SNS COLLEGE OF TECHNOLOGY

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Department of Biomedical Engineering

Course Name: Biocontrol System

II Year : IV Semester

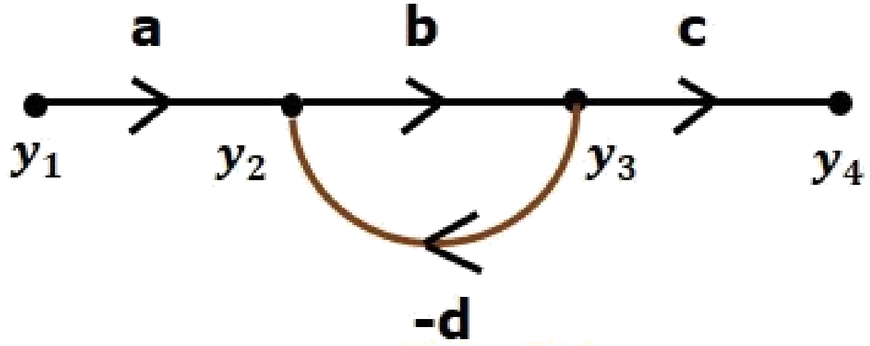
Unit I –Introduction to physiological modeling

Topic : Signal Flow Graph

Introduction

- Signal flow graph is a graphical representation of algebraic equations
- The block diagram reduction process takes more time for complicated system
- So, to overcome this drawback, use signal flow graphs (representation) is done where the calculation of transfer function is just by using a Mason's gain formula without doing any reduction process

Basic Elements of Signal Flow Graph



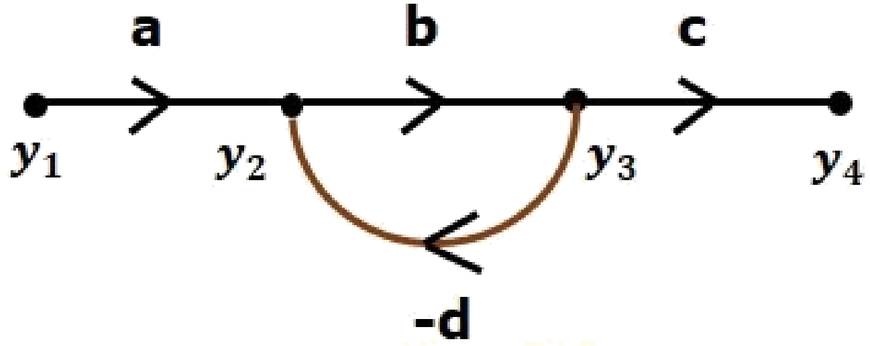
Input Node − It is a node, which has only outgoing branches.

Output Node − It is a node, which has only incoming branches.

Branch is a line segment which joins two nodes. It has both **gain** and **direction**

Open path: A open path starts at a node and ends at another node

Basic Elements of Signal Flow Graph



- **Forward path**: It is a path from an input node to an output node that does not cross any node more than once.
- **Individual loop**: It is a closed path starting from one node and after passing through the graph arrives at the same node without crossing any node more than once.
- **Non-touching loops**: If a loop does not have a common node then they are said to be non-touching loops.

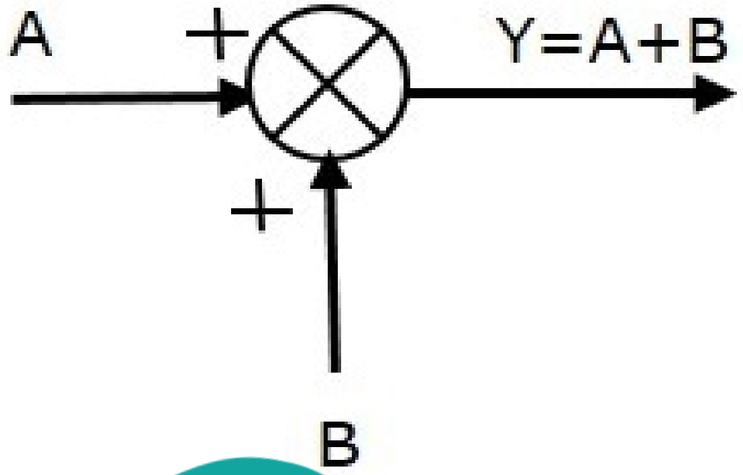
Basic Elements of Block Diagram

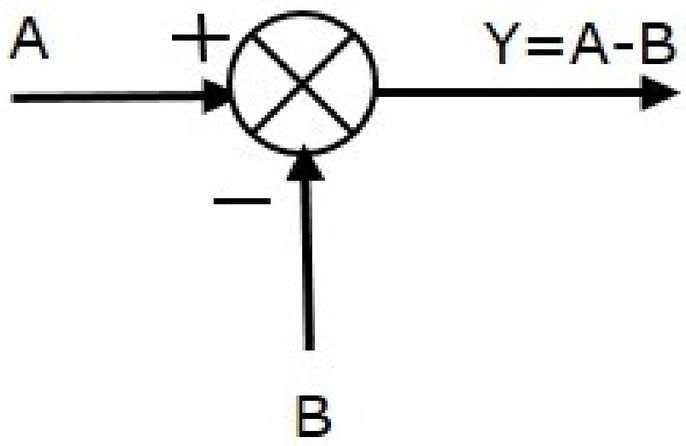
- **Block:**

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

Vision Tit 2

- Summing Point:





Mason's Gain Formula

$$T = \frac{C(s)}{R(s)} = \frac{\Sigma_{i=1}^{N} P_i \Delta_i}{\Delta}$$

Where,

- **C(s)** is the output node
- **R(s)** is the input node
- **T** is the transfer function or gain between R(s) and C(s)
- **P_i** is the i^{th} forward path gain

Δ

$= 1 - (sum\ of\ all\ individual\ loop\ gains)$

$+ (sum\ of\ gain\ products\ of\ all\ possible\ two\ nontouching\ loops)$

$- (sum\ of\ gain\ produts\ of\ all\ possible\ three\ nontouching\ loops) + \ ...$

Converting BDR to SFG

Steps for converting a block diagram into its equivalent signal flow graph.

- Represent all the signals, variables, summing points and take-off points of block diagram as **nodes** in signal flow graph.
- Represent the blocks of block diagram as **branches** in signal flow graph.
- Represent the transfer functions inside the blocks of block diagram as **gains** of the branches in signal flow graph.
- Connect the nodes as per the block diagram. If there is connection between two nodes (but there is no block in between), then represent the gain of the branch as one. **For example**, between summing points, between summing point and take-off point, between input and summing point, between take-off point and output.

Converting BDR to SFG