CONTROL SYSTEMS

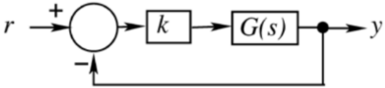
Presentation

Aashrith-EE18BTECH11035

February 18, 2020

EC GATE-2016 Q.NO-45

In the feedback system given below G(s)= $\frac{1}{s^2+2s}$.
The step response of the closed-loop system should have minimum settling time and have no overshoot.



The required value of gain k to achieve this is ___________

Solution

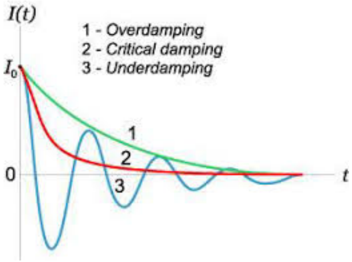
SettlingTime: The time required for the transient's damped oscillations to reach and stay within 2% of the steady-state value.

Overshoot:The amount that the waveform overshoots the steady state, or final, value at the peak time, expressed as a percentage of the steady-state value.

The Transfer function of the negative unity feedback system is given by $\frac{H(s)}{1+H(s)}$ (Where H(s) is the open-loop gain of the system)

In the given Question H(s) = k x G(s).So, Transfer function of the whole feedback system is $\frac{kG(s)}{1+kG(s)}$

By Substituting G(s) function we get $\frac{k}{s^2+2s+K}$



By observing the above figure,minimum settling time is obtained for Critical Damped System.

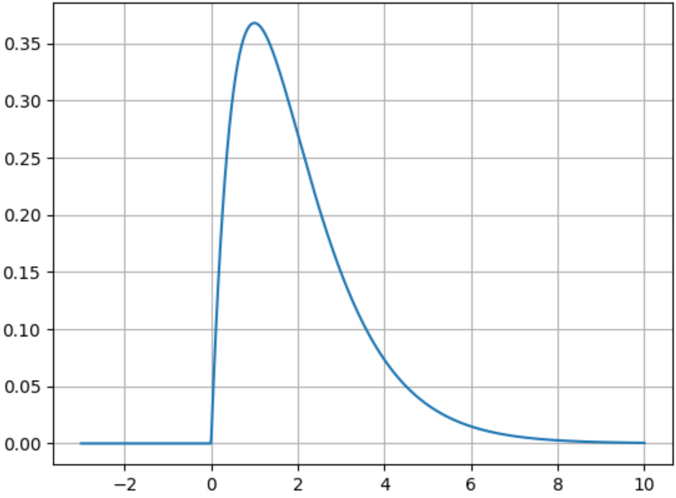
Also, Critically Damped System doesn't have overshoot.
Transfer function of the Critical Damped System is given by
$\frac{\omega_n^2}{s^2+2\zeta\omega_n s+\omega_n^2}$ (Where, $\zeta = 1$)
By comparing Obtained Transfer function $\frac{k}{s^2+2s+K}$ and the general transfer function of Critical Damped System $\frac{\omega_n^2}{s^2+2\zeta\omega_n s+\omega_n^2}$

We get $\zeta = \frac{1}{\sqrt{K}}$
As $\zeta = 1$

$\frac{1}{\sqrt{K}}$ =1

K=1

Therefore, The value of K is 1.


0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
−2
0
2
4
6
8
10