# **EE6302 Control System Design**

Unit 3: Dynami	ic Response and	Transient A	Analysis
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3.3	Time	<b>Domain</b>	Specif	ications	of a	Step	Resi	oonse

For the step response of a system, there are four parameters which are very important in designing the control system.

- Rice time (t<sub>r</sub>)
- Settling time (t<sub>s</sub>)
- Overshoot (M<sub>p</sub>)
- Peak time (t<sub>p</sub>)

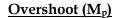
## Rice time (t<sub>r</sub>)

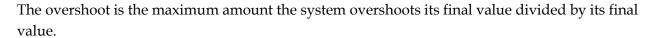
The rice time is the time it takes the system to reach the vicinity of the new set point. The rise time of a second order system can be approximated as follows.

Even for higher order systems, expression for  $t_r$  can be used as a rough approximation.

### Settling time (t<sub>s</sub>)

Settling time is the time it takes the system transients to decay.





By differentiating y(t), w.r.t t and equating to zero, an expression for  $M_p$  can be derived.

## Peak time (tp)

Peak time is the time taken by the system to reach the maximum point.

#### Example-1

Find the allowable region for the poles of the system if the system step response requirements are as follows

 $t_{\rm r} \leq 0.6~{\rm s}$  ,  $t_{\rm s} \leq 3$  and  $M_p \leq 10\%$