SNS COLLEGE OF TECHNOLOGY

(An Autonomous Institution)

COIMBATORE-35

Accredited by NBA-AICTE and Accredited by NAAC – UGC with A++ Grade
Approved by AICTE, New Delhi & Affiliated to Anna University, Chennai

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

COURSE NAME: 19EEB301/ CONTROL SYSTEMS

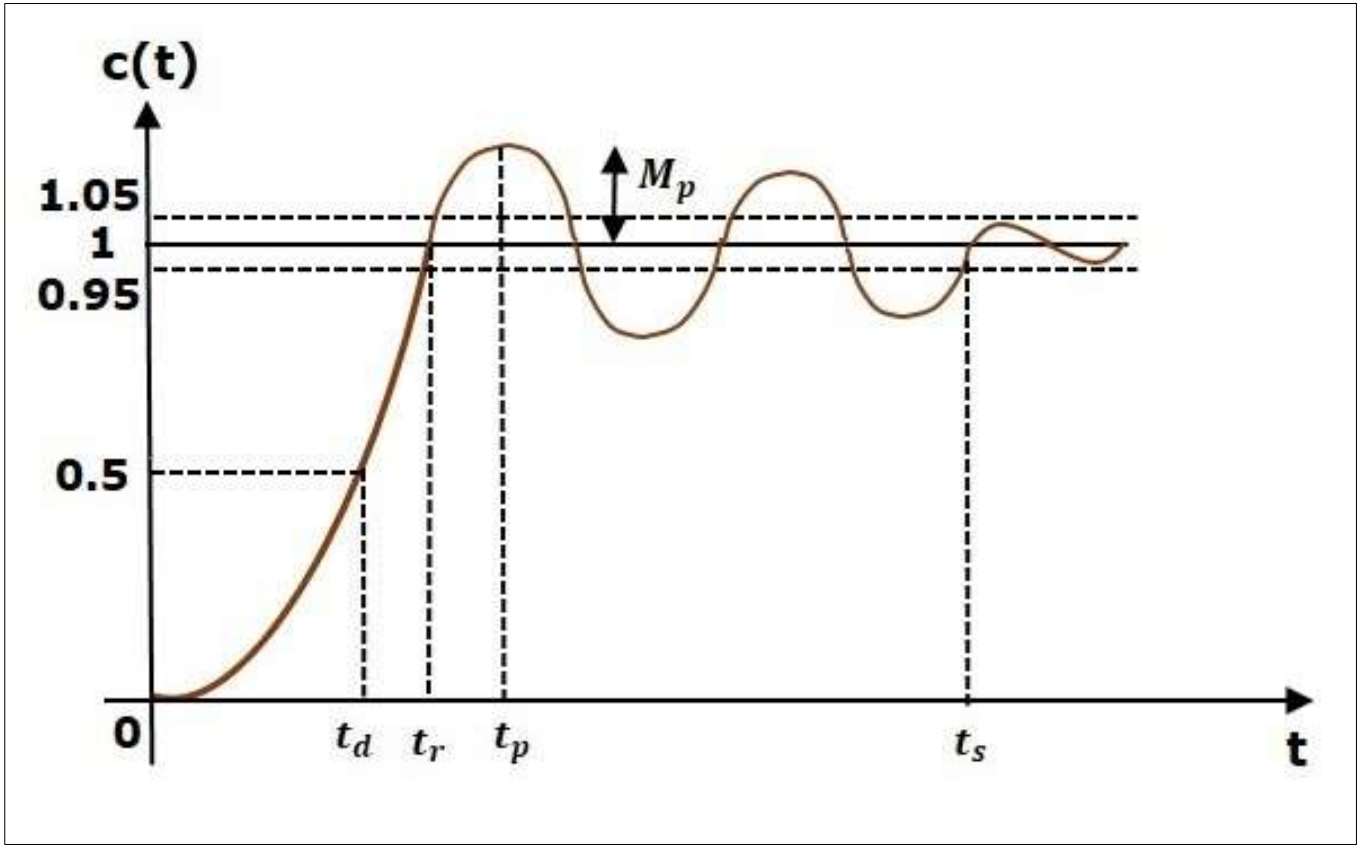
III YEAR / V SEMESTER

Unit II – TIME RESPONSE

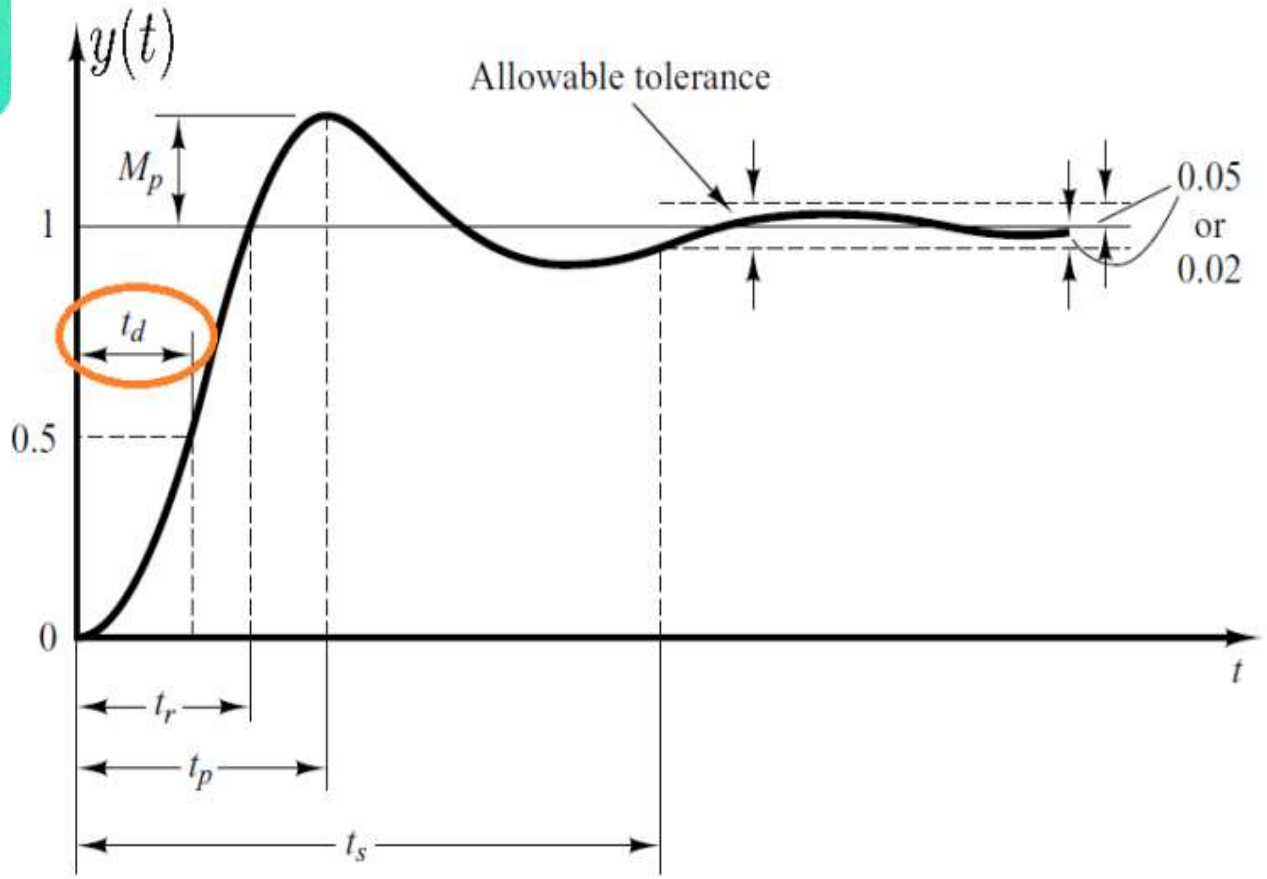
Topic : Time Domain Specification

Time Domain Specification

- In a second-order control system, time domain specifications refer to performance characteristics of the system's response to a unit step input.



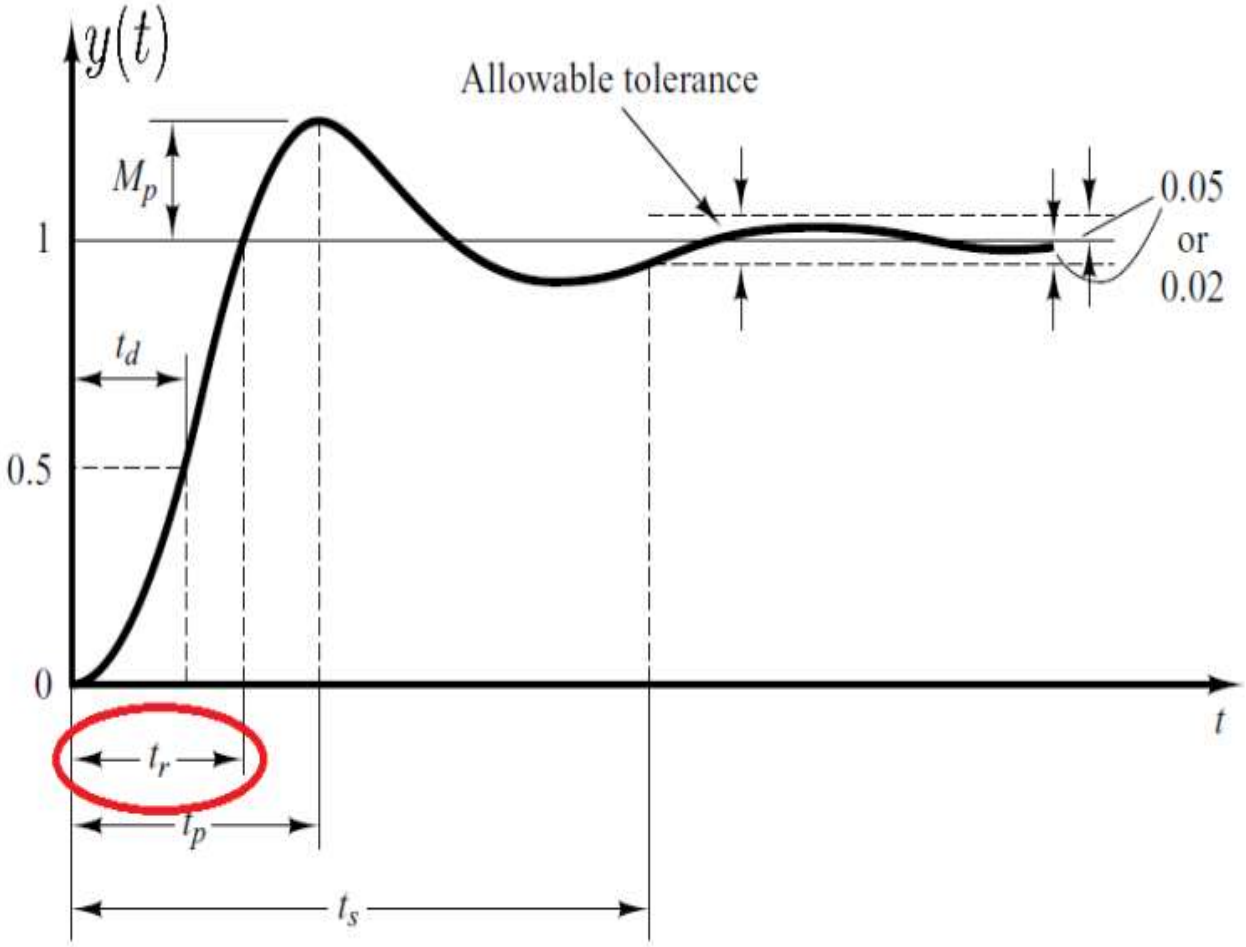
Time Delay



Time Delay, t_d:

It is the time required for the response $y(t)$ to reach **half** of the final value.

Rise Time



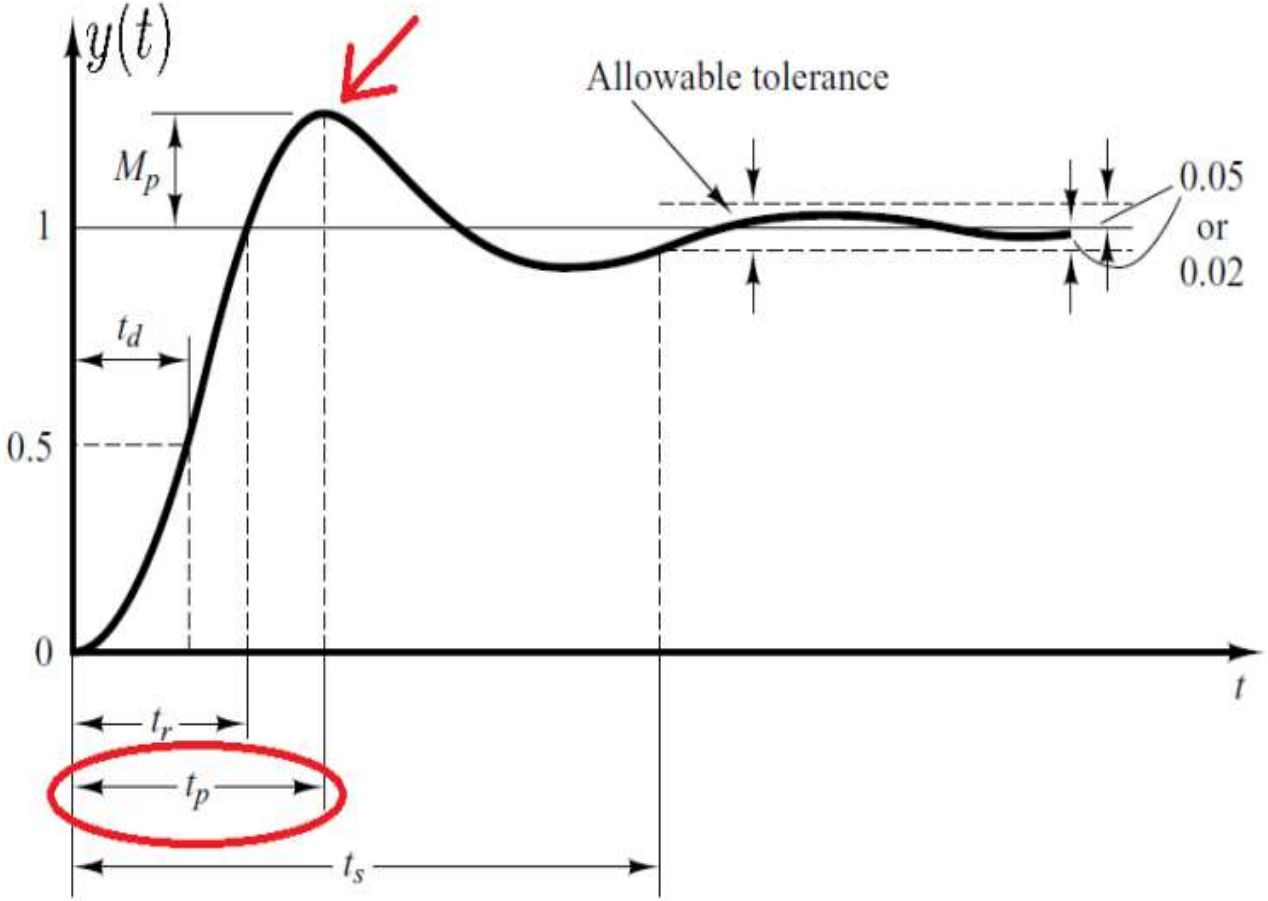
Rise Time, t_r:

It is the time required for the response to rise from:

- 0% to 100% of its final value for the under-damped system.
- 10% to 90% of its final value for the over-damped system.

$$t_r = \frac{\pi - \theta}{\omega_d} = \frac{\pi - \theta}{\omega_n \sqrt{1 - \zeta^2}}$$

Peak Time

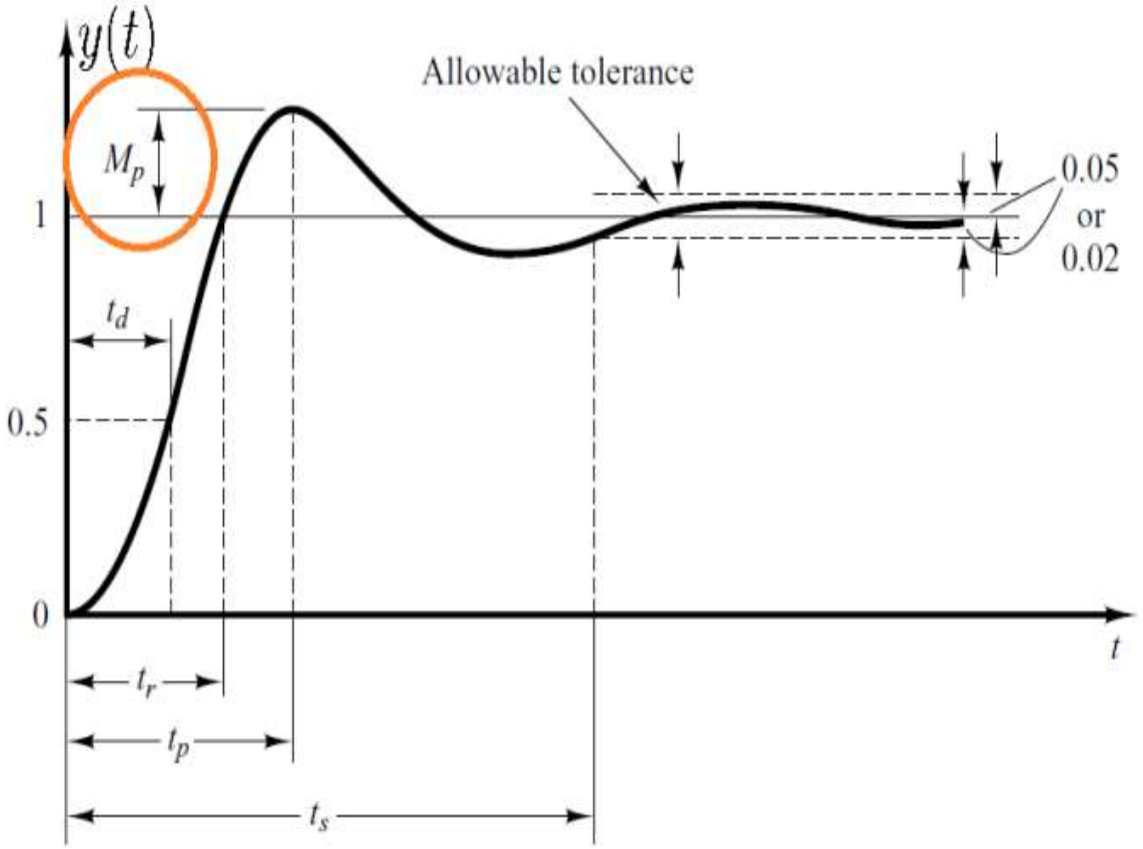


Peak Time, t_p:

It is the time required for the response to reach the first peak of the overshoot.

$$t_p = \frac{\pi}{\omega_d} = \frac{\pi}{\omega_n\sqrt{1-\zeta^2}}$$

Maximum Overshoot

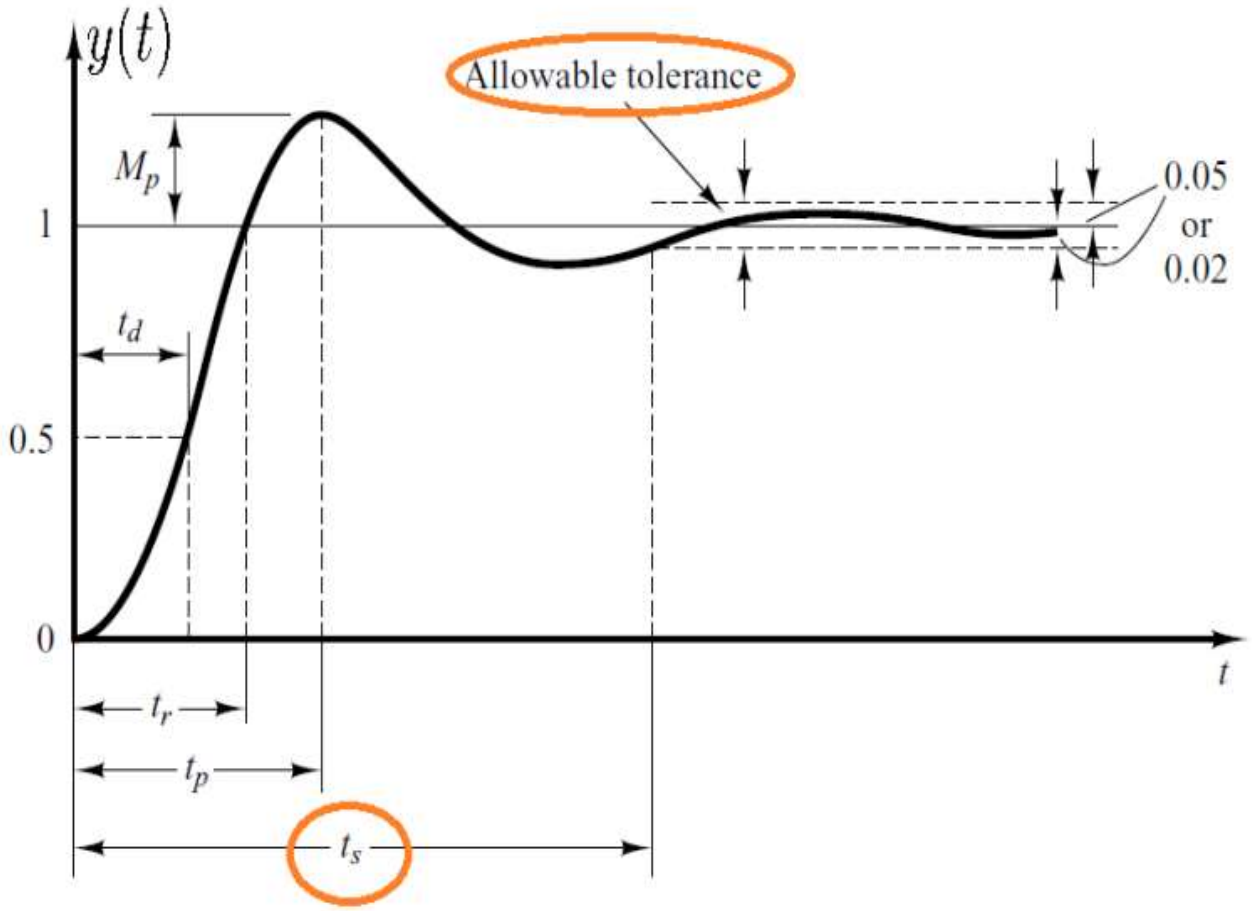


Maximum Overshoot, M_p:

It is the maximum peak value of the response curve measured from unity.

$$M_p = e^{-\frac{\pi\zeta}{\sqrt{1-\zeta^2}}} \times 100$$

Settling Time



Settling Time, t_s:

It is the time required for the response curve to reach and stay **within a range about the final value** of size specified by absolute percentage of the final value (usually 2% or 5%).

$$t_s = 4/\zeta\omega_n$$ 2% criterion

$$t_s = 3/\zeta\omega_n$$ 5% criterion

Time Domain Specification

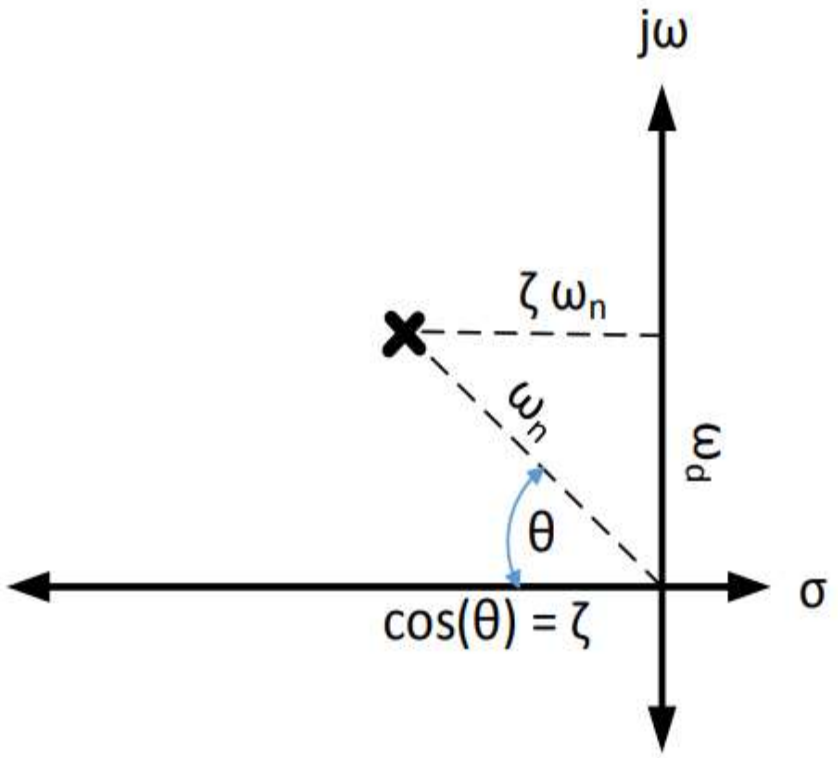
$$t_r = \frac{\pi - \theta}{\omega_d} = \frac{\pi - \theta}{\omega_n \sqrt{1 - \zeta^2}}$$

$$t_p = \frac{\pi}{\omega_d} = \frac{\pi}{\omega_n \sqrt{1 - \zeta^2}}$$

$$M_p = e^{-\frac{\pi\zeta}{\sqrt{1-\zeta^2}}} \times 100$$

$t_s = 4/\zeta\omega_n$ 2% criterion

$t_s = 3/\zeta\omega_n$ 5% criterion



Thank You