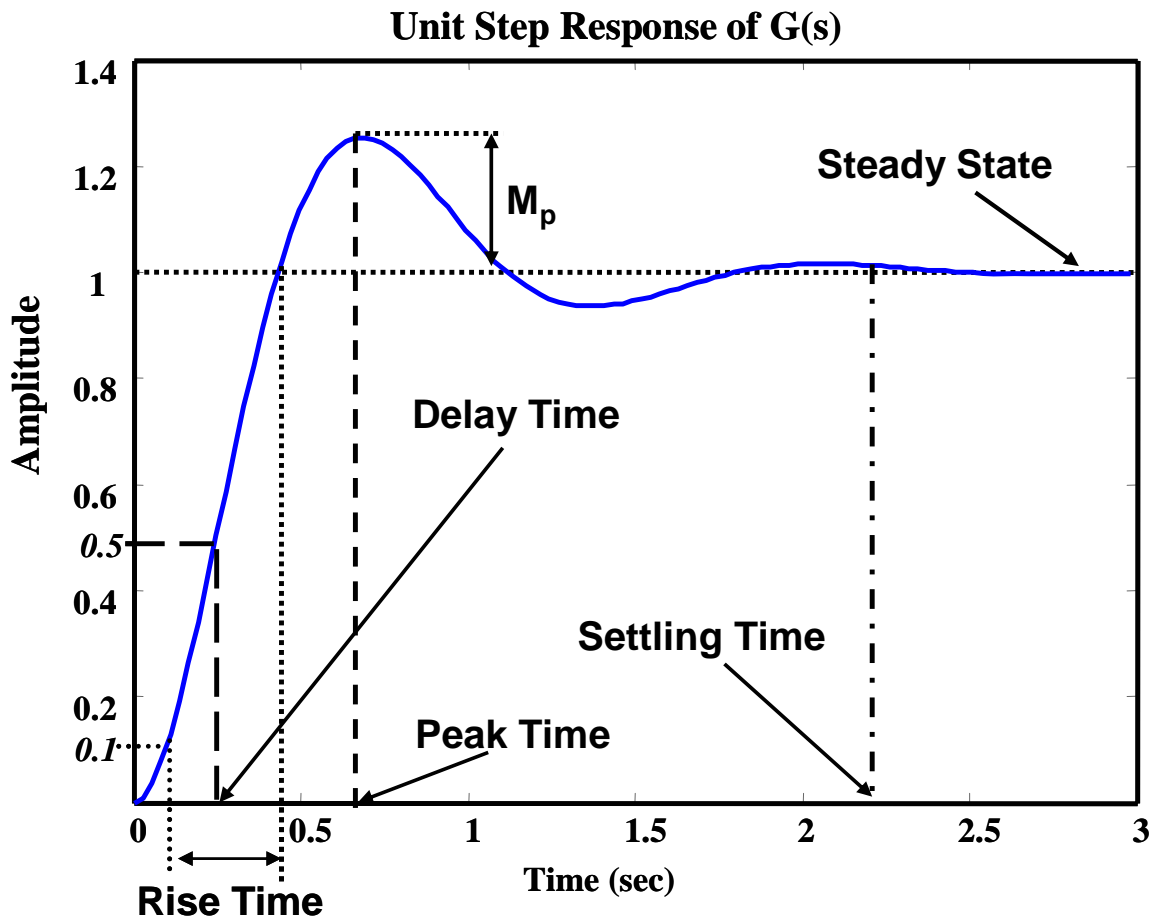


Supplementary Notes for Project

Background: Systems with energy can't respond instantaneously; they will exhibit transient response when subject to inputs or disturbances. Hence transient response characteristics constitute one of the important factors in system design. The desired performance of control systems is given in terms of transient response specification. Common transient responses are step response, impulse response and ramp response. Transient response of control system often exhibit damped oscillations before reaching steady state. [from text book]

Given a transfer function, $G(s)$, the unit step response of $G(s)$ is shown below:



The Transient response Specifications are defined as follow:

- **Percentage Maximum overshoot** – The maximum overshoot, M_p is the maximum peak value of the response curve measured from the final steady state value of the response. It is defined by

$$\% \text{ Max. Overshoot} = \frac{y(t = \text{peak value}) - y(\infty)}{y(\infty)} \times 100\%$$

- **Rise Time, t_r** – Time required for the response to rise from 10% to 90% or 5% to 95% or 0%-100% of its final value.
- **Delay Time, t_d** – The time needed for the response to reach half the final value the very first time.
- **Peak Time, t_p** – Time required for the response to reach the first peak of the overshoot.
- **Settling time, t_s** – Time required for the response curve to reach and stay within 2% of the final value. For second order system, t_s is about $4 \sim 5 \tau$.
- **Steady-State value** – The value that the response curve reaches the final value.