer function when numerator = 1')  
figure, step(n2,den);  
title('Standard transfer function')
2. **For the impulse input:**  
figure  
impulse(n2,den)



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