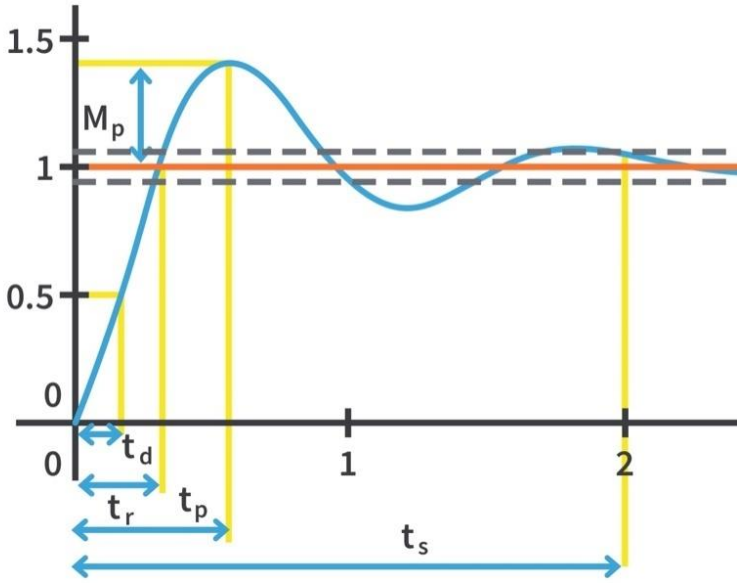
Linear Control System

Lab 2

Control system important terms

- Settling time
- Rise time
- Peak time
- First Order system
- Second Order System
- Overshoot



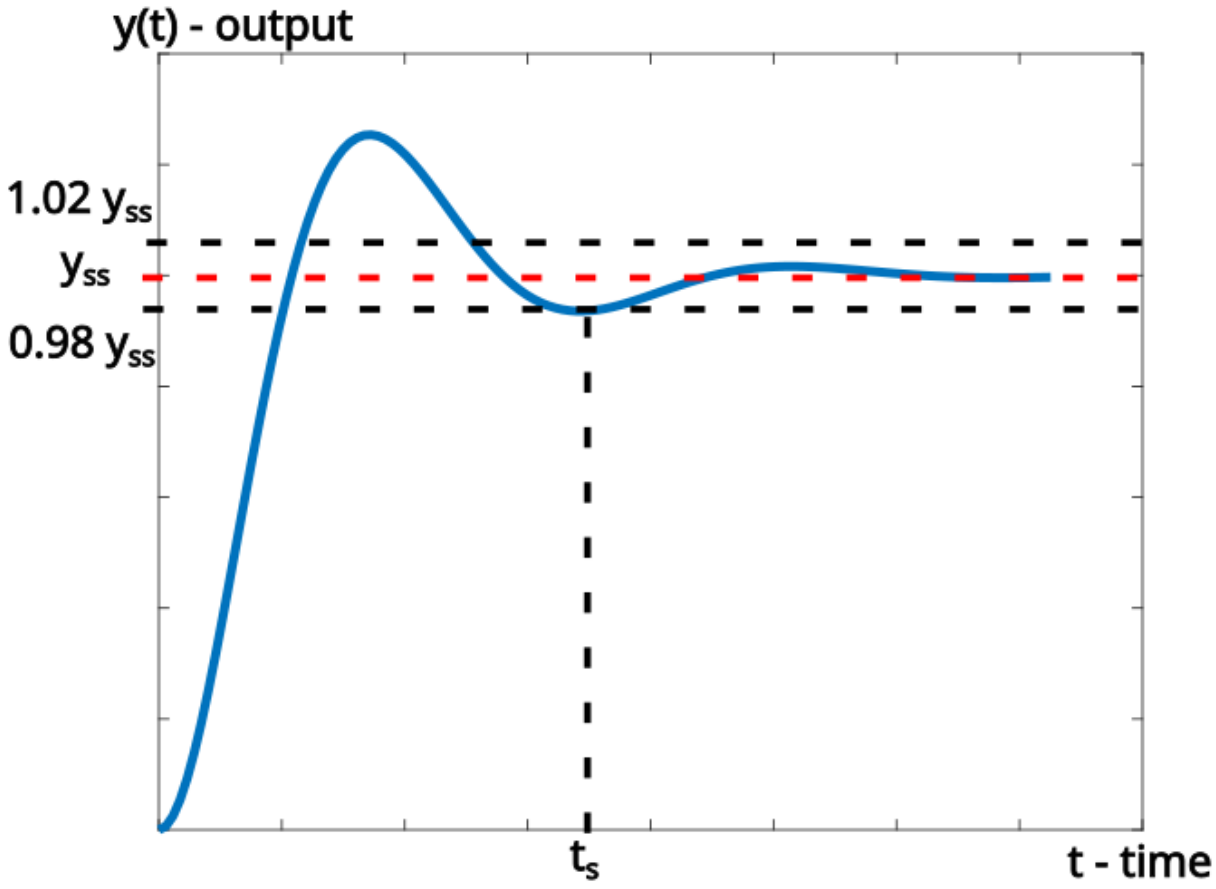
Settling time

- **What is Settling Time?**
  - The time required for a system's output to stay **within a certain error band** around the final steady-state value after a disturbance or input change.
  - Typically defined as the time to stay within **±2% or ±5%** of the final value **without leaving the band again**.

Important of Settling time in CS

- Measures how **fast the system stabilizes** after a change.
- Indicates the **speed of response** — critical in control system performance.
- Helps determine if the system's reaction time meets design requirements.

Settling Time (Cont…)



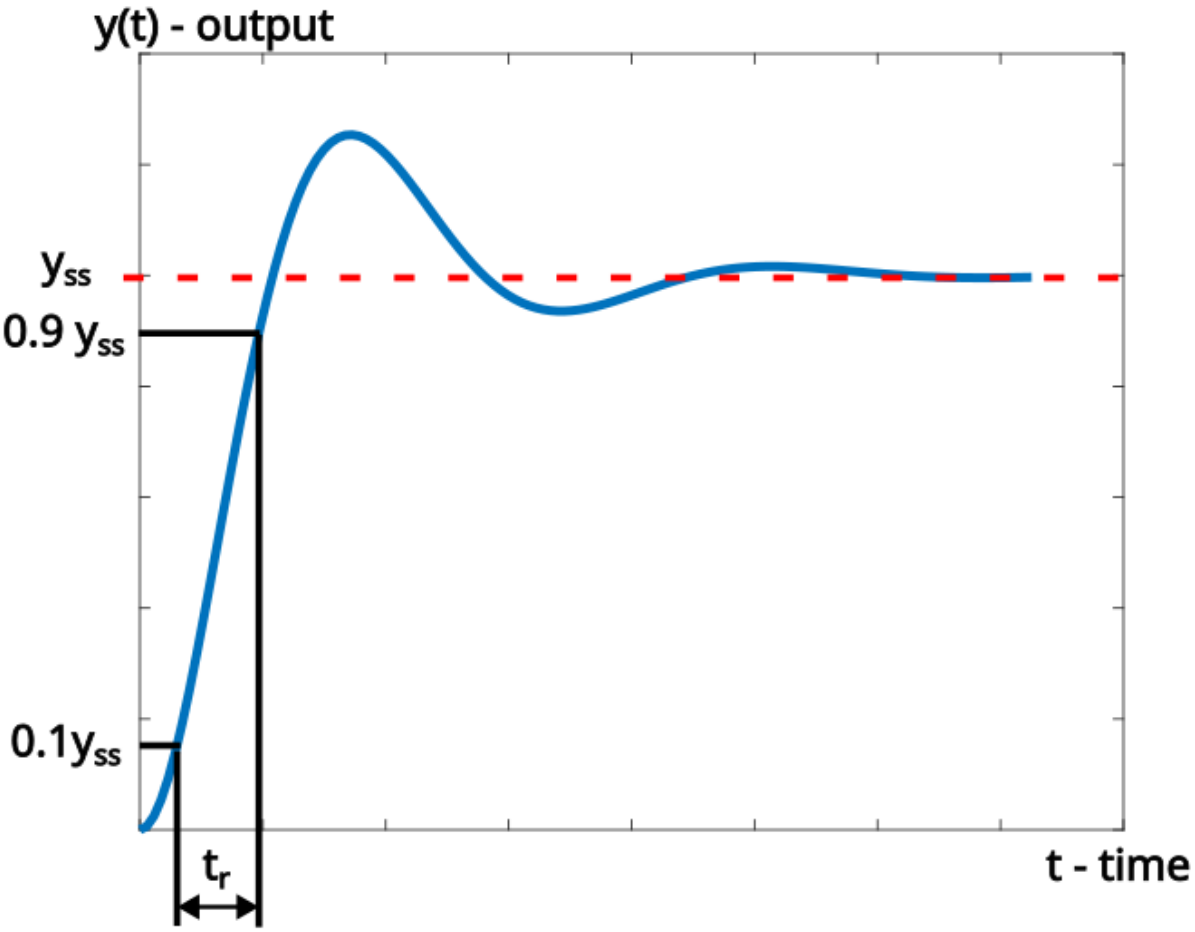
Rising time in system response

- **What is Rise Time?**
  - The time taken by the system's output to **rise from a lower percentage to a higher percentage** of its final steady-state value.
  - Typically measured as the time to go from **10% to 90%** (or sometimes 0% to 100%) of the final value after an input change (like a step input).

Why is Rise Time Important?

- Indicates how quickly the system **starts responding** to an input.
- Shows the **initial speed** of the system's reaction.
- Helps assess system performance for **fast or slow response** requirements.

Rise time

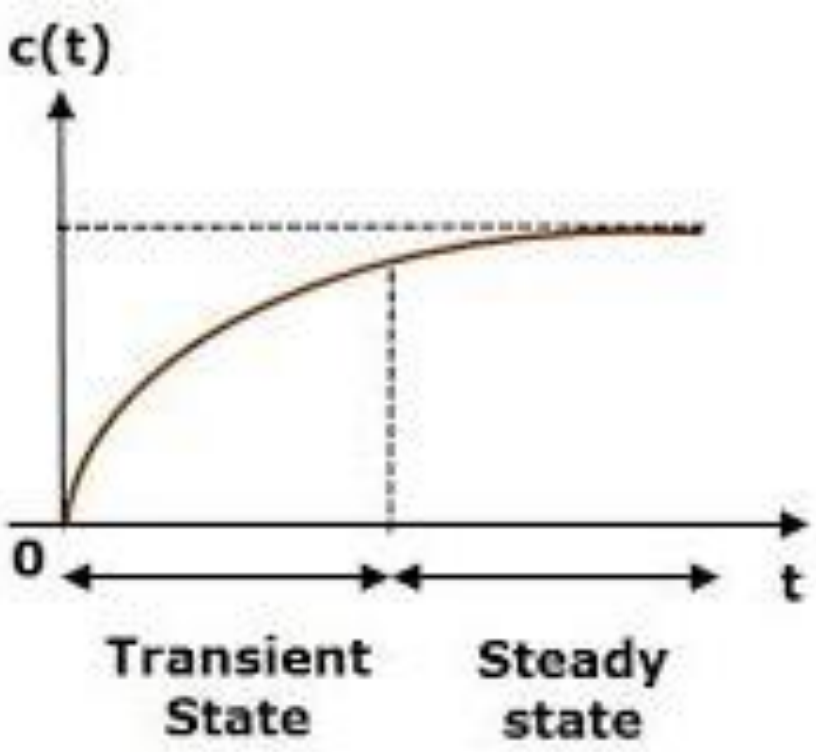


Peak-time

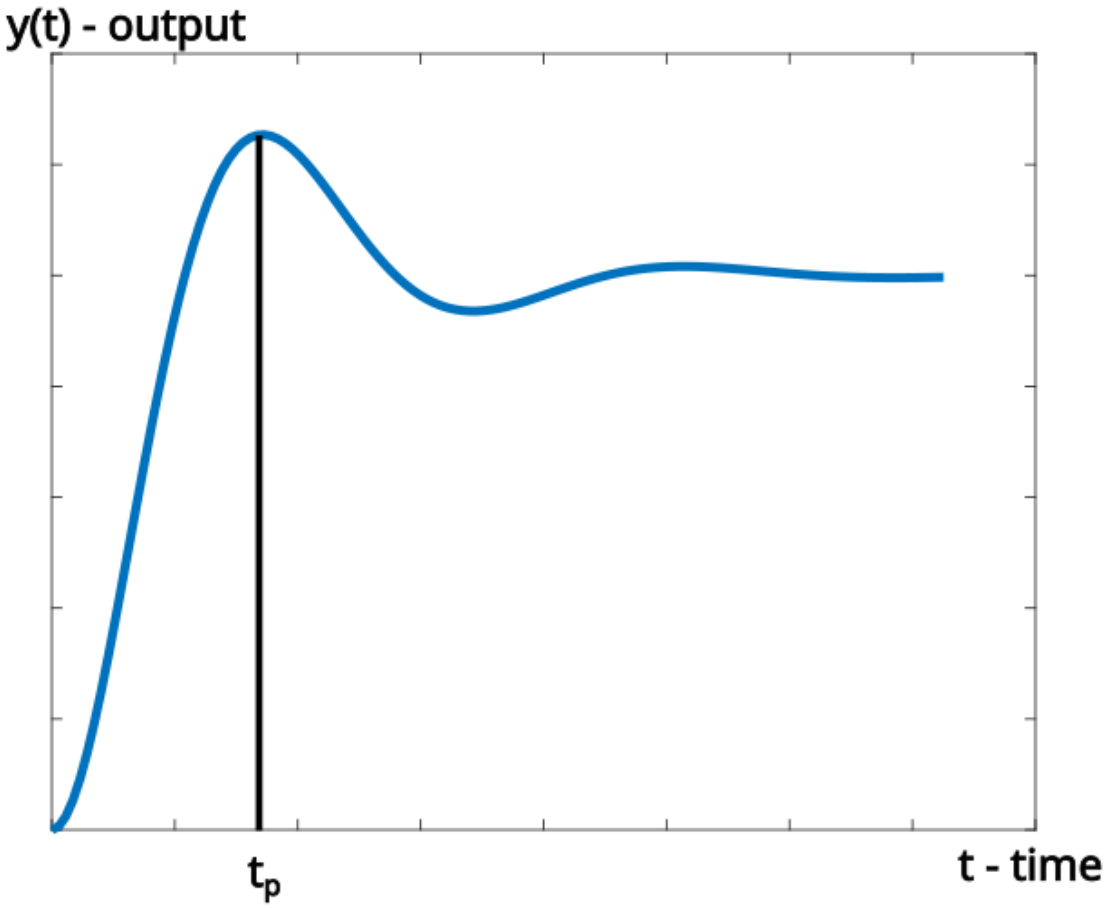
- The time it takes for the system's output to reach its **first maximum peak** after an input change (such as a step input).
- It corresponds to the point where the output reaches its **highest overshoot** before settling down.

Cont…

- Indicates when the system reaches its **maximum deviation** from the steady-state value.
- Helps understand the system's **transient behavior** and potential overshoot.
- Useful for assessing how **quickly** the system reacts before stabilizing.



Peak time



Overshoot and percentage overshoot

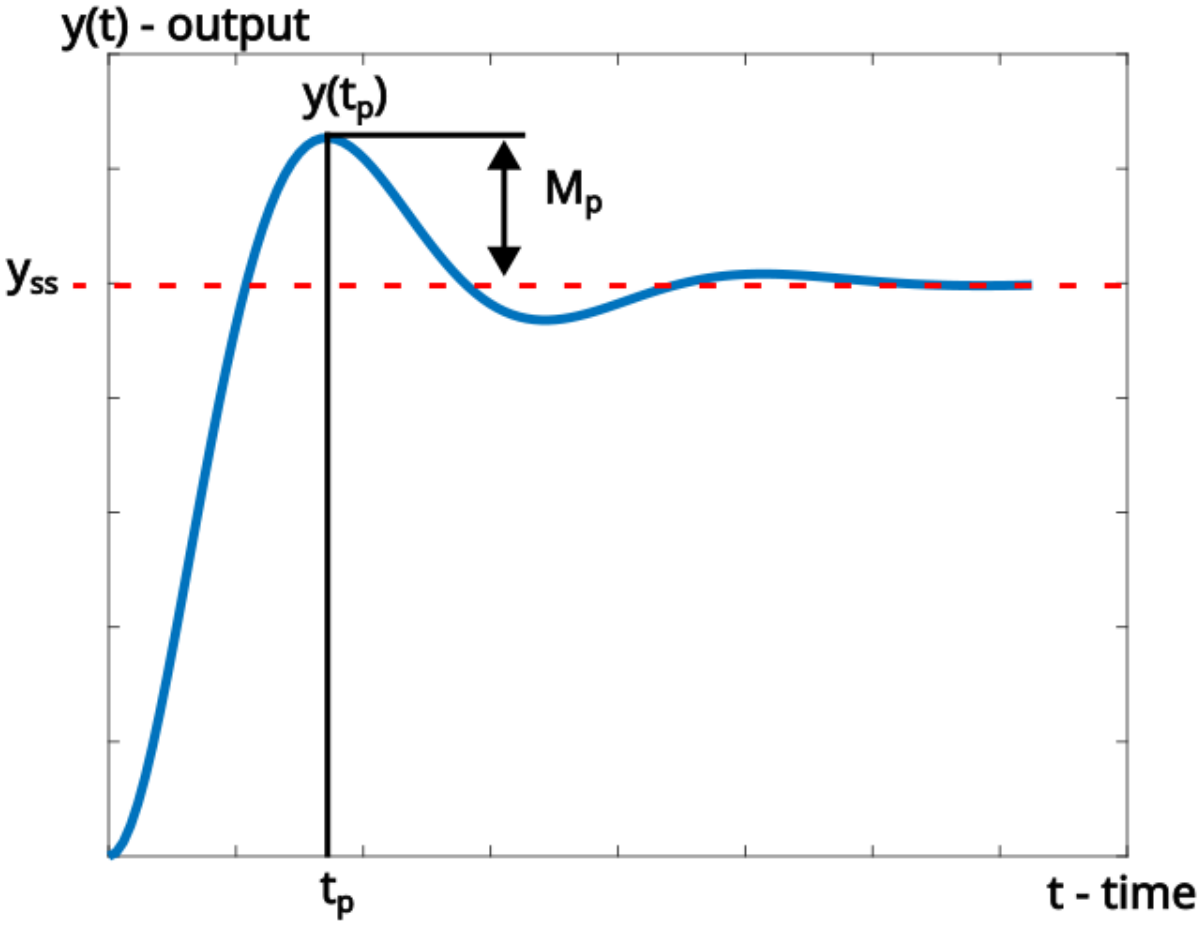
- **Overshoot** is the amount by which the system's output **exceeds its final steady-state value** during the transient response.
- It happens when the system "goes beyond" the target before settling.

$$\text{Percentage Overshoot} = \frac{(\text{Peak value - Steady-state value})}{\text{Steady-state value}} \times 100\%$$

Overshoot

- Indicate the degree of **oscillation or instability** in the system.
- Help assess if the system **response is smooth or too “bouncy”**.
- Useful for tuning control systems to reduce excessive overshoot.

Overshoot



$$M_{\%p} = \frac{M_p}{y_{ss}} \times 100\%$$