Automatic Control Systems

Course code: ECE 251

Sheet 06 — Time response

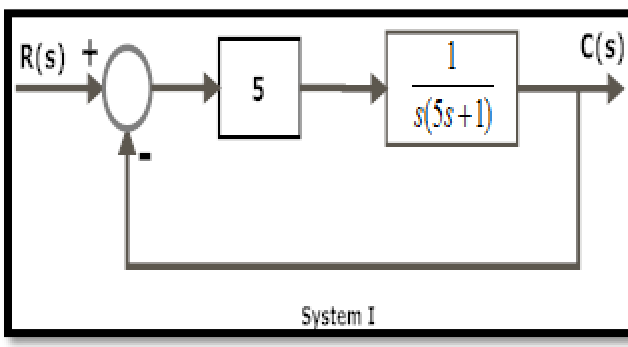
1. Consider the unit-step response of a unity-feedback control system whose open-loop transfer function is $G(s) = \frac{1}{s(s+1)}$
   Obtain the rise time, peak time, maximum overshoot, and settling time.

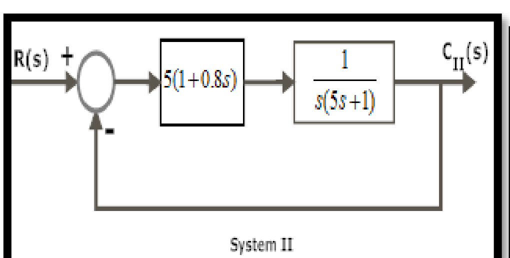
2. Consider the closed-loop system given by
   $$\frac{C(s)}{R(s)} = \frac{\omega_n}{s^2 + 2\zeta\omega_n s + \omega_n{}^2}$$
   Determine the values of ζ *and* ω_n so that the system responds to a step input with approximately **5%** overshoot and with a settling time of **2** sec.

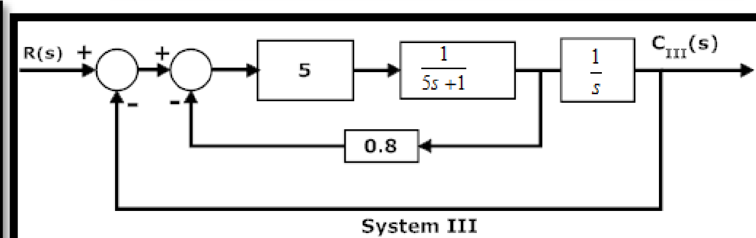
3. Using MATLAB, obtain the unit-step response, unit-ramp response, and unit-impulse response of the following system:
   $$\frac{C(s)}{R(s)} = \frac{10}{s^2 + 2s + 10}$$

4. Obtain both analytically and computationally the rise time, peak time, maximum overshoot, and settling time in the unit-step response of a closed-loop system given by
   $$\frac{C(s)}{R(s)} = \frac{36}{s^2 + 2s + 36}$$

5. Fig. below shows three systems. System I is a positional servo system. System II is a positional servo system with **PD** control action. System III is a positional servo system with velocity feedback. Compare the unit-step, unit-impulse, and unit-ramp responses of the three systems. Which







system is best with respect to the speed of response and maximum overshoot in the step response?

6. Using MATLAB, obtain the unit-step response curve for the unity-feedback control system whose open-loop transfer function is

$$\boldsymbol{G(s) = \frac{10}{s(s+2)(s+4)}}$$

Using MATLAB, obtain also the rise time, peak time, maximum overshoot, and settling time in the unit-step response curve

7. Consider the differential equation system given by

$$\boldsymbol{\ddot{y} + 3\dot{y} + 2y = 0,\ y(0) = 0.1,\ \dot{y}(0) = 0.05}$$

Using MATLAB, obtain the response $\boldsymbol{y(t)}$, subject to the given initial condition