Block diagram Redution Technique Rules

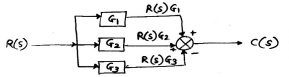
1] Blocks in series or cascade :-

$C(s) = G_1 G_2 R(s)$

$G = G_1 G_2$

★ Blocks in series ⟺ Multiplication ★

2] Blocks in parallel :-



Direction of flow of signal must be same

$C(s) = R(s)G_1 + R(s)G_2 - R(s)G_3$

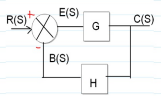
$= R(s)(G_1 + G_2 - G_3)$

$\therefore C(s) = (G_1 + G_2 - G_3) R(s)$

$G = G_1 + G_2 - G_3$

Blocks in Parallel ⟺ Addition

Rule 3) Elimination of feedback loop



$E(s) = R(s) \mp B(s)$

$B(s) = C(s) \cdot H(s)$

$C(s) = E(s) \cdot G(s) = G(s)[R(s) \mp B(s)]$

$= G(s) \cdot R(s) \mp G(s) \cdot B(s)$

$= G(s) \cdot R(s) \mp G(s) \cdot C(s) \cdot H(s)$

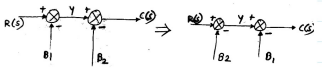
$C(s) \pm G(s) \cdot C(s) \cdot H(s) = G(s) \cdot R(s)$

$C(s)[1 \pm G(s) H(s)] = G(s) \cdot R(s)$

$\frac{C(s)}{R(s)} = \frac{G(s)}{1 \pm G(s) H(s)}$

+ve for negative f/b
−ve for positive f/b

4] Associative Law for Summing Point :-



$Y = R(s) - B_1$

$C(s) = Y - B_2$

$C(s) = R(s) - B_1 - B_2$

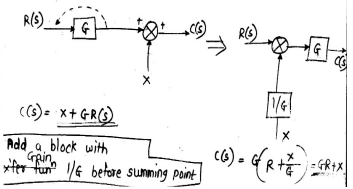
$Y = R(s) - B_2$

$C(s) = Y - B_1$

$C(s) = R(s) - B_2 - B_1$

Applicable only if two summing points are directly connected to each other.

5] Shifting a summing point before a block :-

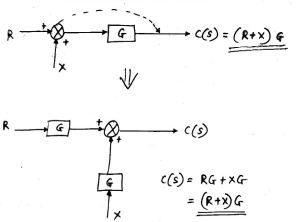


$C(s) = X + GR(s)$

Add a block with gain after X as 1/G before summing point

$C(s) = G\left(R + \frac{X}{G}\right) = GR + X$

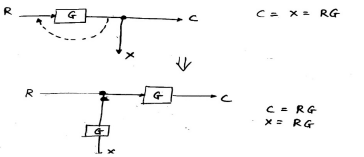
6] Shifting a summing point after a block



$C(s) = RG + XG$

$= (R+X)G$

7] Shifting a take-off point before a block :-

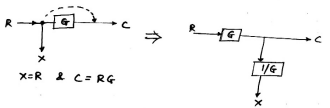


$C = X = RG$

$C = RG$

$X = RG$

8] Shifting a take-off point after a block :-



$X = R$ & $C = RG$

$X = R \cdot G \cdot \frac{1}{G} = R$

$C = RG$