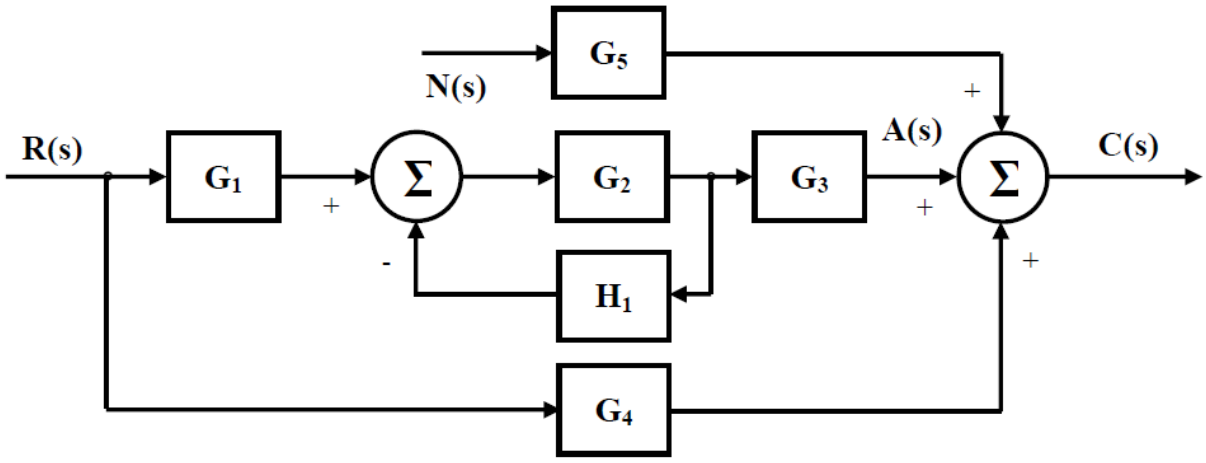
ÇALIŞMA SORULARI ve CEVAPLARI

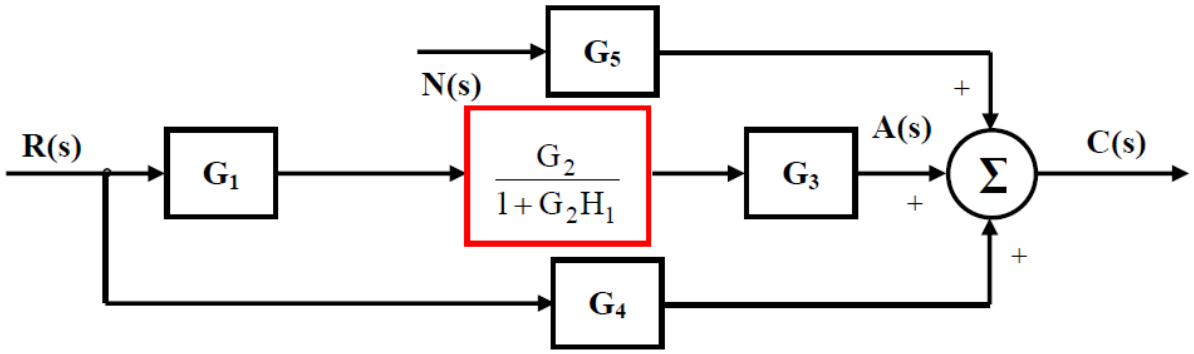
Problem 1: Aşağıdaki blok diyagram ile temsil edilen bir sistem için aşağıda verilen transfer fonksiyonlarını bulunuz.



i. $G_{CN}(s)$
ii. $G_{CR}(s)$
iii. $G_{AN}(s)$
iv. $G_{AR}(s)$

ÇÖZÜM:

Sorudaki tek döngüyü dönüştürelim. Böylece sorulan transfer fonksiyonlarını bulmamız kolaylaşır.



$$C(s) = A(s) + G_5 \cdot N(s) + G_4 \cdot R(s) \quad (1)$$

$$A(s) = \left(G_1 \cdot \frac{G_2}{1 + G_2 H_1} \cdot G_3\right) R(s) \qquad (2)$$

(2)'yi (1)'de yerine yazalım.

$$C(s) = \left(G_1 \cdot \frac{G_2}{1 + G_2 H_1} \cdot G_3\right) R(s) + G_5 \cdot N(s) + G_4 \cdot R(s)$$

$$C(s) = \left(G_4 + \frac{G_1 G_2 G_3}{1 + G_2 H_1}\right) R(s) + G_5 \cdot N(s) \quad (3)$$

i. $G_{CN}(s)$'yi bulmak için (3) denkleminde diğer giriş $R(s)$'i sıfır kabul edelim.

$$C(s) = G_5 \cdot N(s) \Rightarrow \frac{C(s)}{N(s)} = G_{CN} = G_5$$

ii. $G_{CR}(s)$ 'yi bulmak için (3) denkleminde diğer giriş $N(s)$'i sıfır kabul edelim.

$$C(s) = \left(G_4 + \frac{G_1G_2G_3}{1 + G_2H_1}\right)R(s) \Rightarrow \frac{C(s)}{R(s)} = G_{CR} = \frac{G_4 + G_2G_4H_1 + G_1G_2G_3}{1 + G_2H_1}$$

iii. A(s), N(s) arasında bir giriş çıkış ilişkisi yok dolayısıyla $G_{AN}(s)=0$

iv. $G_{AR}(s)$ (2) denkleminden bulunur.

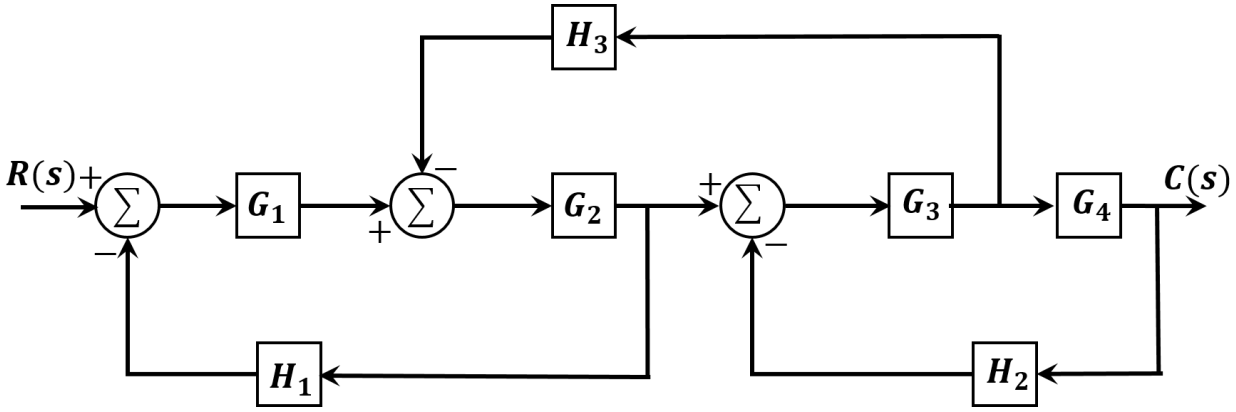
$$G_{AR}(s) = \frac{G_1G_2G_3}{1 + G_2H_1}$$

Problem 2.

Aşağıda şekilde verilen blok diyagramı, giriş ve çıkış arasındaki transfer fonksiyonu $G_{CR}(s) = \frac{C(s)}{R(s)}$'i bulmak üzere

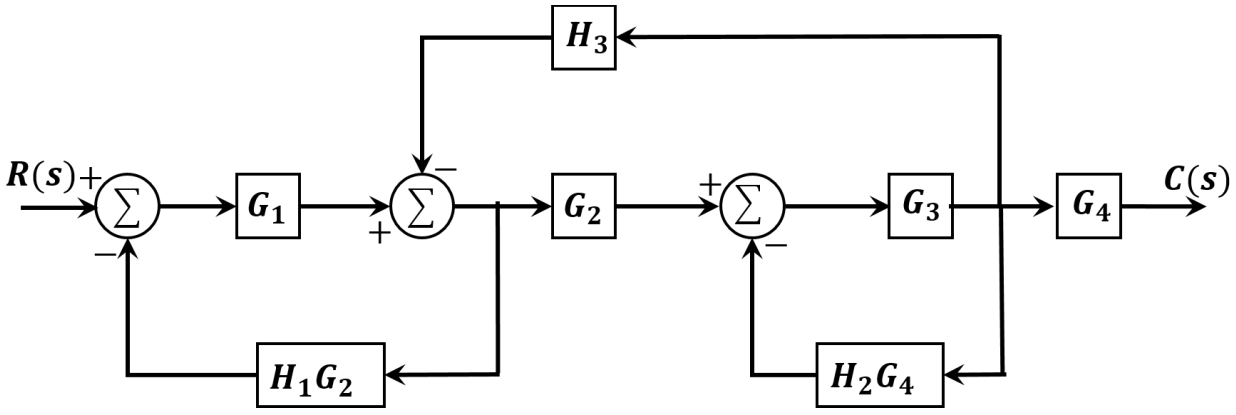
i. Blok diyagram indirgeme kurallarını kullanarak

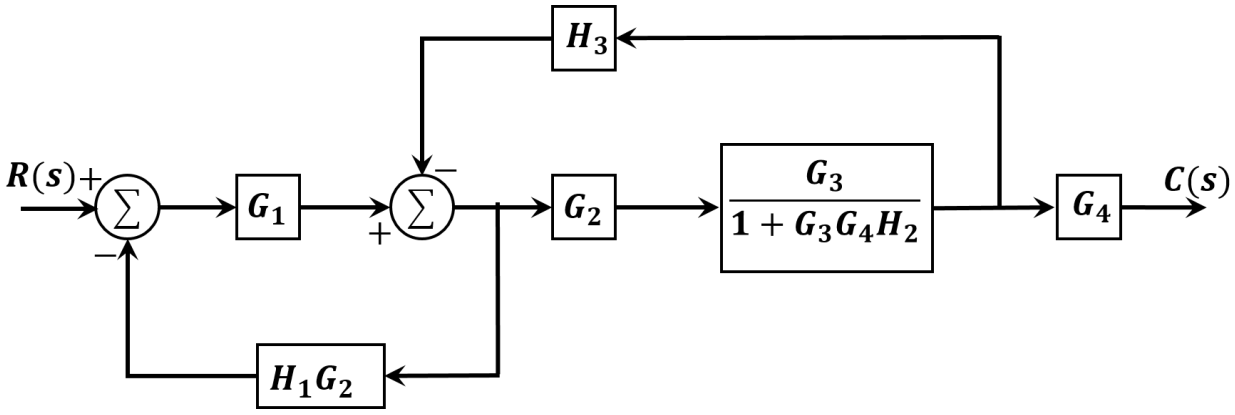
ii. Giriş-çıkış denklemlerini yazarak cebirsel olarak bulunuz.

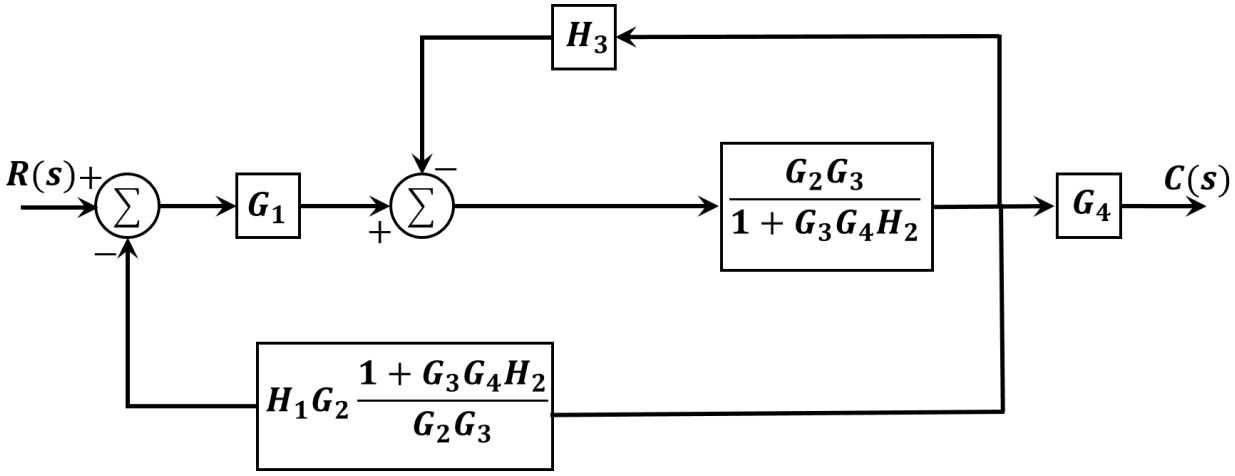


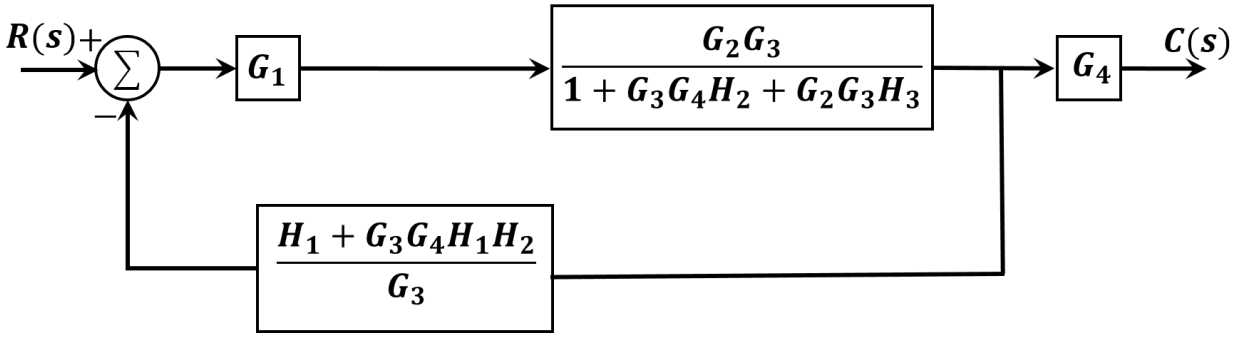
Çözüm:

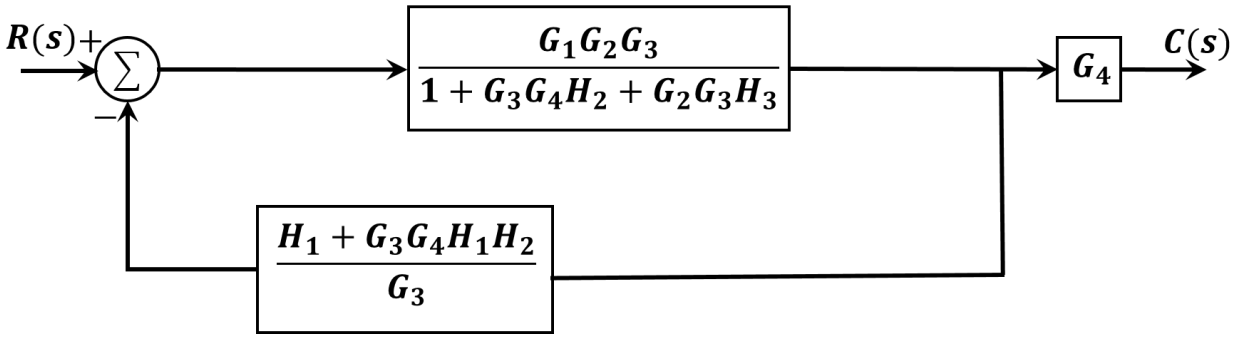
i.) Blok diyagram indirgeme kurallarını kullanarak

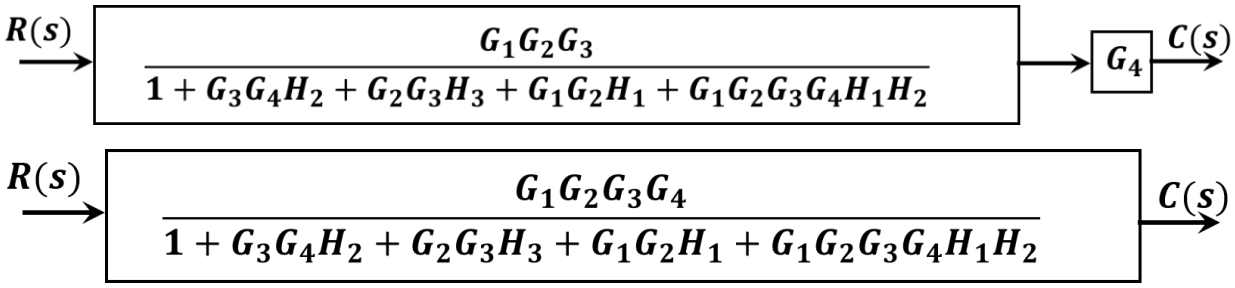



H_3
$R(s)$
G_1
G_2
$\frac{G_3}{1+G_3G_4H_2}$
G_4
$C(s)$
H_1G_2

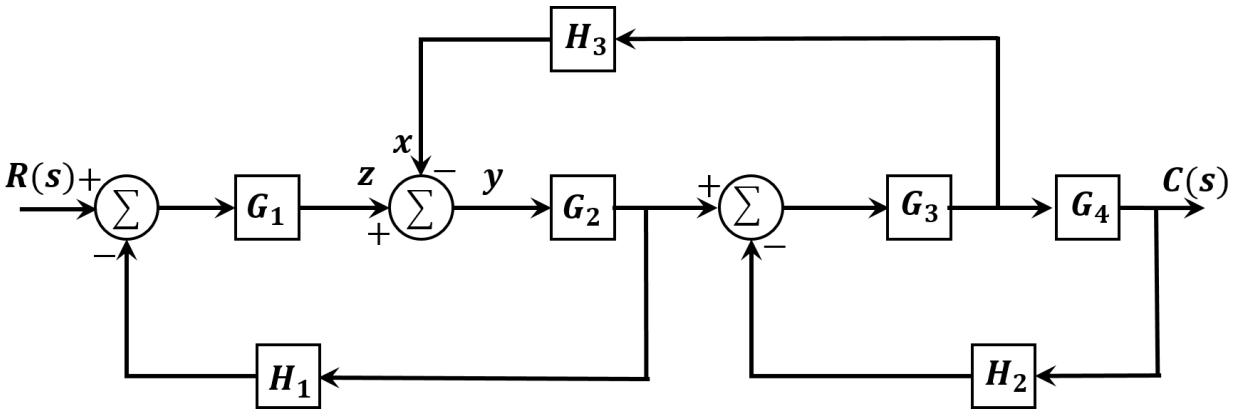

H_3
$R(s)$
G_1
$\frac{G_2G_3}{1+G_3G_4H_2}$
G_4
$C(s)$
$H_1G_2\frac{1+G_3G_4H_2}{G_2G_3}$


$R(s)$
G_1
$\frac{G_2G_3}{1+G_3G_4H_2+G_2G_3H_3}$
G_4
$C(s)$
$\frac{H_1+G_3G_4H_1H_2}{G_3}$


$R(s)$
$\frac{G_1G_2G_3}{1+G_3G_4H_2+G_2G_3H_3}$
G_4
$C(s)$
$\frac{H_1+G_3G_4H_1H_2}{G_3}$



ii.) Giriş-çıkış denklemlerini yazarak cebirsel olarak



$$z = (R(s) - yG_2H_1)G_1 = G_1R(s) - G_1G_2H_1y$$

$$x = (yG_2 - H_2C(s))G_3H_3 = yG_2G_3H_3 - G_3H_2H_3C(s)$$

$$C(s) = (yG_2 - H_2C(s))G_3G_4 = yG_2G_3G_4 - G_3G_4H_2C(s) \Longrightarrow\Longrightarrow y = \frac{1+G_3G_4H_2}{G_2G_3G_4}C(s)$$

$$y = z - x = G_1R(s) - G_1G_2H_1y - yG_2G_3H_3 + G_3H_2H_3C(s)$$

$$y(1 + G_1G_2H_1 + G_2G_3H_3) = G_1R(s) + G_3H_2H_3C(s)$$

$$\frac{1+G_3G_4H_2}{G_2G_3G_4}(1 + G_1G_2H_1 + G_2G_3H_3)C(s) = G_1R(s) + G_3H_2H_3C(s)$$

$$(1 + G_1G_2H_1 + G_2G_3H_3 + G_3G_4H_2 + G_1G_2G_3G_4H_1H_2 + G_2(G_3)^2G_4H_2H_3 - G_2(G_3)^2G_4H_2H_3)C(s) = G_1G_2G_3G_4R(s)$$

$$\frac{C(s)}{R(s)} = \frac{G_1G_2G_3G_4}{1 + G_1G_2H_1 + G_2G_3H_3 + G_3G_4H_2 + G_1G_2G_3G_4H_1H_2}$$

Problem 3.