EGE UNIVERSITY
ELECTRICAL AND ELECTRONICS ENGINEERING

CONTROL SYSTEMS 1

LAB-8

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Control Lab-8

$M_p = 0.16$

$t_s = 2sn$

$K_v = 50\ sec^{-1}$

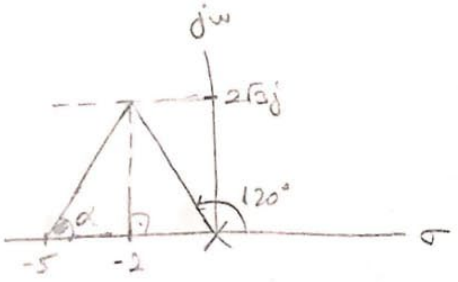
$$0.16 = e^{\frac{-\pi\delta}{\sqrt{1-\delta^2}}} \longrightarrow \underline{\delta = 0.5} \qquad t_s = 2 = \frac{4}{\delta \omega_n}$$

$$\underline{\omega_n = 4}$$

$$Q(s) = s^2 + 2(0.5)4s + 4^2 = 0$$

$$s_{1,2} = 2 \pm j2\sqrt{3}$$

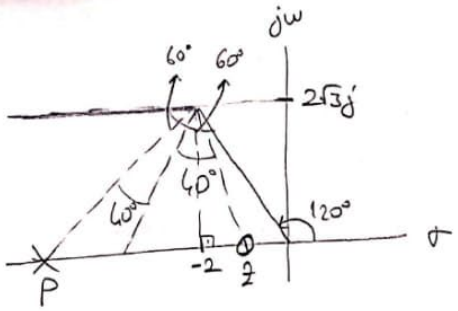
$$G(s) = \frac{10}{s(s+2)(s+5)} \qquad \begin{aligned} s_1 &= 0 \\ s_2 &= -2 \\ s_3 &= -5 \end{aligned}$$



$$180 - 120 - 90 - \alpha + \phi_{lead} = 0$$

$$\alpha = \tan^{-1}\left(\frac{2\sqrt{3}}{3}\right) = 49.106^\circ$$

$$\underline{\phi_{lead} \simeq 80^\circ}$$



$$\tan(10) = \frac{2-z}{2\sqrt{3}}$$

$$|z| = 1.38$$

$$\underline{z = -1,38}$$

$$\tan(70) = \frac{p-2}{2\sqrt{3}}$$

$$\underline{p = -11,51}$$

$$G_{lead} = K_c \frac{s+1,38}{s+11,51}$$

$$= K_c \cdot \frac{s+\frac{1}{T_1}}{s+\frac{1}{\alpha T_1}} \longrightarrow \alpha = 0,112$$

$$|G\, G_{lead}\, G_{lag}| = 1 \qquad s = -2 \pm j2\sqrt{3}$$

$$\left| \frac{10}{s(s+2)(s+5)} K_c \frac{s+1,38}{s+11,51} \underbrace{G_{lag}}_{\approx 1} \right| = 1 \qquad s = -2 \pm j2\sqrt{3}$$

$$K_c = 18.29$$

$$K_v = \lim_{s \to 0} s \cdot \frac{s+\frac{1}{T_1}}{s+\frac{1}{\alpha T_1}} \cdot \frac{s+\frac{1}{T_2}}{s+\frac{1}{\beta T_2}} \cdot \frac{10}{s(s+2)(s+5)}$$

$$K_v = K_c \alpha\beta \longrightarrow 50 = 18,29 \cdot 0,112\beta$$

$$\underline{\beta = 24,4}$$

$$\left| \frac{s+\frac{1}{T_2}}{s+\frac{1}{\beta T_2}} \right| \cong 1 \qquad s = -2 + j2\sqrt{3}$$

$$-5^\circ \angle \underline{\left| \frac{s+\frac{1}{T_2}}{s+\frac{1}{\beta T_2}} \right|} \angle 0^\circ \qquad s = -2 + j2\sqrt{3}$$

$T_2 = 10$

$$\left| \frac{s+\frac{1}{10}}{s+\frac{1}{24,4 \cdot 10}} \right| \cong 1 \checkmark$$

$$\underline{\left| \frac{s+\frac{1}{10}}{s+\frac{1}{24,4 \cdot 10}} \right|} = -1,25^\circ \checkmark$$

$$G_c = 18,29 \cdot \frac{s+1,38}{s+11,51} \cdot \frac{s+0,1}{s+0,0041}$$

MATLAB KODU

```
clc;clear;close all;

num=10;
den=conv(conv([1 0],[1 2]),[1 5]);
G=tf(num,den);
figure(1)
rlocus(G)

num2=[1 1.38];
den2=[1 11.15];
Glead=tf(num2,den2);

num3=[1 0.1];
den3=[1 0.0041];
Glag=tf(num3,den3);

Kc=18.29;
Gc=Kc*Glead*Glag;

Gopenloop=Gc*G;


figure(2)
rlocus(Gopenloop)
```

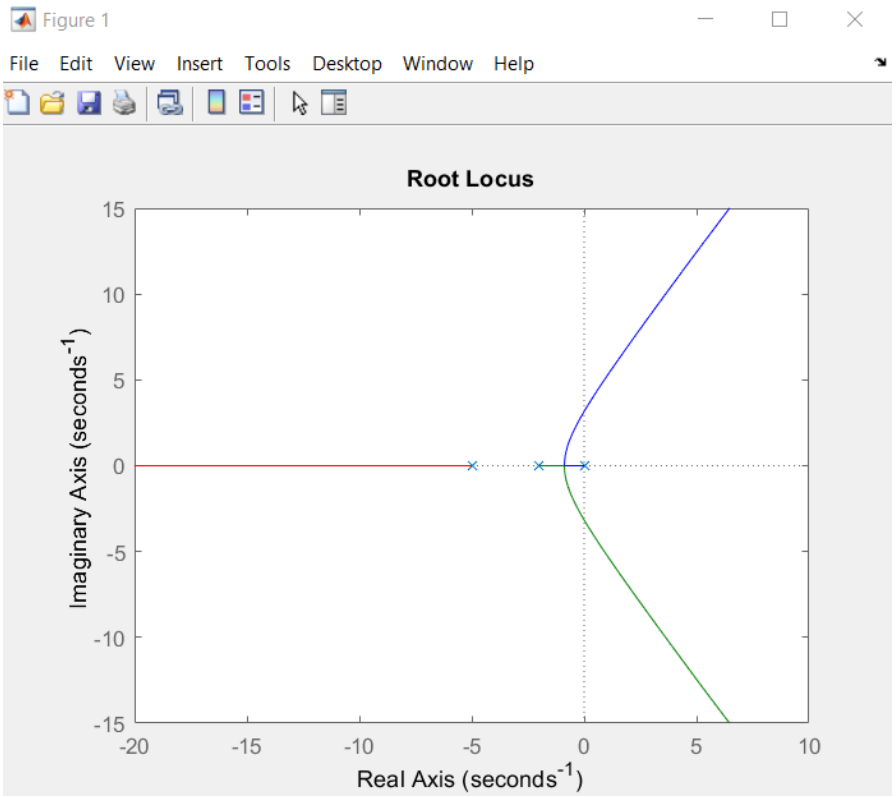


Figure 1 G=tf(num,den) için Root Locus

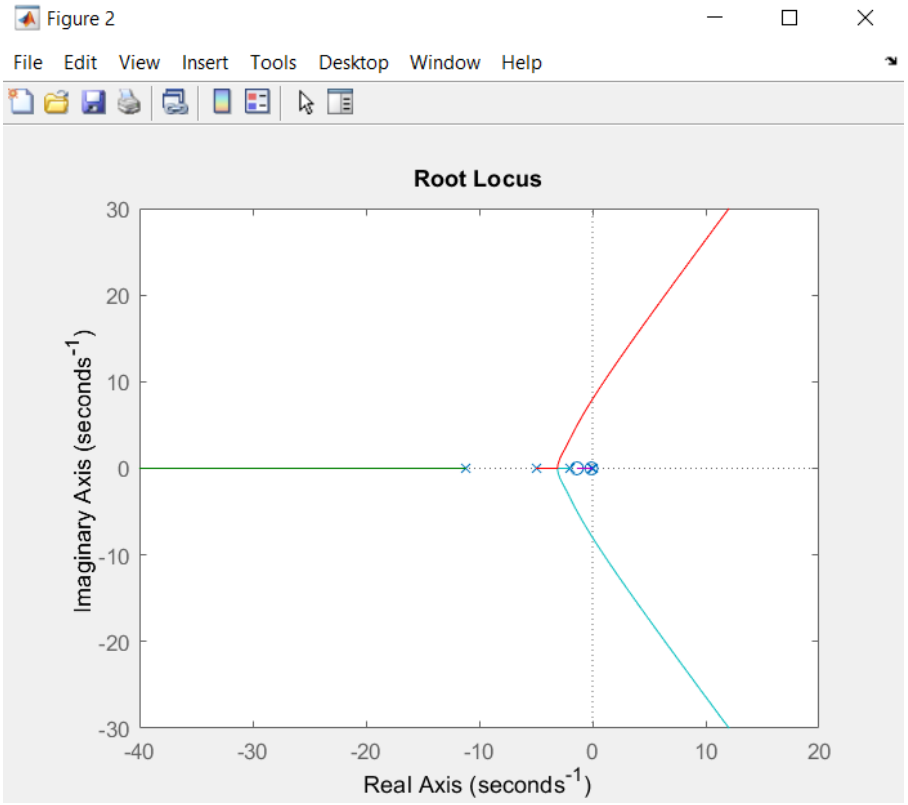


*Figure 2 Gc=Kc*Glead*Glag için Root Locus*

SİMULİNK

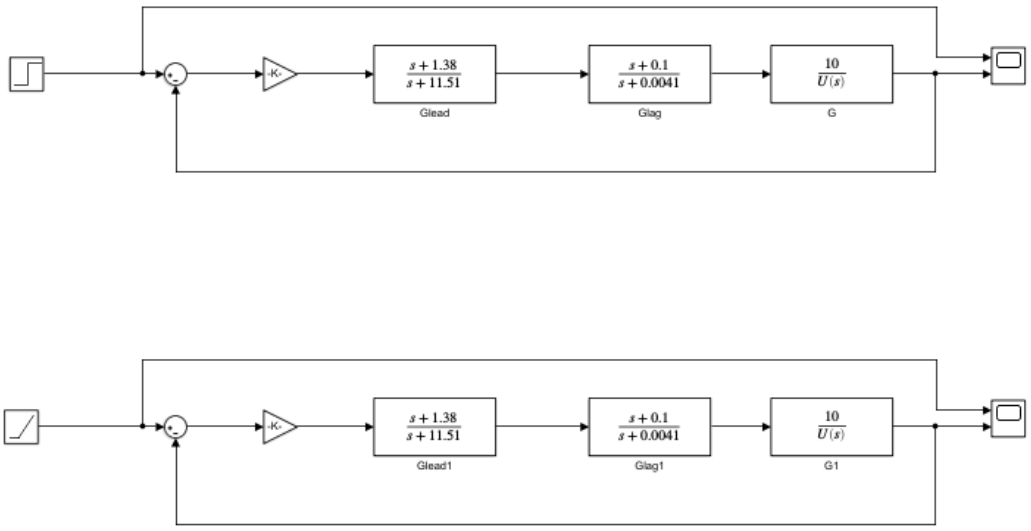


Figure 3 Simulink similasyon devresi

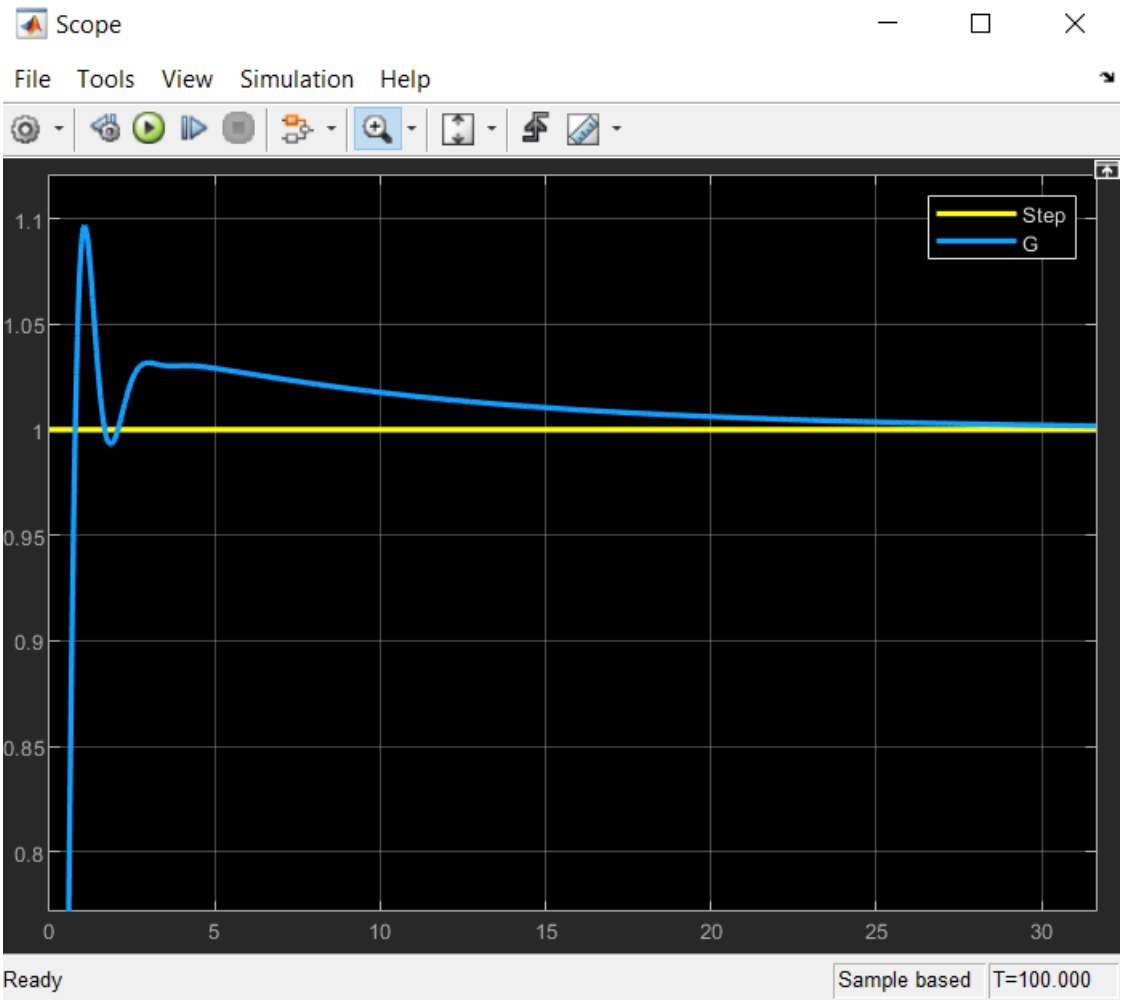


Figure 4 Unit step için scope çıktısı

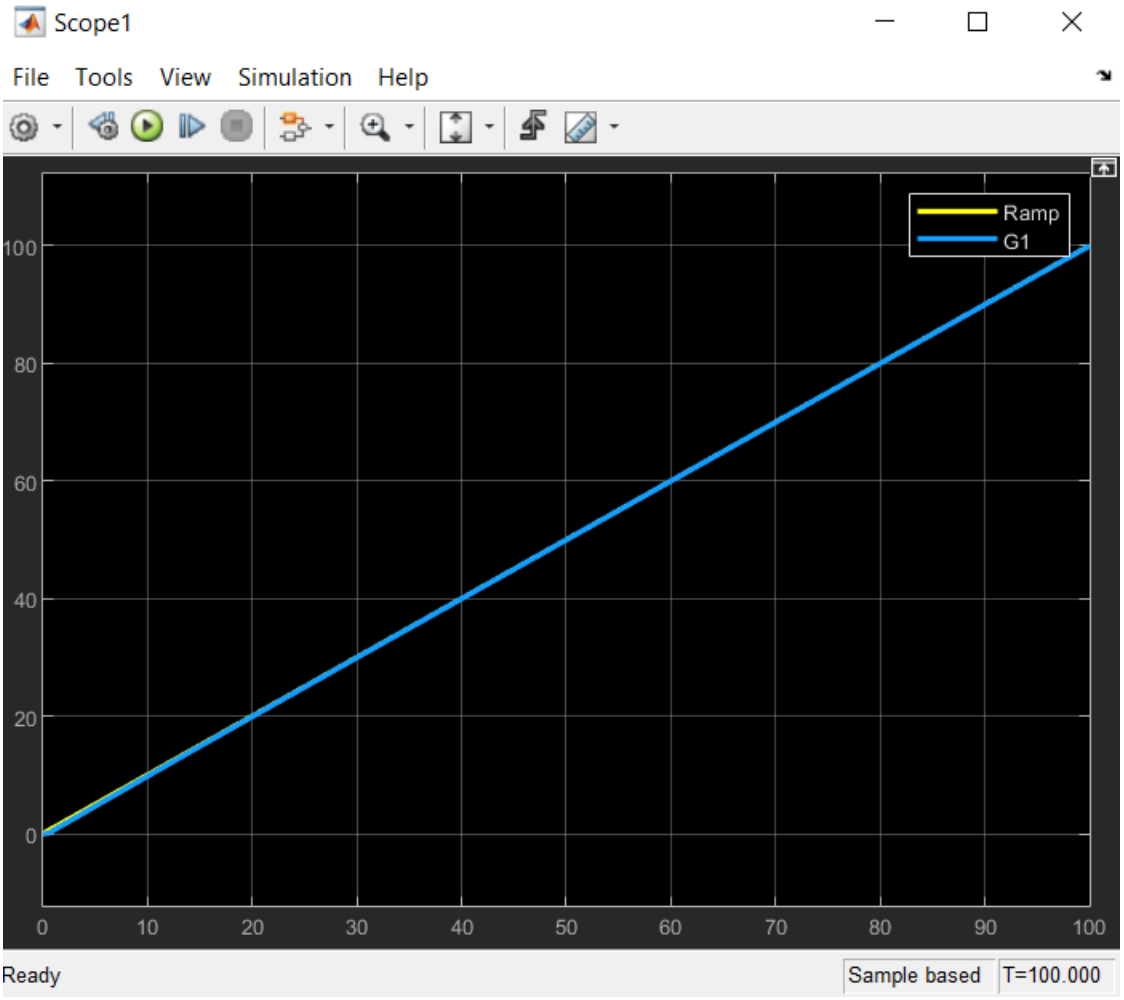


Figure 5 Rampa step için scope çıktısı