Solutions of Assignment_1

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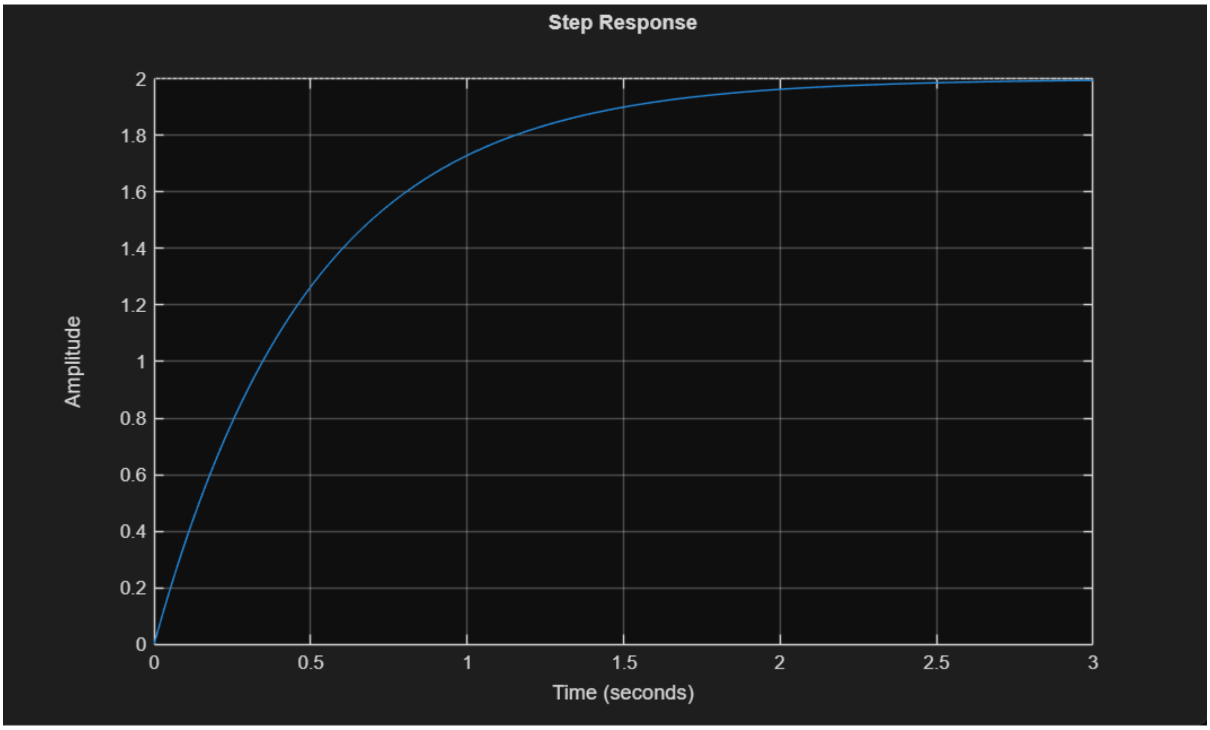
Question 1:

1.



2.

Time constant = : G(s) = k$/s * T + 1$

Here k is DC gain and T is time constant . so time constant for this equation is 0.5 seconds .

Rise time = 1.0985

Settling time = 1.9560

Final value can be found out by the final value theorem as -2(pole) lies on the left half of the plane and there is not more then one pole at origin.

Final value : $\lim_{s \to 0}$ s.Y(s) = $\lim_{t \to \infty}$ y(t)

So, final Y(s) = g(s)×X(s)

X(s) = 1/s (unit step input)

Final value = 2

Steady state error is the difference in the given input and output at t→ ∞(steady state).

Steady state error = s.((1-G(s))/s) for s→∞

So , =1-2 = -1

3.
Final value of MATLAB = 2 = final value by the expression

Question 2:

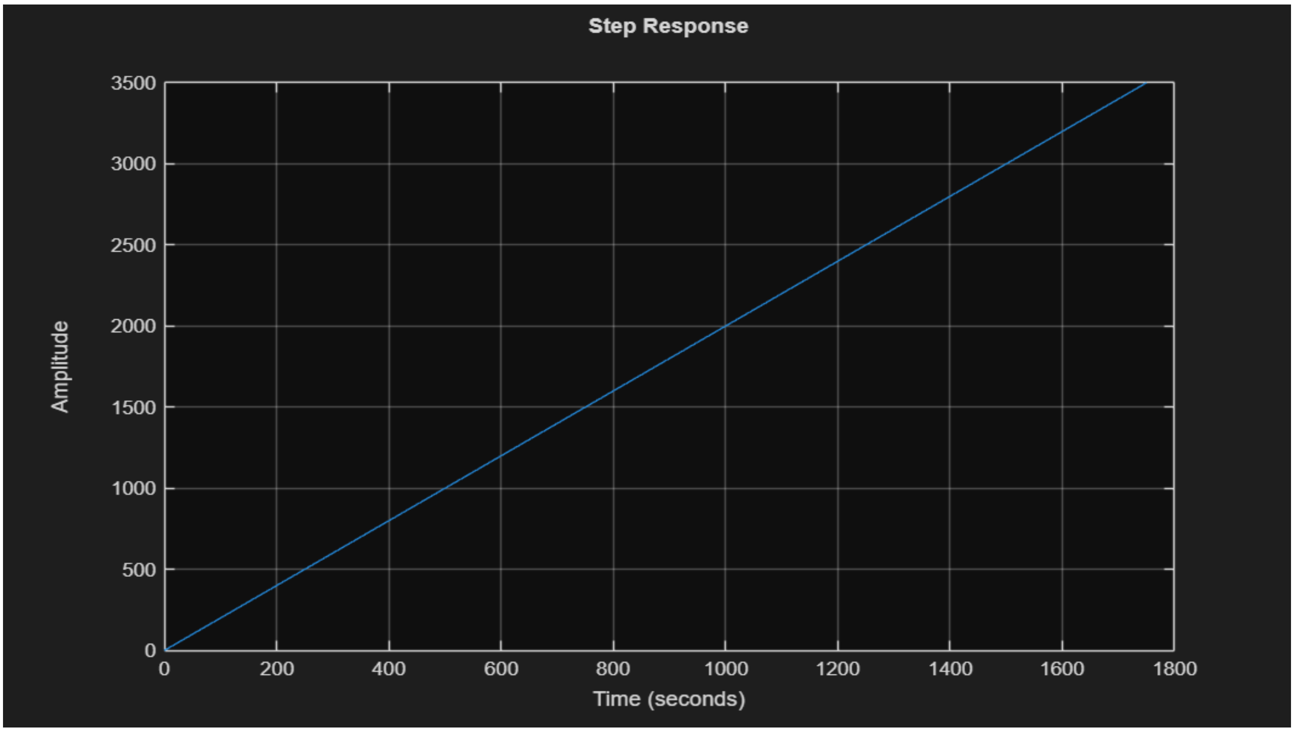
1.
The system is an open loop system with single integrator(1/s).
So,it is a type 1 and order 2 system.

2.
Steady state error = $\lim_{s \to 0}$ s.(1/s-G(s)/s)

= $\lim_{s \to 0}$ 1-G(s)

= -∞

3.
Judging by final value of the function = ∞
So, overshoot one .



Question 3:

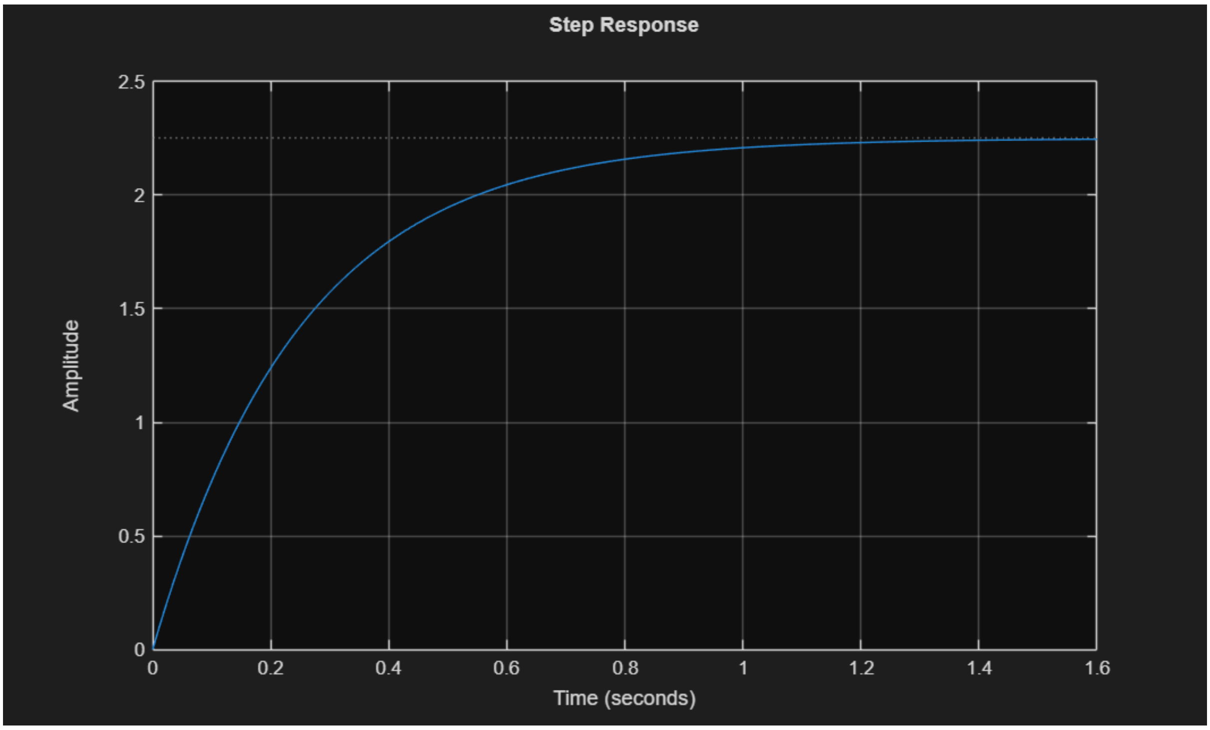
1.
We have , ts < 1.2 sec also ,for ess = 0.1

4/a < 1.2 K = 9(Static Gain)

4/1.2 < a

3.33 < a(pole may be at anywhere > -3.33)

2.
Gnew(s) = K/s+a = 9/s+4 (let)
3.
The response will be faster then the Question one as the pole is more left hand side .
Final value : K/a = 9/a
Always greater then 2 which is final value of the Question 1.

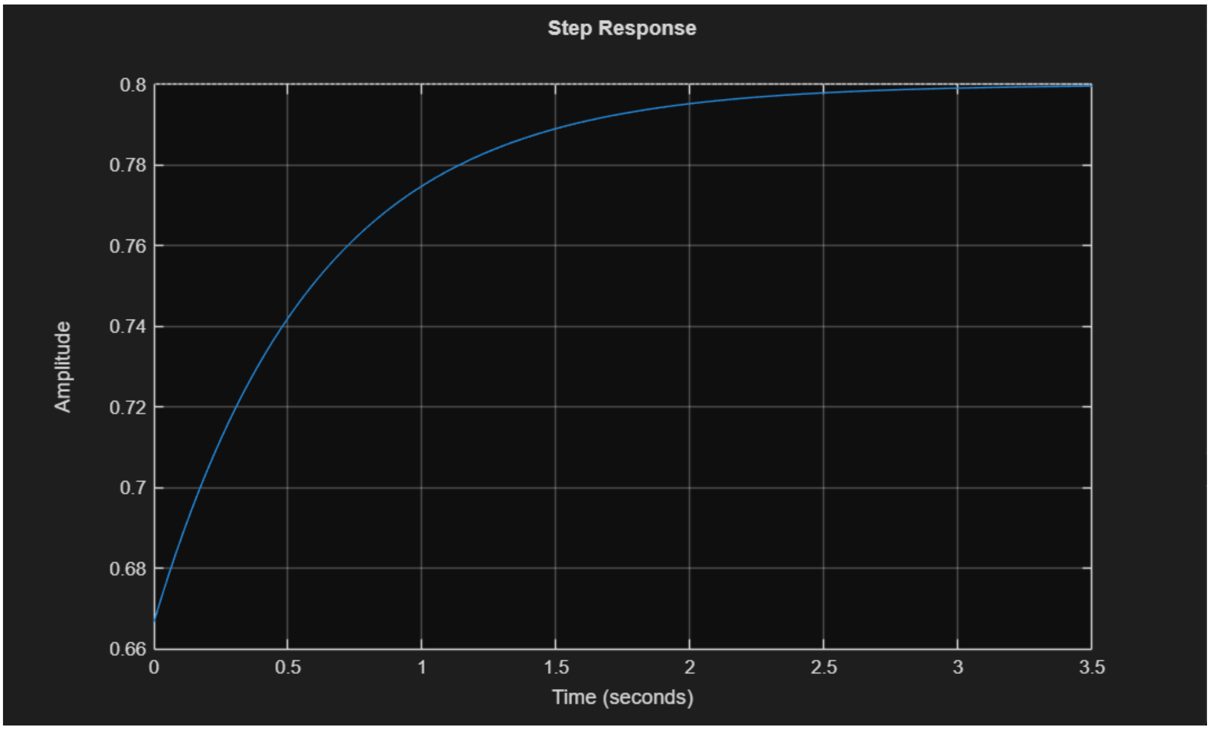


Question 4:

1.
We have G(s) = 3/s+1
c(s) = K(s+z)
G(s).C(s) = 3K(s+z)/s+1
So , Transfer function = 3K(s+z)/3K(s+z)+s+1
For step input : Y(s) = T.F.
So, at t→∞ y(t) = Y(s) at s→ 0
Y(s) = 3Kz/3Kz+1 = 0.8 (Given)
Kz =4/3

We have overshoot < 10:
So, Mp = $e^{-\pi\xi/\sqrt{1-\xi 2}}$
Calculating , $\xi >= 0.6$
Also , ts ≈ 4/ξw given that ts < 2

→ choosing a value of z as we have to minimise the rise time ξ should be minimum as 1/w is proportional to the rise time as well as ξ .
So choosing $\xi = 0.6$
→ increasing the zero in left leads to increase in rise time so a choice can be 2.
→ $Kz=4/3 \Rightarrow K=2/3 \Rightarrow 3K=2$
2.
Transfer function = $3Ks+3Kz/(3K+1)s+3Kz+1$
= $2s+4/3s+5$
3.
→ Yss = $3Kz/3Kz+1$ here it can easily be predicted increase in value of K leads to increase in value of Yss .
→addition of the zeros makes the plant faster then the original plant .
→yes increase in overshoot is be observed when zero is added because the DC Gain increases.



Question 5:

1.
System type is determined by the number of integrators in the G(s).C(s)
So calculating open loop transfer function = $3K(s+z)/s+1$
It is a type zero system .
2.
Ramp error = 1/kv
Where , kv = $\lim_{s \to 0} sG(s)C(s)$

$Kv = 0$

So, the ramp error will be infinite.

3. Simplifying we get : $\lim_{s \to 0} (1 - T(s))/s$ where $T(s) = 2(s+2)/s+1$

Infinite error.

4. Ramp Tracking depends only on system type.