1.8 BLOCK DIAGRAM REDUCTION TECHNIQUES

A system that can change its output in accordance with change in input is known as a closed loop system. This can be implemented by introducing a feedback path in an open-loop system and manipulating the input that is applied to the system. Such as closed-loop system can be represented by using a block diagram shown in figure 1.8.1.

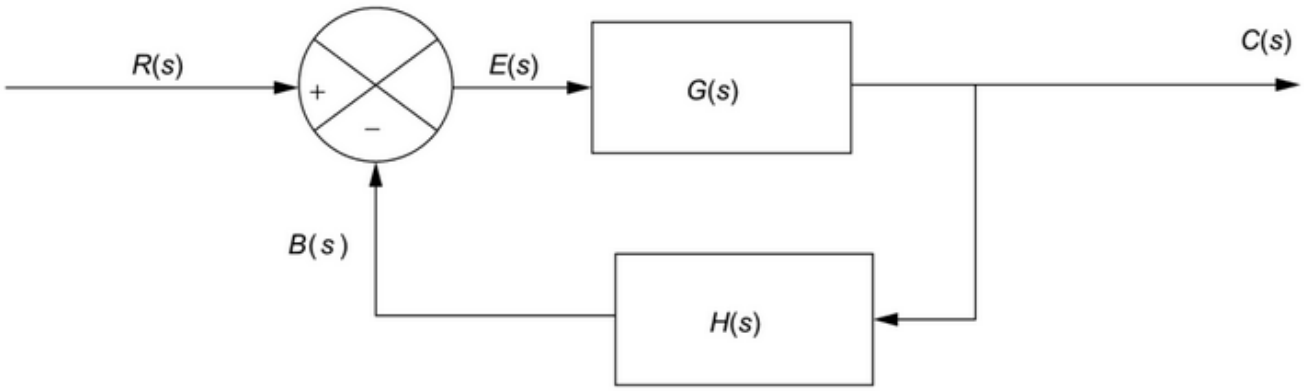


Figure 1.8.1 Simple block diagram representation

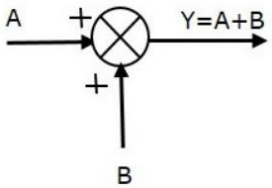
[Source: "Control Systems Engineering" by S.Salivahanan, R.Rengaraj, G.R.Venkatakrishnan, Page: 3.2]

BLOCK

The transfer function of a component is represented by a block. Block has single input and single output.

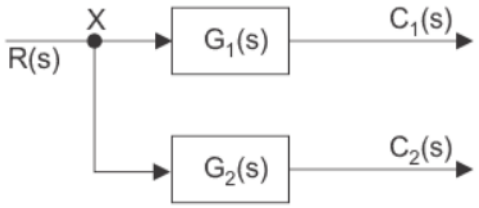
SUMMING POINT

The summing point is represented with a circle having cross (X) inside it. It has two or more inputs and single output. It produces the algebraic sum of the inputs. It also performs the summation or subtraction or combination of summation and subtraction of the inputs based on the polarity of the inputs. Let us see these three operations one by one. The following figure shows the summing point with two inputs (A, B) and one output (Y). Here, the inputs A and B have a positive sign. So, the summing point produces the output, Y as sum of A and B.



NODE

The node is a point from which the same input signal can be passed through more than one branch. That means with the help of node, we can apply the same input to one or more blocks, summing points. In the following figure, the node is used to connect the same input, R(s) to two more blocks.



The advantages of block diagram representation are:

(i) It facilitates easier representation of complex systems.

(ii) Calculation of transfer function by block diagram reduction techniques is easy.

(iii) Performance analysis of a complex system is simplified by determining its transfer function.

(iv) It facilitates easier access of individual elements in a system that is represented by a block diagram.

(v) It facilitates visualization of operation of the whole system by the flow of signals.

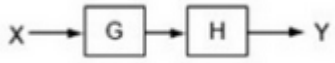
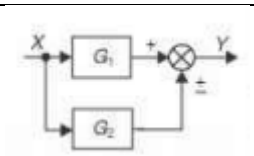
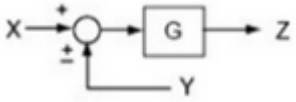
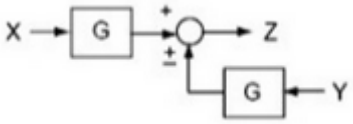
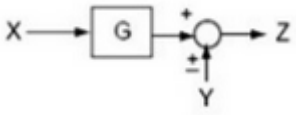
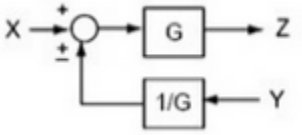
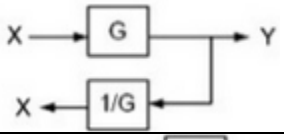
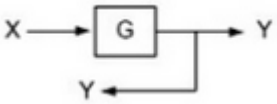
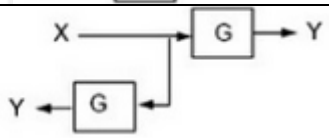
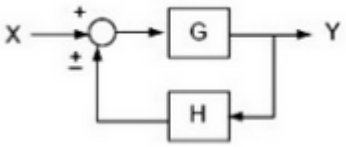
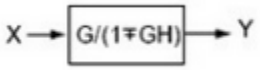
The disadvantages of block diagram representation are:

(i) It is difficult to determine the actual composition of individual elements in a system.

(ii) Representation of a system using block diagram is not unique.

(iii) The main source of signal flow cannot be represented definitely in a block diagram.

RULES FOR BLOCK DIAGRAM REDUCTION

Rule No.	Rule	Block diagram	Equivalent block diagram
1	Blocks in cascade		
2	Blocks in parallel		
3	Moving a summing point behind the block		
4	Moving a summing point ahead of the block		
5	Moving a branch point behind the block		
6	Moving a branch point ahead of the block		
7	Eliminating a feedback loop		
8	Interchanging the summing point