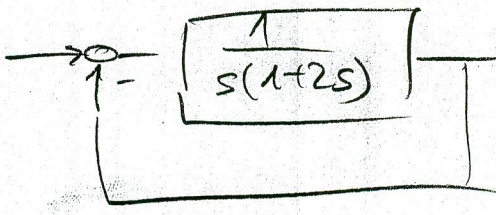
b

1 2nd order system

The open loop transfer function of a unity feedback system is

$G(s) = \frac{1}{s(1+2s)}$



The desired performance specifications are:

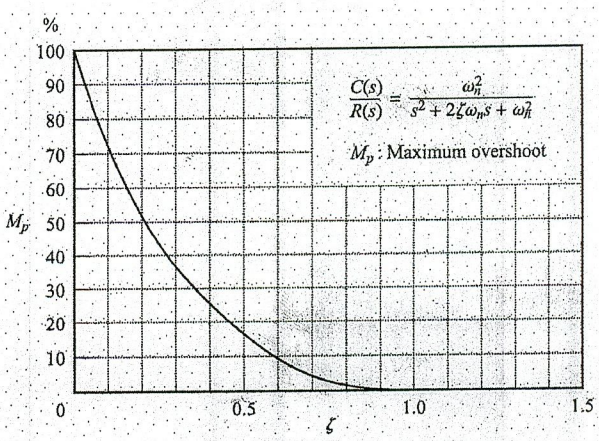
- peak time $t_p = 1\,\text{sec}$
- Overshoot $M_p \approx 5\%$

$$G_0(s) = \frac{K}{2s^2 + s + K}$$

Can those requirements be met?

a) yes

b) no



$s^2 + \frac{1}{2}s + \frac{K}{2} \Rightarrow \omega_n = \frac{K}{2}$

$2\xi\omega_n = \frac{1}{2}$

$\Rightarrow \xi = \frac{1}{2\omega_n \cdot 2} = \frac{1}{4\omega_n}$

$M_p \approx 5\% \Rightarrow \xi = 0{,}7$

$\Rightarrow 0{,}7 = \frac{1}{4\omega_n} \Rightarrow \omega_n = 0{,}357$

$t_p = \frac{\pi}{\omega_d} = \frac{\pi}{\omega_n\sqrt{1-\xi^2}} = 12{,}3\,s$

2 Routh

Suppose that unity feedback is to be applied around the open loop system:

$$G_{\text{ol}} = \frac{2(s+2)}{s^2(s+1)}$$

Then the closed loop has

$1 + G_{ol}(s) =$

a) no poles in RHP (right half plane)

b) 1 pole in RHP

c) 2 poles in RHP

$s^3 + s^2 + 2s + 4 = 0$

s^3	1	2
s^2	1	4
s	-2	
1	4	

3 System type

Two feedback systems are shown below:

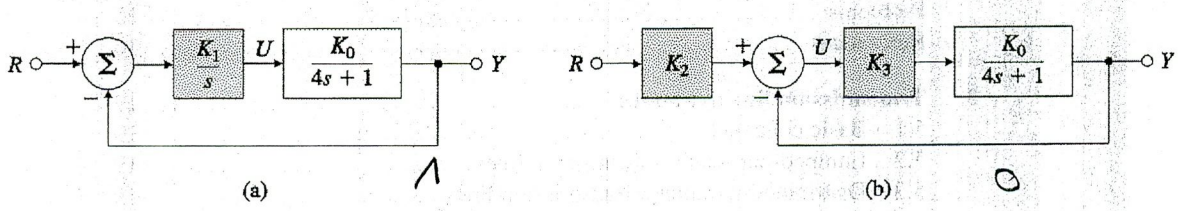


Figure 1: Two feedback systems

The system types are:

a) system a: type 2, system b: type 1

b) system a: type 1, system b: type 0

c) system a: type 1, system b: type 0

d) system a: type 2, system b: type 0

4 Steady state error

Consider the system below:

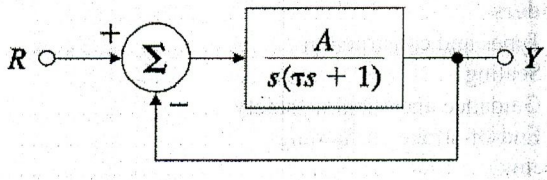


Figure 2: Feedback system

The steady state error due to ramp input $R(s) = \frac{r_0}{s}$ is

a) $e_\infty = \frac{r_0}{A}$

b) $e_\infty = \frac{A}{r_0}$

c) none of the above

5 True or false

The final value theorem is only applicable for stable systems

a) True
b) False

6 True or false

Stability of a system does not depend on the kind of system input

a) True
b) False

7 True or false

Overshoot of a second order system depends mainly on the system damping ration but also on the natural undamped frequency

a) True
b) False