



# **SNS COLLEGE OF TECHNOLOGY**

**(An Autonomous Institution)**



**COIMBATORE-35**

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

## **DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING**

**COURSE NAME: 19EEB301/ CONTROL SYSTEMS**

**III YEAR / V SEMESTER**

**Unit I – SYSTEMS AND THEIR REPRESENTATIONS**

**Topic : Signal flow Graphs**



# Signal Flow Graphs

- It is a graphical representation of the control systems.
- It consists of a network in which nodes represent system variables. These nodes are connected by direct branches.

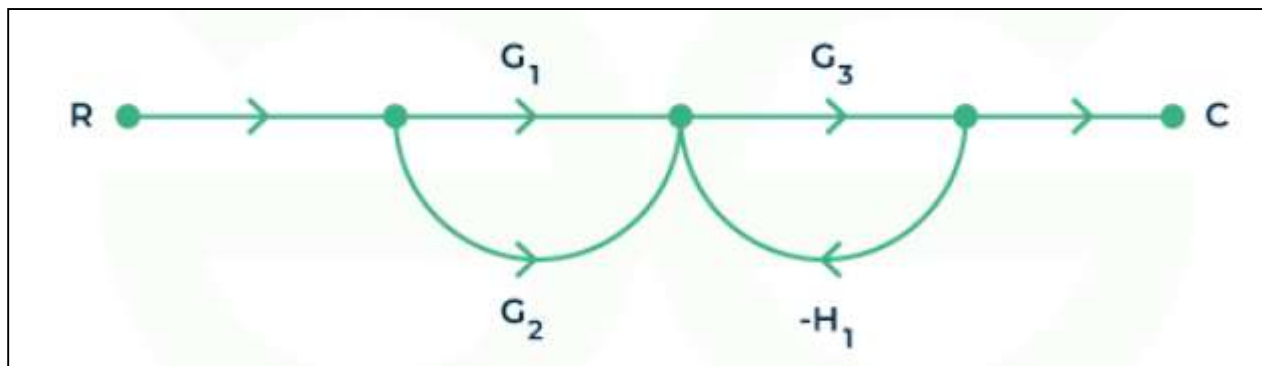
## TERMINOLOGIES

- **Node:** It is a system variable equal to the sum of all signals arriving at a node. Output signals do not affect the value of the node.
- **Branch:** A branch is a line that connects two nodes in the direction of the signal flow.
- **Transmittance:** Transmittance is gain between nodes, also known as branch gain.
- **Input or source node:** It is a node that has only outgoing branches.
- **Output or sink node:** It is a node that has only incoming branches.
- **Chain or mixed node:** It is a node having both incoming and outgoing nodes.



# Signal Flow Graphs

- **Path:** It is the traversal from one node to another in the direction of the signal such that no node is traversed more than once.
- **Forward Path:** It is the path from the input node to the output node.
- **Closed loop:** It is the loop that starts from a particular node and ends at the same node.
- **Self loop:** It starts from one end and ends at the same node. It has only one branch.
- **Path gain:** It is the product of all branch gain in a path.
- **Loop gain:** It is the product of branch gain in a closed loop.



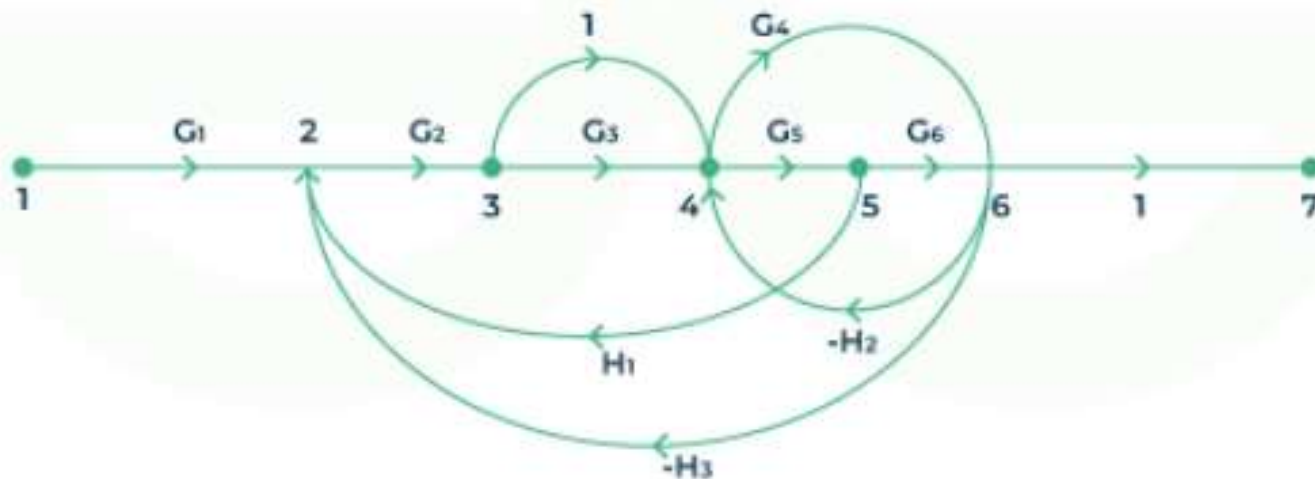
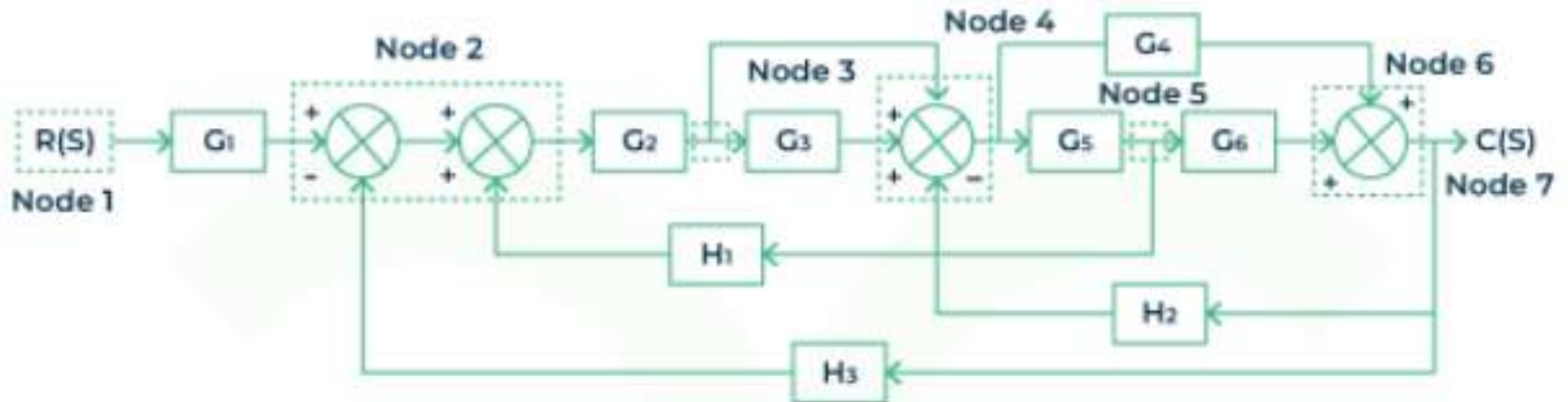


# Steps to Draw Signal Flow Graph from Block Diagram

- Replace the input and output signal by nodes.
- Replace all the summing points by nodes.
- Replace all taking off points by nodes.
- If the branch connecting a summing point and take off point can be combined then it is represented by a single node.
- If there are more takeoff points from the same signal then all the take off points can be combined and represented by a single node.
- If the gain of the link connecting two summing points is one then the two summing points can be combined and replaced by a single node.



# Steps to Draw Signal Flow Graph from Block Diagram





# Mason's Gain Formula

- Mason's gain formula is used to find the overall transmittance or gain of the system from signal flow graph.

$$T = \frac{\sum_{k=1}^n P_k \Delta_k}{\Delta}$$

Where,

$P_k$  is the forward path gain of  $k$ th path from a specified input node to an output node

$\Delta_k$  is the path factor associated with the concerned path and involves all closed loops in the graph which are isolated from the forward path under consideration.

$\Delta = 1 - [\text{sum of all individual loop transmittance}] + [\text{sum of loop transmittance products of all possible pairs of non-touching loops}] - [\text{sum of loop transmittance products of all possible triplets of non-touching loops}] + \dots\dots\dots$



# Thank You