Assignment-1

1. 2.

$$G(s) = \frac{4}{s+2} = \frac{2}{0.5s+1}$$

So, $\zeta = 0.5$

Now from MATLAB.

- Rise time = 1.0985
- Settling time = 1.9560
- Final value = $\lim_{s \to 0} G(s)$ (as unit step response)

$= 2$

- Steady stt error = $x(\infty) - y(\infty)$

$= 1 - 2 = -1$

3. $y_{ss} = \lim_{s \to 0} s \cdot G(s) \cdot \frac{1}{s} = \lim_{s \to 0} \frac{4}{s+2} = 2.$

2. $G(s) = \frac{10}{s(s+5)}$

1. $G(s)$ is of form $\frac{K}{s(s+a)}$ $\Rightarrow$ Type 1 : one integrator

2. $e_{ss} = \lim_{s \to 0} s\left(\frac{1}{s} - \frac{10}{s(s+5)} \frac{1}{s}\right)$

$= \lim_{s \to 0} 1 - \frac{10}{s(s+5)} = -\infty$

for close loop

$e_{ss} = 0$

3. it should overshoot as e_{ss} is ∞.

Q.3.

1. $\frac{4}{a} < 1.2 \Rightarrow a > 3.33$

$\frac{1}{1+k} = 0.1 \Rightarrow K = 9$

2. $G_{new}(s) = \frac{9}{s+4}$

3. $\tau = \frac{1}{4} = 0.25 \quad (< 0.5)$.

faster than QL

- final value $= \lim_{s \to 0} s.(Y(s)) = \lim_{s \to 0} G(s) = 2.25$

Higher than QL

In MATLAB value of $a = 3.33$, here for simplicity of calculation $a = 4$.

Q.4. 1. $T(s) = \frac{3K(s+2)}{s+1+3K(s+2)}$

to reduce rise time $2 = 1$.

$\lim_{s \to 0} T(s) = \frac{3K}{1+3K} = 0.8 \Rightarrow K = 1.33$

$$M_p = e^{-\left(\frac{\zeta\pi}{\sqrt{1-\zeta^2}}\right)} < \frac{1}{10}$$

$$\frac{\pi\zeta}{\sqrt{1-\zeta^2}} > \ln 10$$

$$\Rightarrow \quad \zeta > \frac{\ln 10}{\sqrt{(\ln 10)^2 + \pi^2}} = 0.5911$$

3.
- slightly increase
- increase
- Faster.

Q.5. Close loop : $T(s) = \dfrac{C(s)\,G(s)}{1 + C(s)\,G(s)}$

$$= \frac{3K(s+2)}{s+1+3K(s+2)} \Rightarrow \text{Type 0}$$

(No integrator)

Open loop : $T(s) = C(s)\,G(s) = \dfrac{3K(s+2)}{s+1}$

Type 0

No integrator

2. $e_{ss} = \lim_{s \to 0} s\left(\frac{1}{s^2} - \frac{T(s)}{s^2}\right) = \infty$

(can't be tracked)

4. No effect.

MATLAB R2025b

HOME PLOTS APPS

bodeplot nicholsplot nyquistplot sigmaplot rlocusplot pzplot

SELECTION PLOT

C › Users › LENOVO › OneDrive › Documents › MATLAB

Files

Name

untitled.m
matlab.mat
2.mat
1.mat

Workspace

Name	Value	Siz
ans	1×1 struct	1×
G	1×1 tf	1×

Command Window

```
>> G = tf(4,[1 2]);

figure;
step(G);
grid on;
title('Unit Step Response');

stepinfo(G)


ans =

  struct with fields:

        RiseTime: 1.0985
    TransientTime: 1.9560
     SettlingTime: 1.9560
      SettlingMin: 1.8090
      SettlingMax: 1.9987
        Overshoot: 0
       Undershoot: 0
             Peak: 1.9987
         PeakTime: 3.6611

>> bode(G)
>> G = tf([4],[1 2])

G =

   4
  -----
  s + 2

Continuous-time transfer function.
```

Figures

FIGURE FORMAT TOOLS LAYOUT

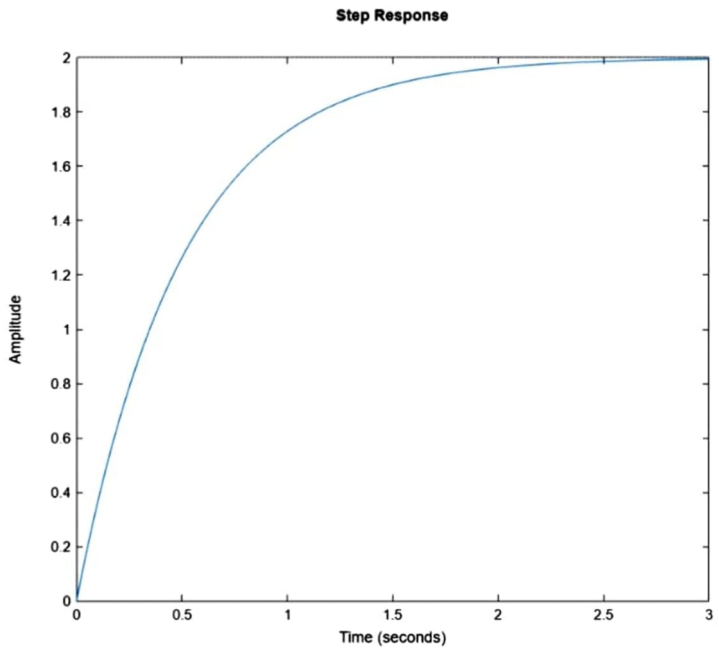
Save As Copy Figure Print Show Code

FILE

Title Subtitle X-Label Y-Label Legend Grid Text Arrow Arrow

LABELS AND ANNOTATIONS

Figure 1



Search

ENG US

14:58 16-12-2025

MATLAB R2025b

HOME | PLOTS | APPS | LIVE EDITOR | INSERT | VIEW

No Variable Selected

SELECTION

plot | Plot as multipl... | Plot as multipl... | area | bar | Select variab | scatter

PLO

C › Users › LENOVO › OneDrive › Documents › MATLAB

Files

Name

- untitled.m
- matlab.mat
- 2.mat
- 1.mat

Workspace

Name	Value	Siz
a	3.3300	1×
G_new	1×1 tf	1×
G_Q1	1×1 tf	1×
K	9	1×

untitled

Command Window

```
>> K = 9;
a = 3.33;

G_new = tf([K], [1 a])

G_new =

     9
  --------
  s + 3.33

Continuous-time transfer function.
Model Properties
>> figure;
step(G_new);
grid on;
title('Unit Step Response of Designed First-Order System');
>> G_Q1 = tf(4, [1 2]);

figure;
step(G_Q1, G_new);
grid on;
legend('Q1 System', 'Designed System');
title('Comparison of Step Responses');
>>
```

Figures

FIGURE | FORMAT | TOOLS | LAYOUT

Save As | Copy Figure | Print | Show Code

FILE

Title | Subtitle | X-Label | Y-Label | Legend | Grid | Text Arrow | Arrow

LABELS AND ANNOTATIONS

Figure 1 | Figure 2