SNS COLLEGE OF TECHNOLOGY

Coimbatore-641035
An Autonomous Institution

Accredited by NBA – AICTE and Accredited by NAAC – UGC with 'A++' Grade
Approved by AICTE, New Delhi & Affiliated to Anna University, Chennai

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

23ECT212 – LINEAR CONTROL SYSTEMS

II YEAR/ IV SEMESTER

UNIT I – CONTROL SYSTEM MODELING

TOPIC - BLOCK DIAGRAM REDUCTION TECHNIQUES

INTRODUCTION

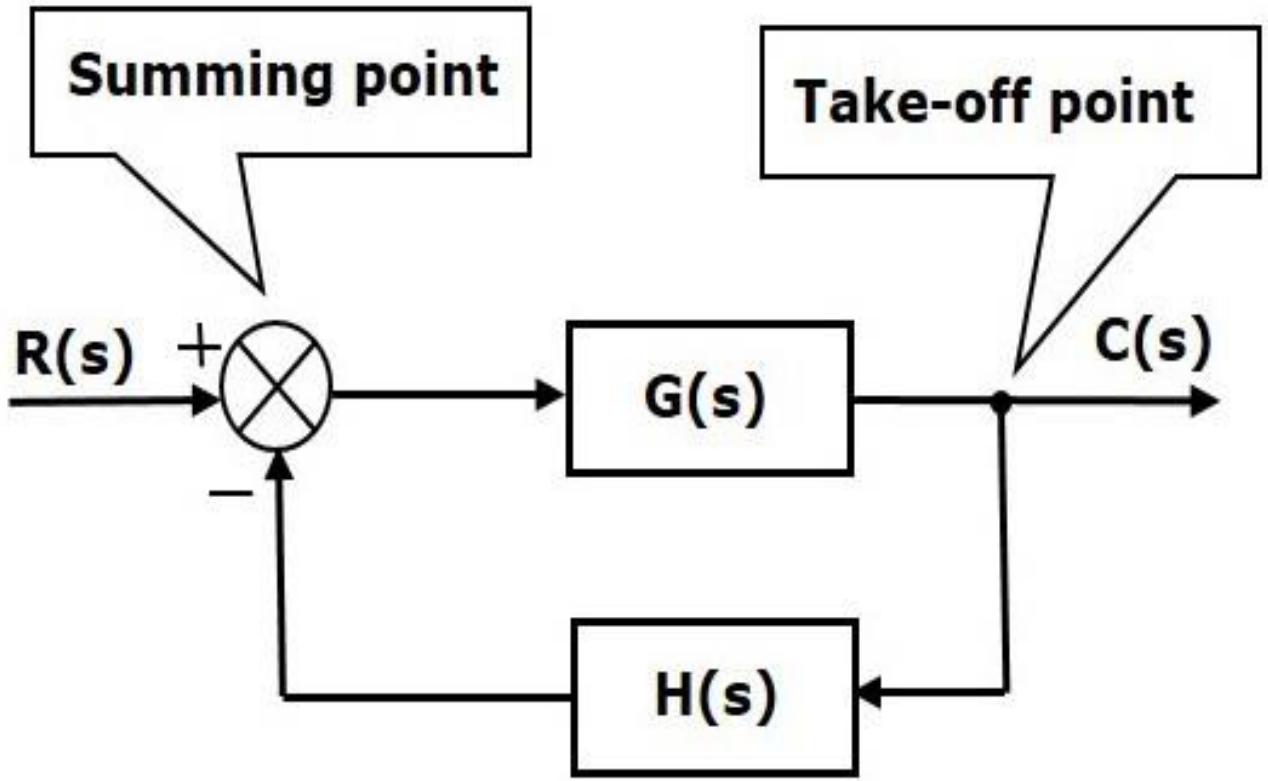
•It consists of a single block or a combination of blocks.

•These are used to represent the control systems in pictorial form.

•Signal into the block represents the **input R(s)** and signal out of block represents **output C(s),** while the block itself stands for the **transfer function G(s).**

•Flow of information is unidirectional, output being equal to input multiplied by the transfer function of the block.

BASIC ELEMENTS OF BLOCK DIAGRAM

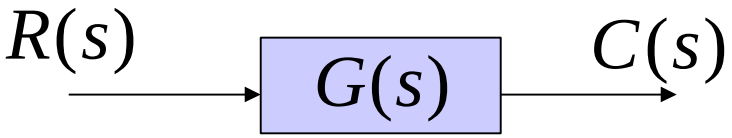


BLOCK DIAGRAM

A Block diagram is basically modelling of any simple or complex system.
It Consists of multiple Blocks connected together to represent a system to explain how it is functioning

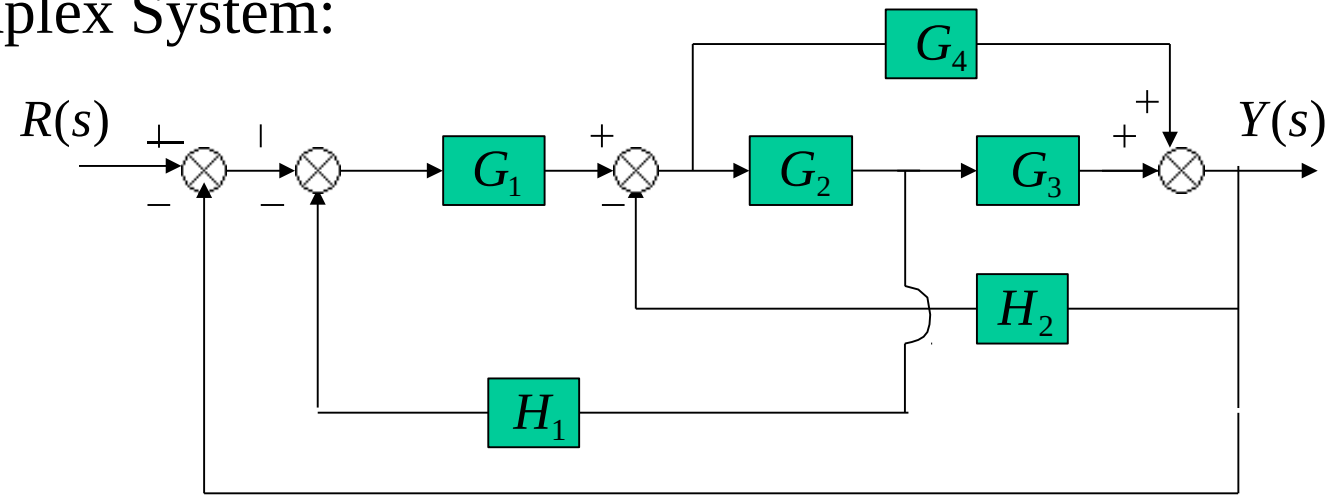
Transfer Function: Ratio between transformation of output to the transformation of input when all the initial conditions are zero.

Simple system:



G(s)=C(s)/R(s)

Complex System:

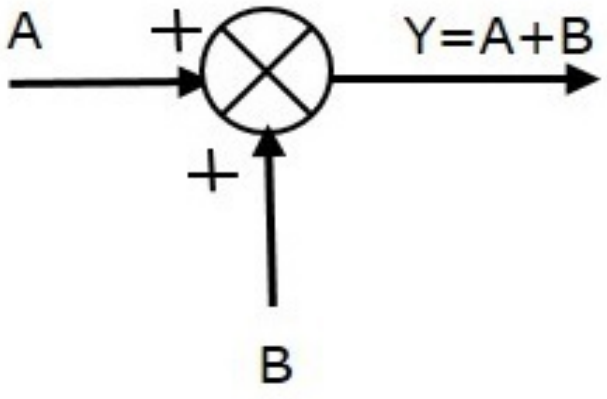


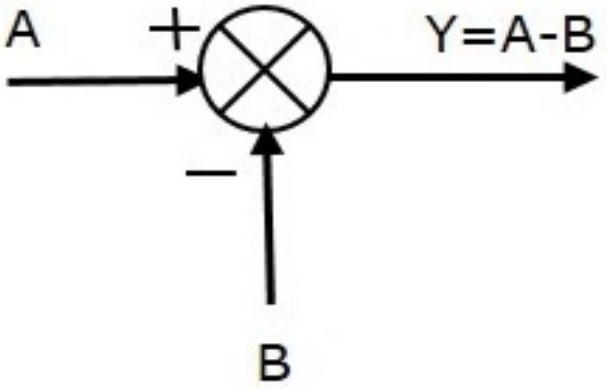
BASIC ELEMENTS OF BLOCK DIAGRAM

- **Block**

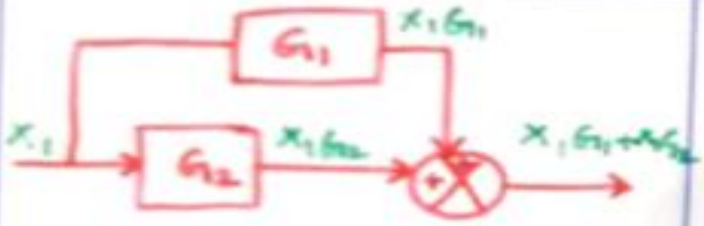
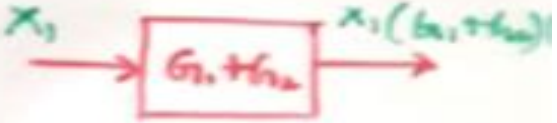
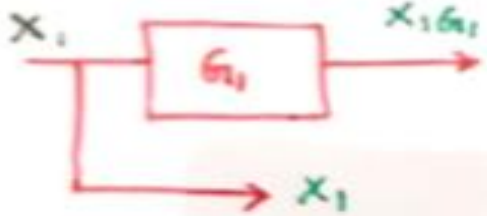
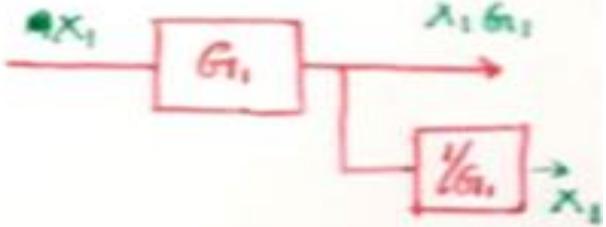
$$Y(s) = G(s) * X(s)$$

- **Summing Point**

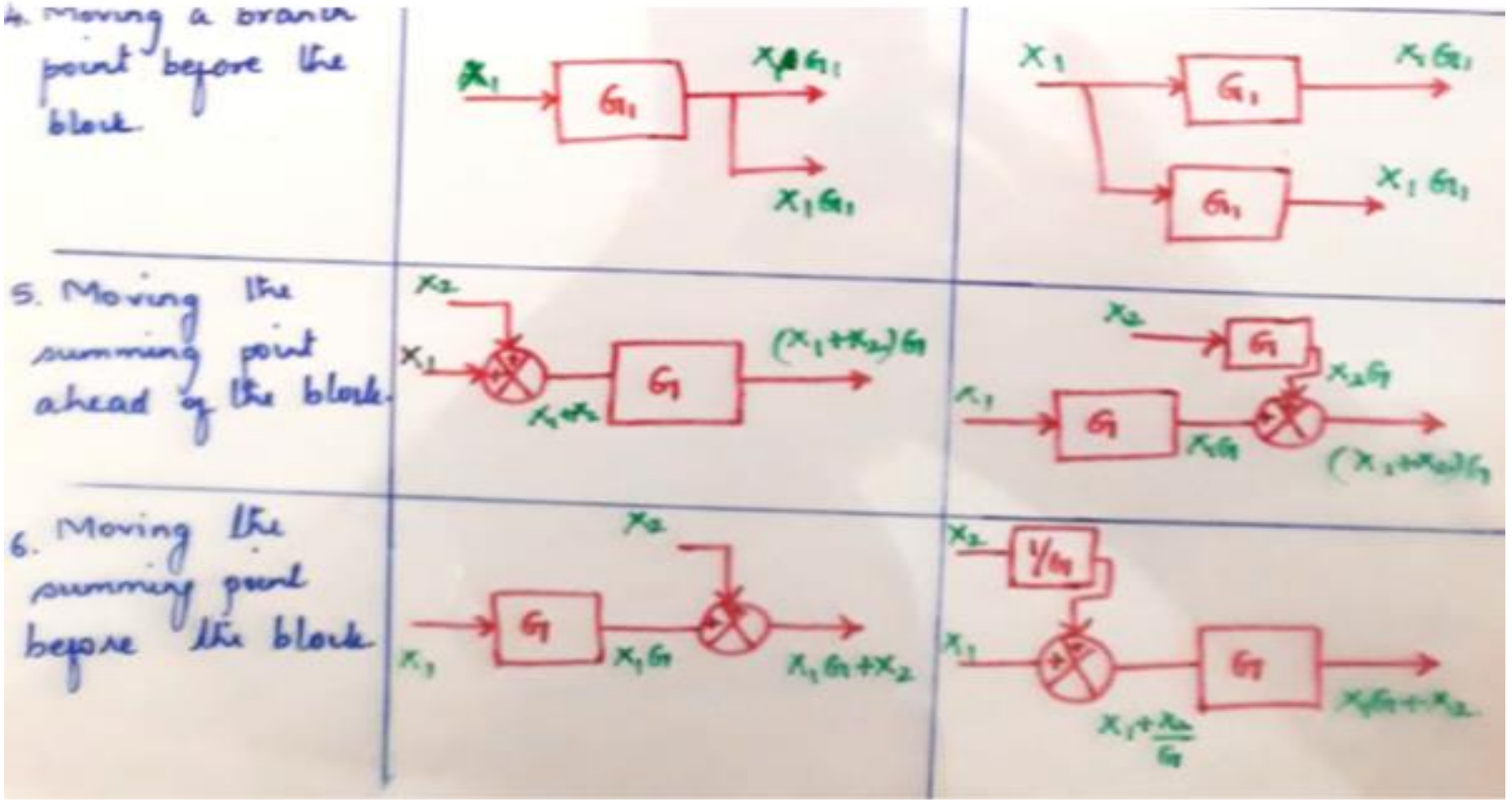




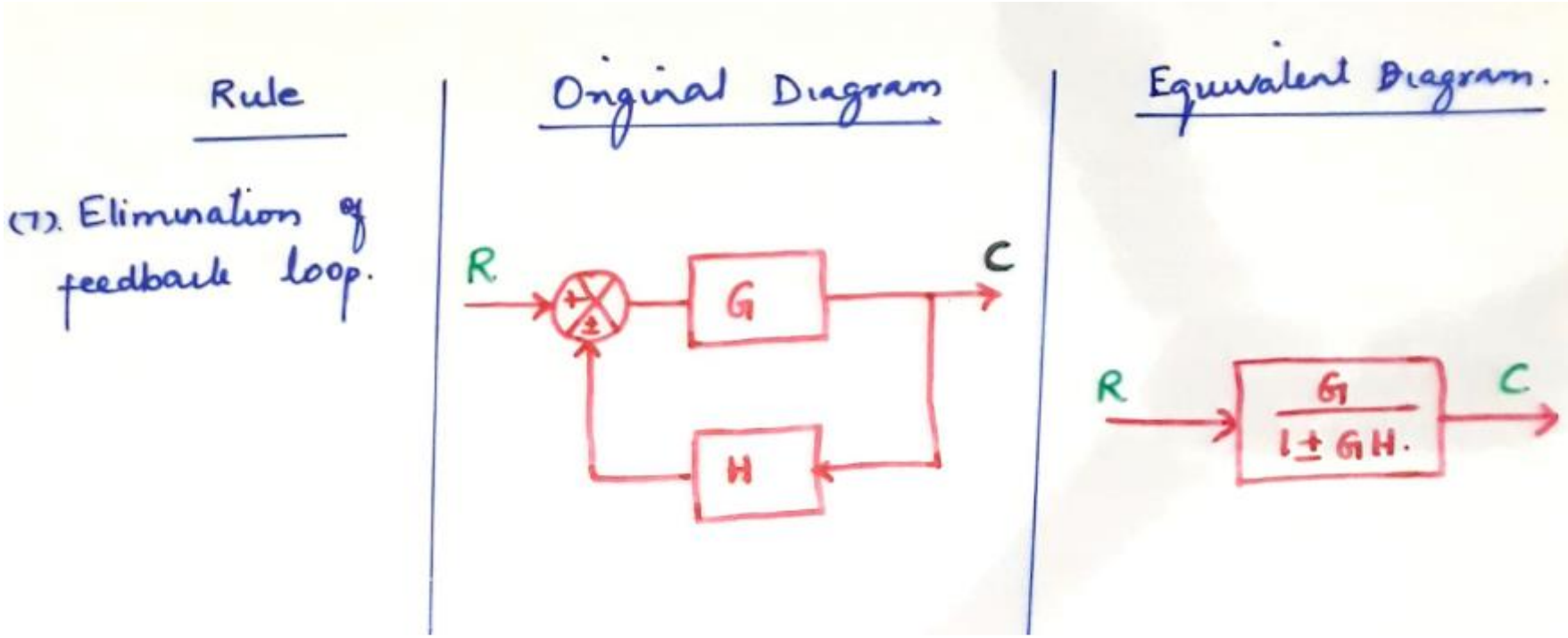
BLOCK DIAGRAM REDUCTION TECHNIQUE

Rule	Original Diagram	Equivalent diagram
(1) Combining blocks in cascade		
2. Combining Parallel blocks.		
3. Moving a branch point ahead of the block.		

BLOCK DIAGRAM REDUCTION TECHNIQUE...

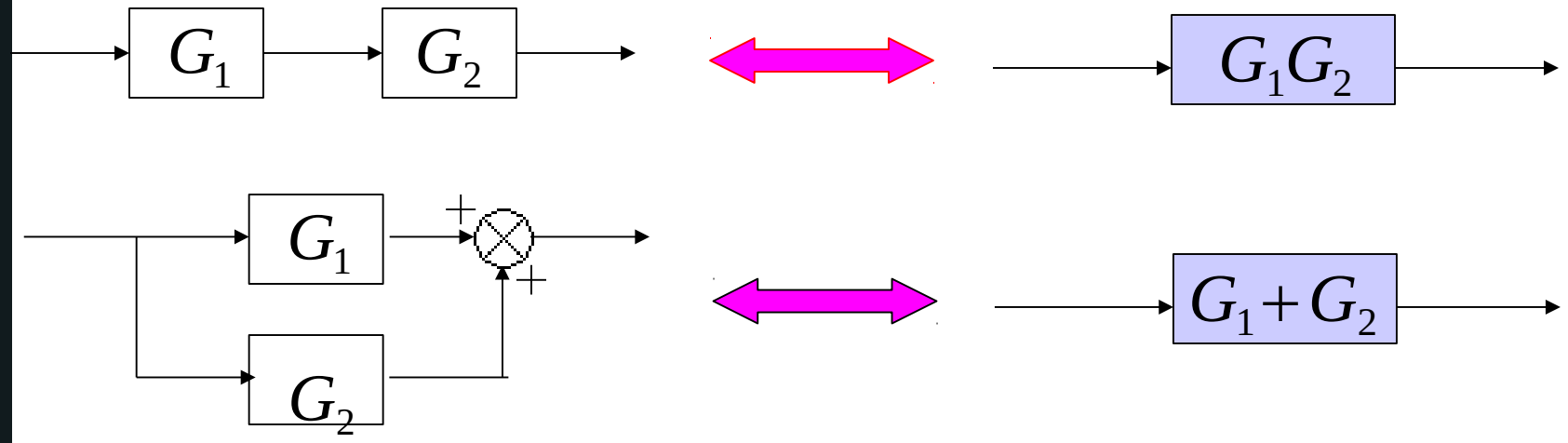


BLOCK DIAGRAM REDUCTION TECHNIQUE...

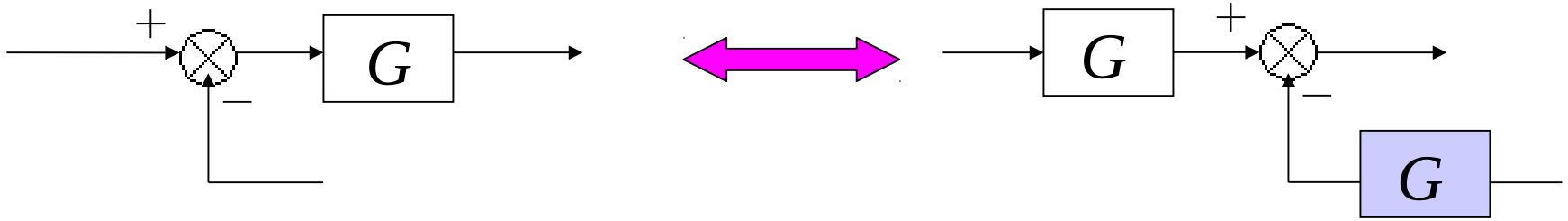


BLOCK DIAGRAM REDUCTION TECHNIQUE...

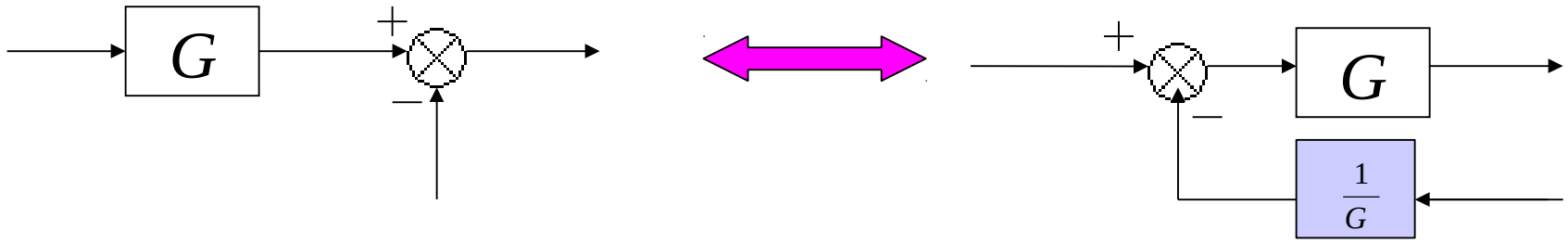
1. Combining blocks which are in cascade or in parallel



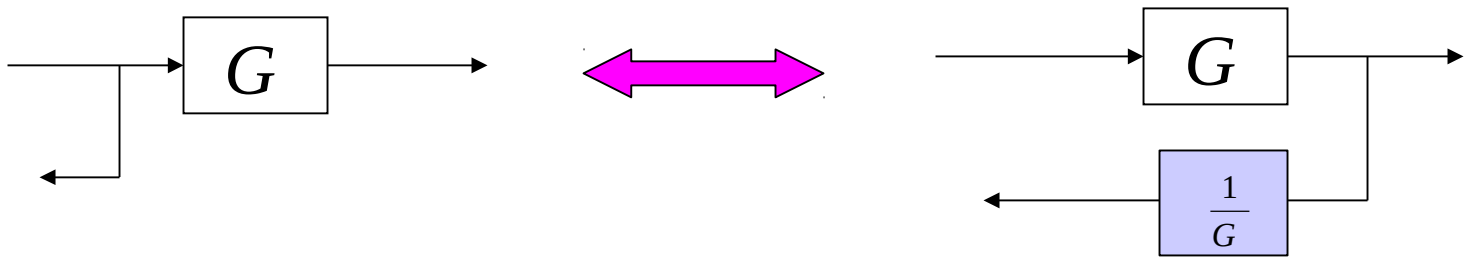
2. Moving a summing point behind a block



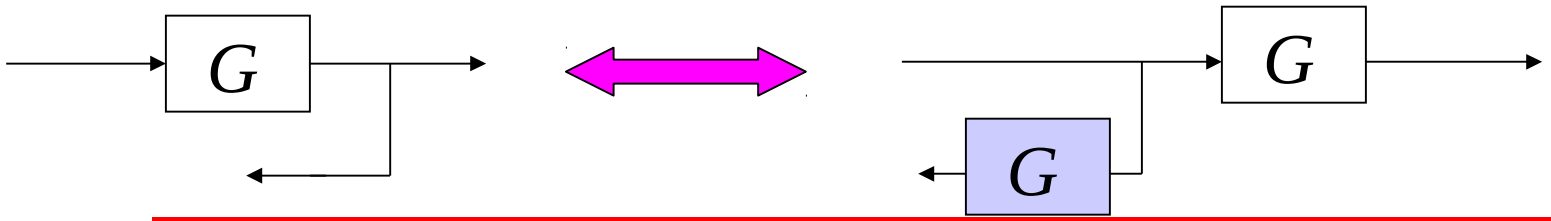
3. Moving a summing point ahead of a block



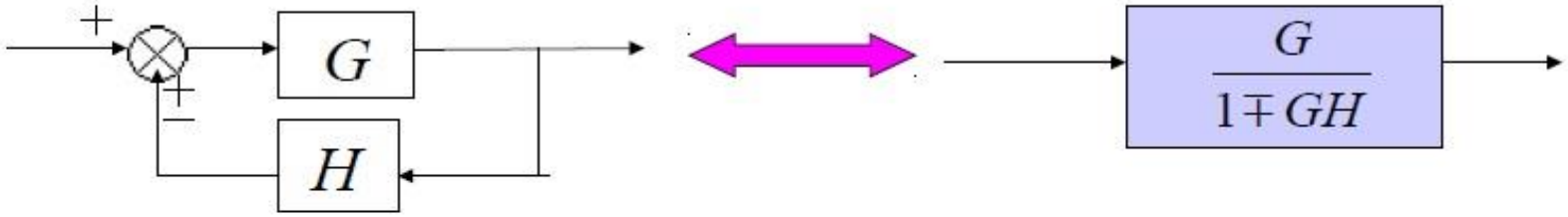
4. Moving a pickoff point behind a block

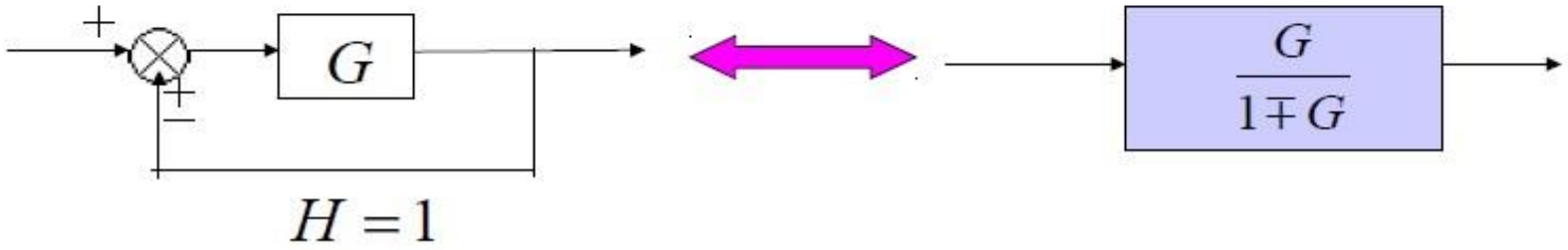


5. Moving a pickoff point ahead of a block

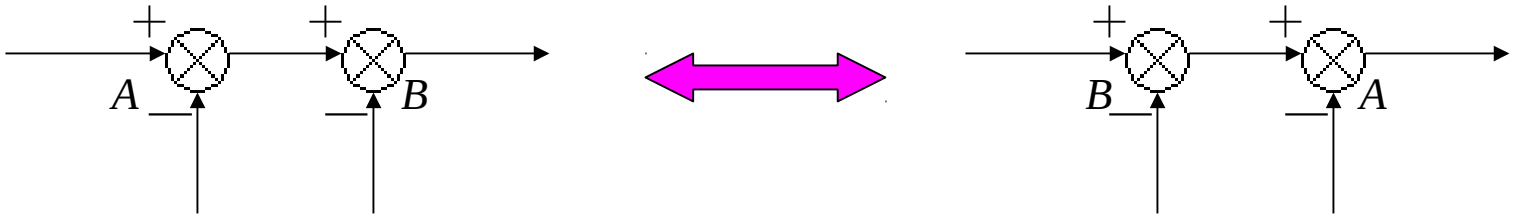


6. Eliminating a feedback loop



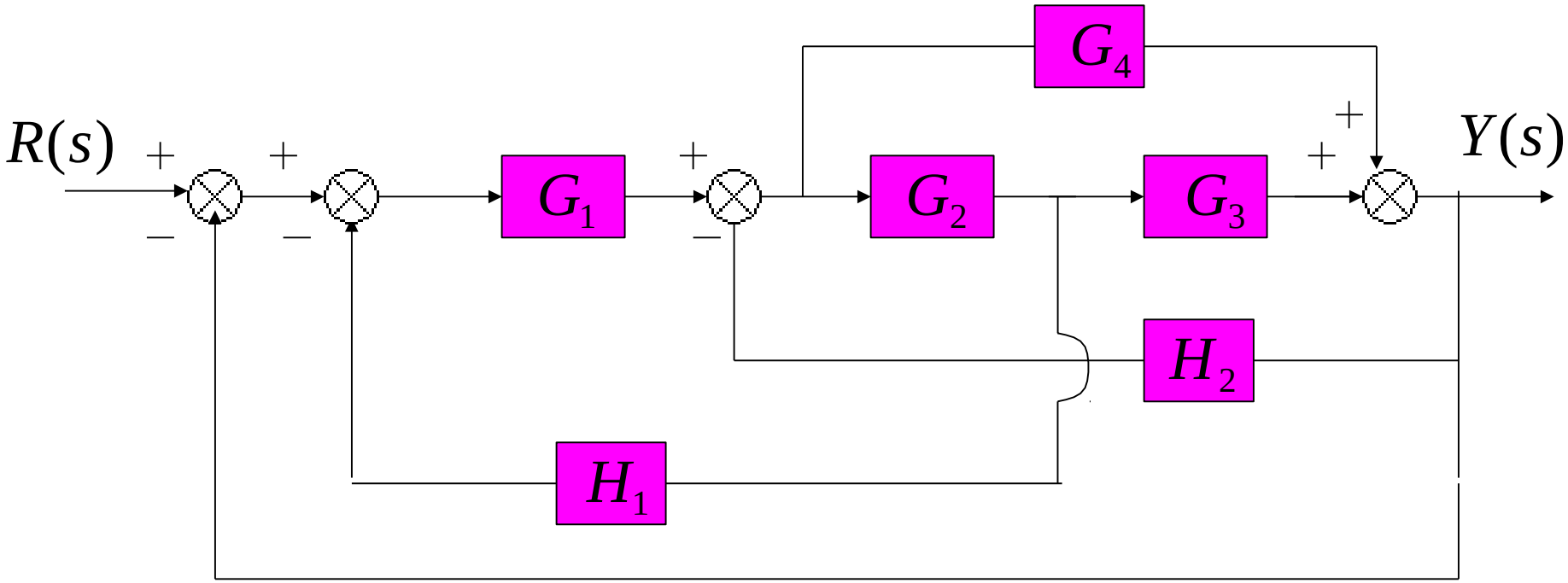


7. Swapping with two adjacent summing points

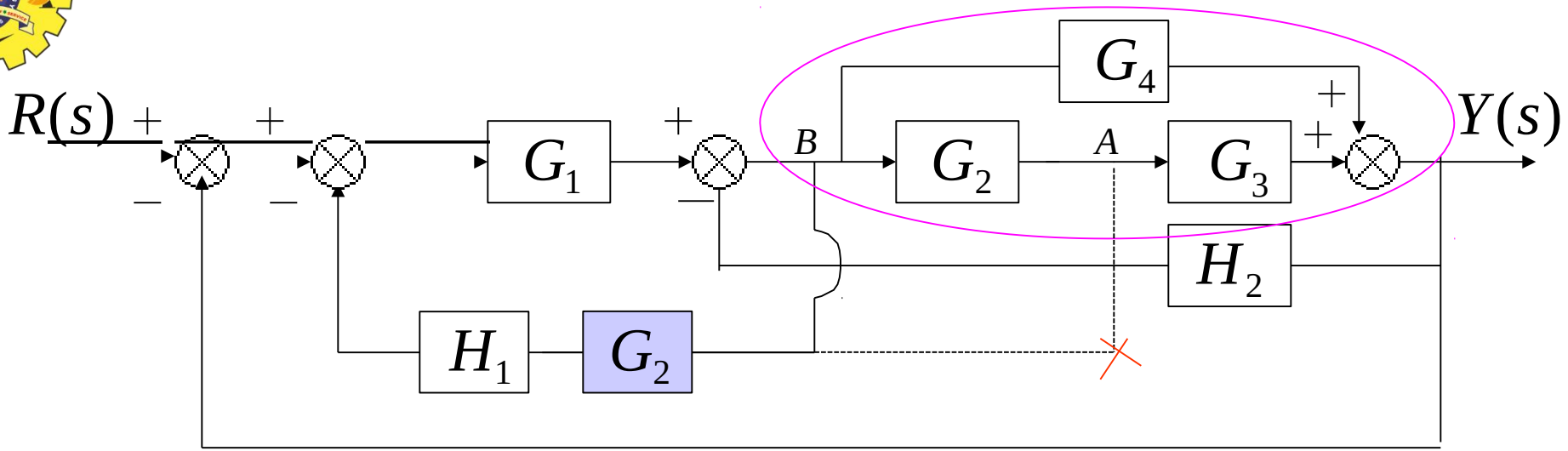


Assessment

Find the transfer function of the following block diagrams



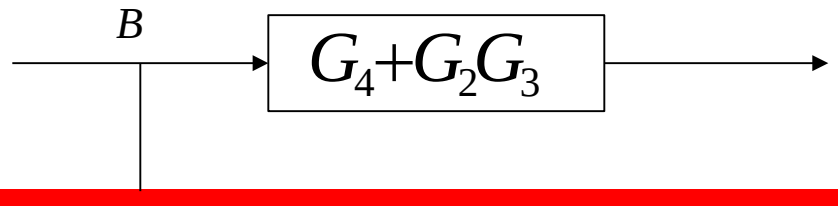
EXAMPLE 1

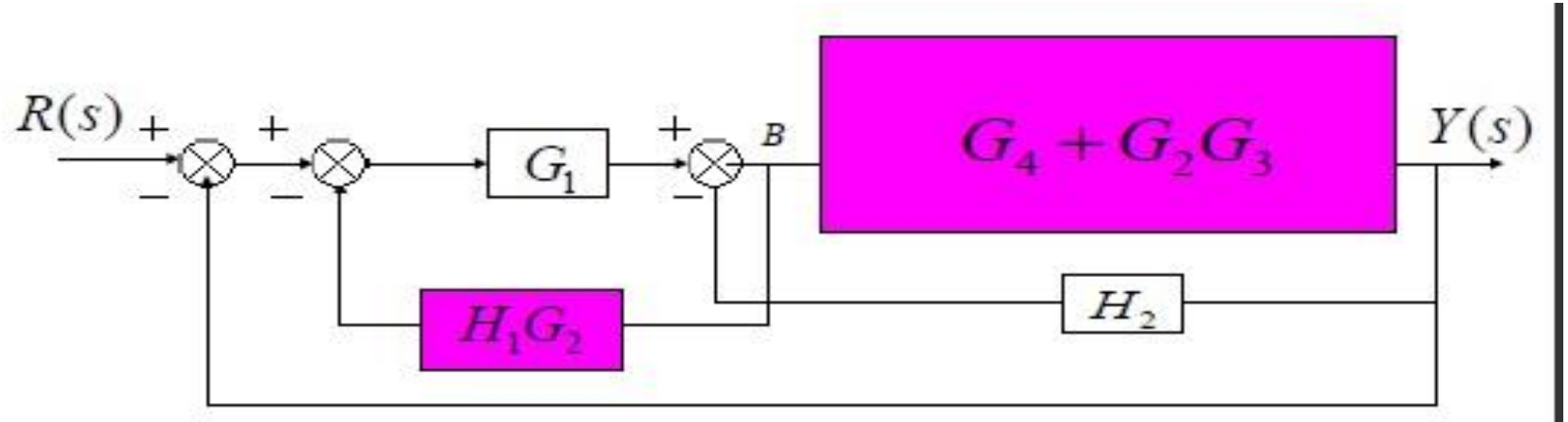


Solution:

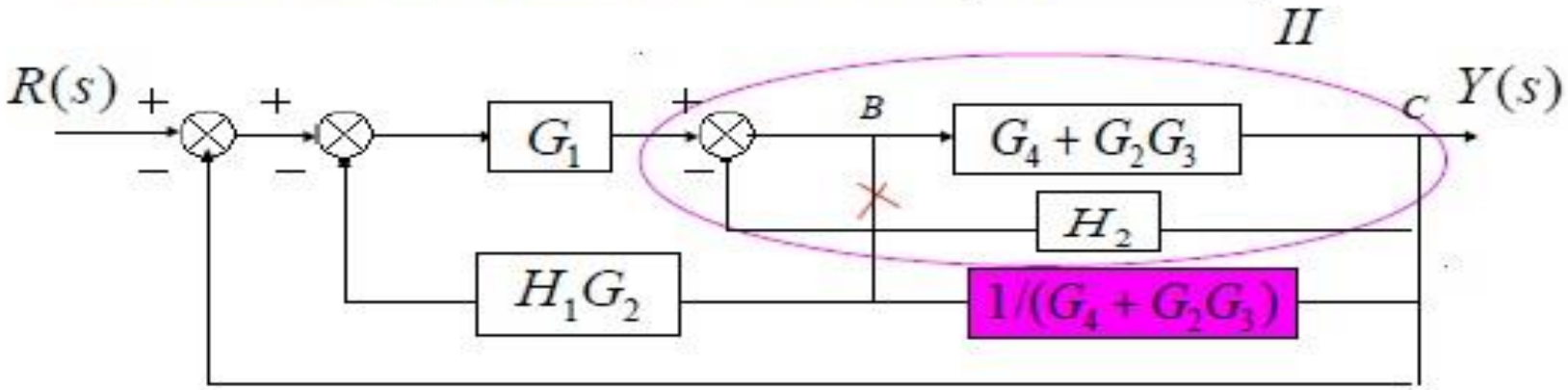
1. Apply the rule that Moving pickoff/takeoff point ahead of block G_2

2. Eliminate loop I & simplify as

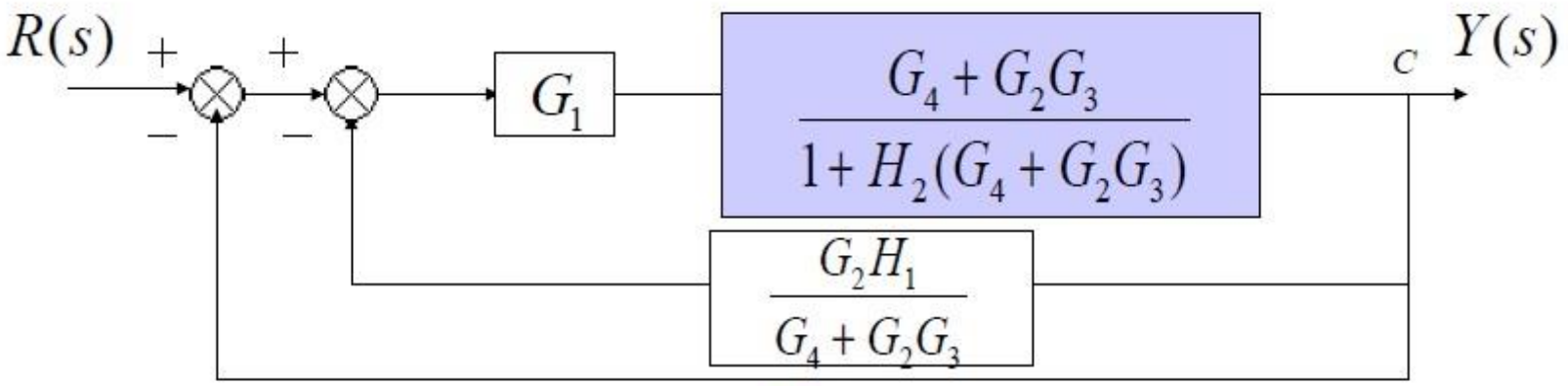




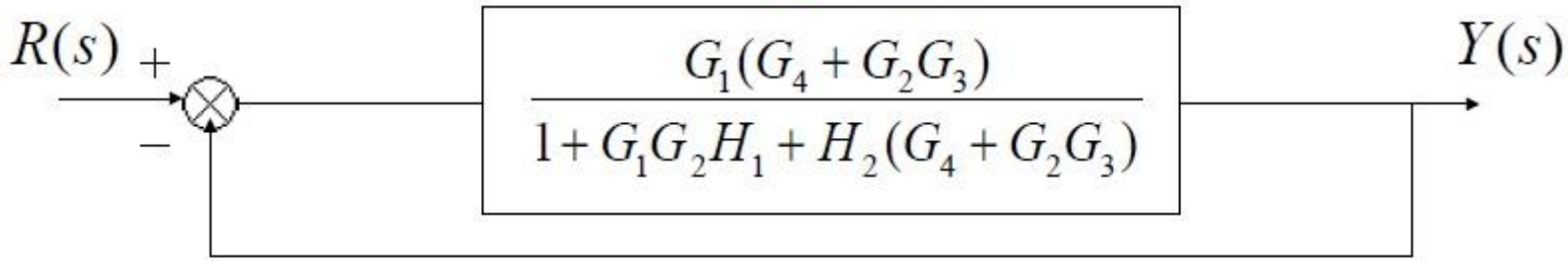
3. Moving pickoff point B behind block $G_4 + G_2G_3$



4. Eliminate loop III

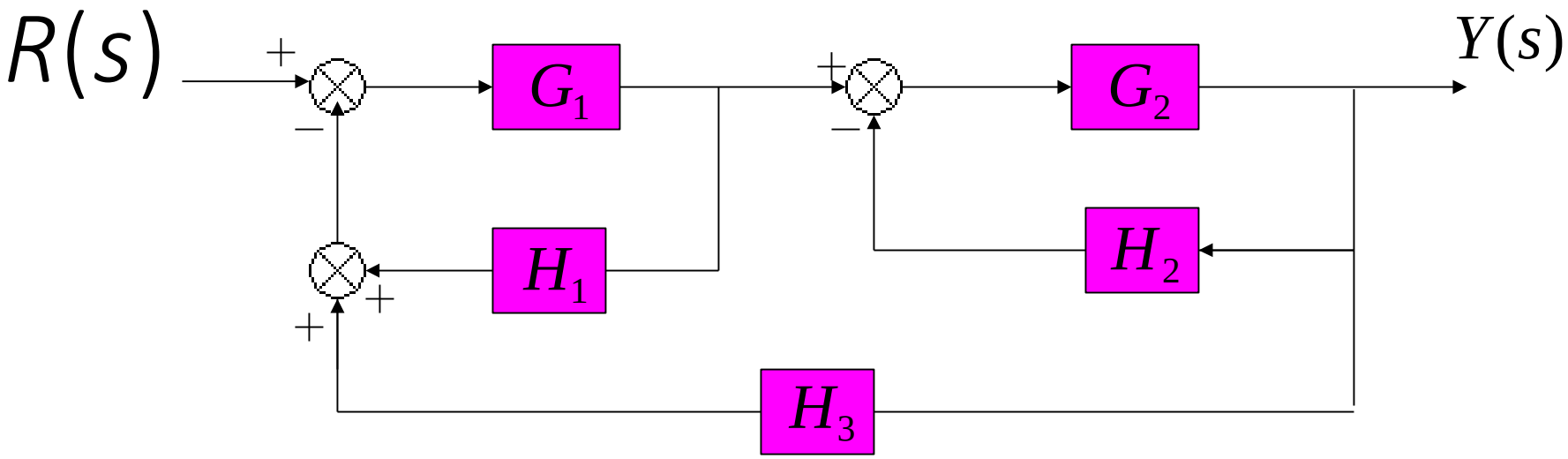


Using rule 6



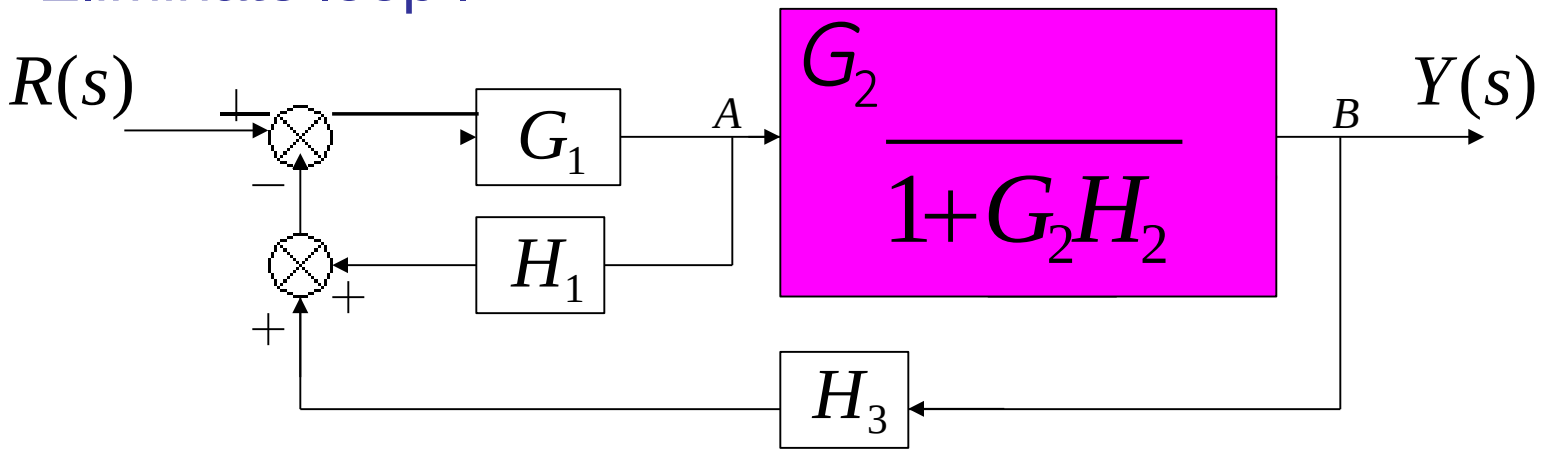
$$T(s) = \frac{Y(s)}{R(s)} = \frac{G_1(G_4 + G_2G_3)}{1 + G_1G_2H_1 + H_2(G_4 + G_2G_3) + G_1(G_4 + G_2G_3)}$$

(b)

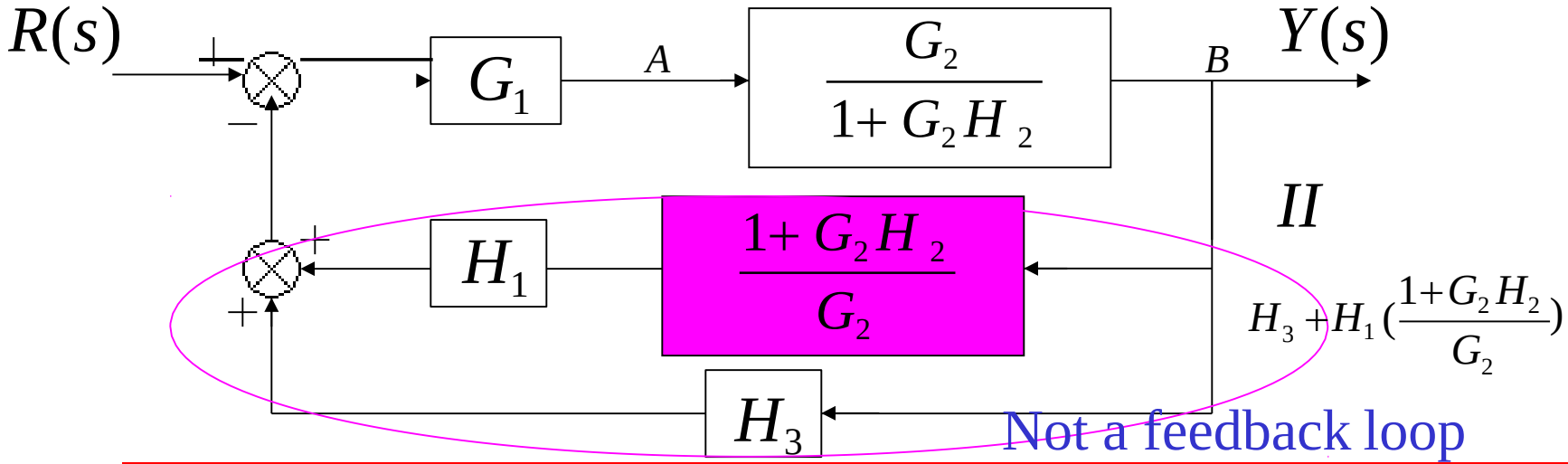


Solution:

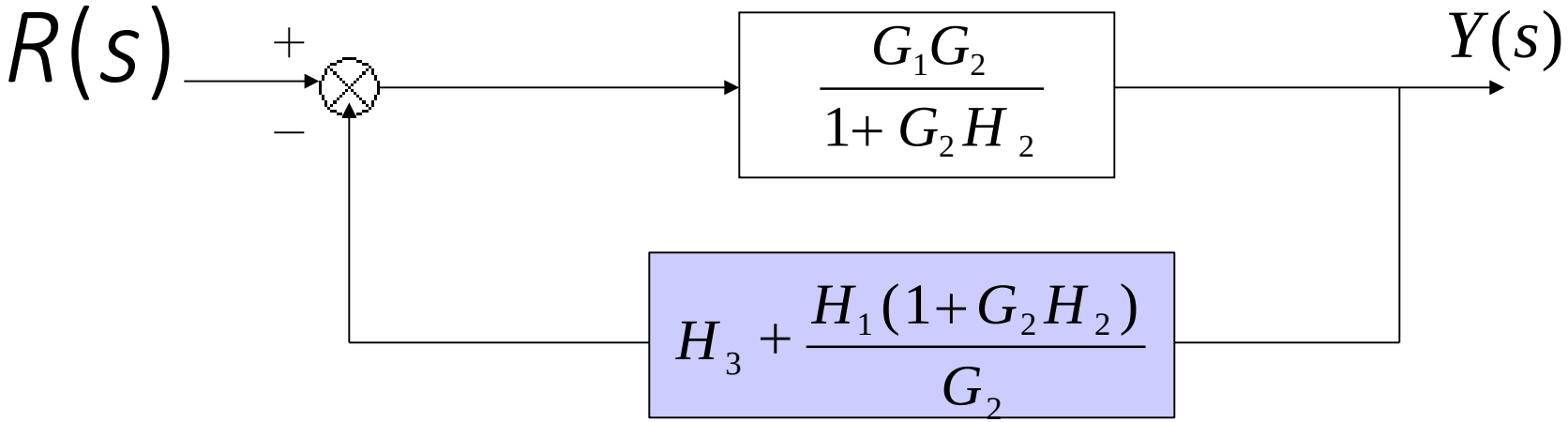
1. Eliminate loop I



2. Moving pickoff point A behind block $\frac{G_2}{1+G_2H_2}$



3. Eliminate loop II



Use rule 6

$$T(s)=\frac{Y(s)}{R(s)}=\frac{G_1G_2}{1+G_2H_2+G_1G_2H_3+G_1H_1+G_1G_2H_1H_2}$$

SUMMARY