UESTC3001 Dynamics & Control
Lecture 3

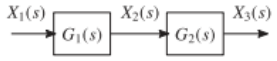
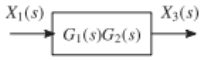
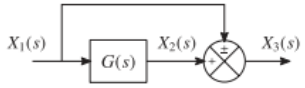
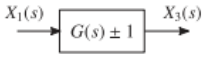
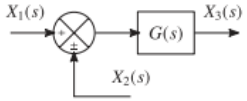
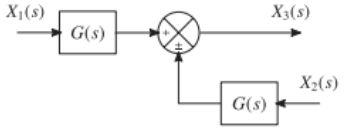
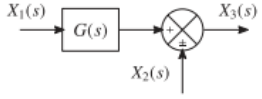
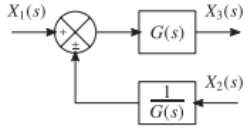
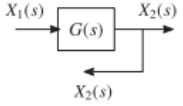
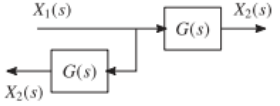
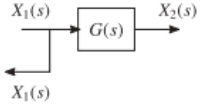
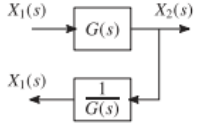
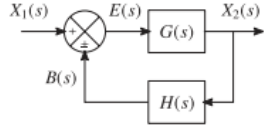
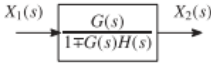
Block Diagram Reduction

Prof. Kelum Gamage kelum.gamage@glasgow.ac.uk
School of Engineering, University of Glasgow, UK

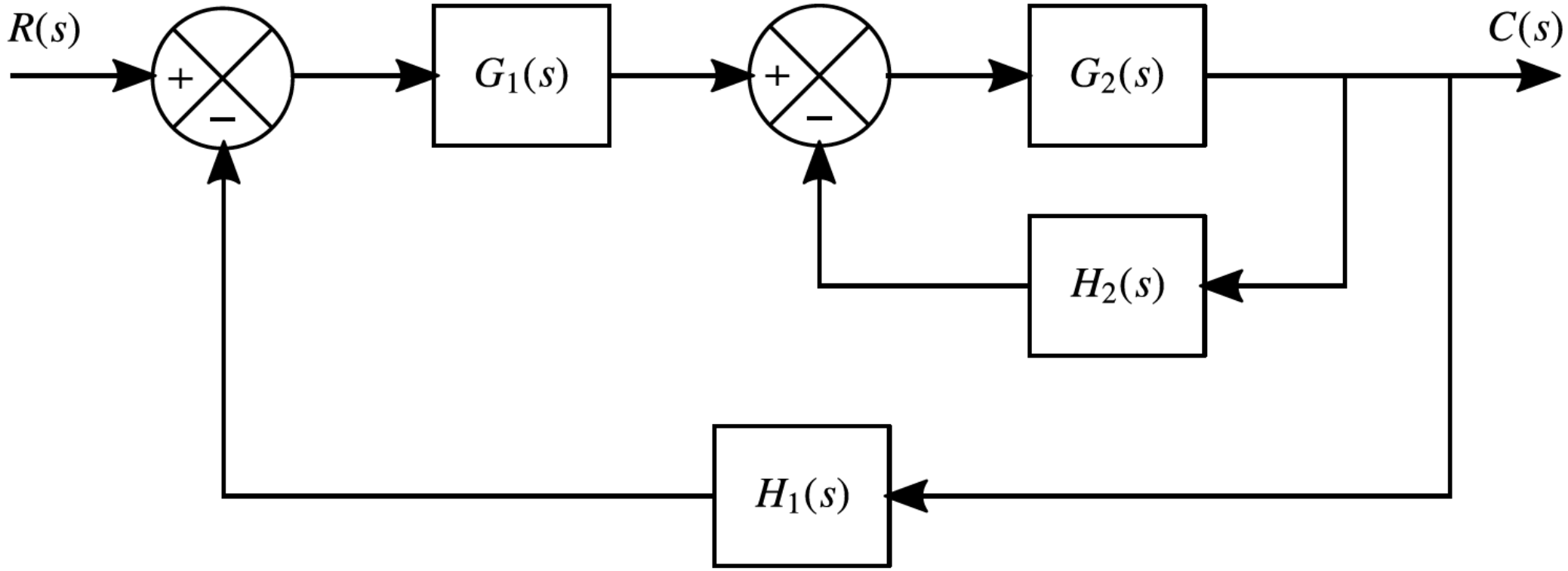
Outline

- Apply Block Diagram Reduction Rules
- Analyse Control System Subjected to a Disturbance

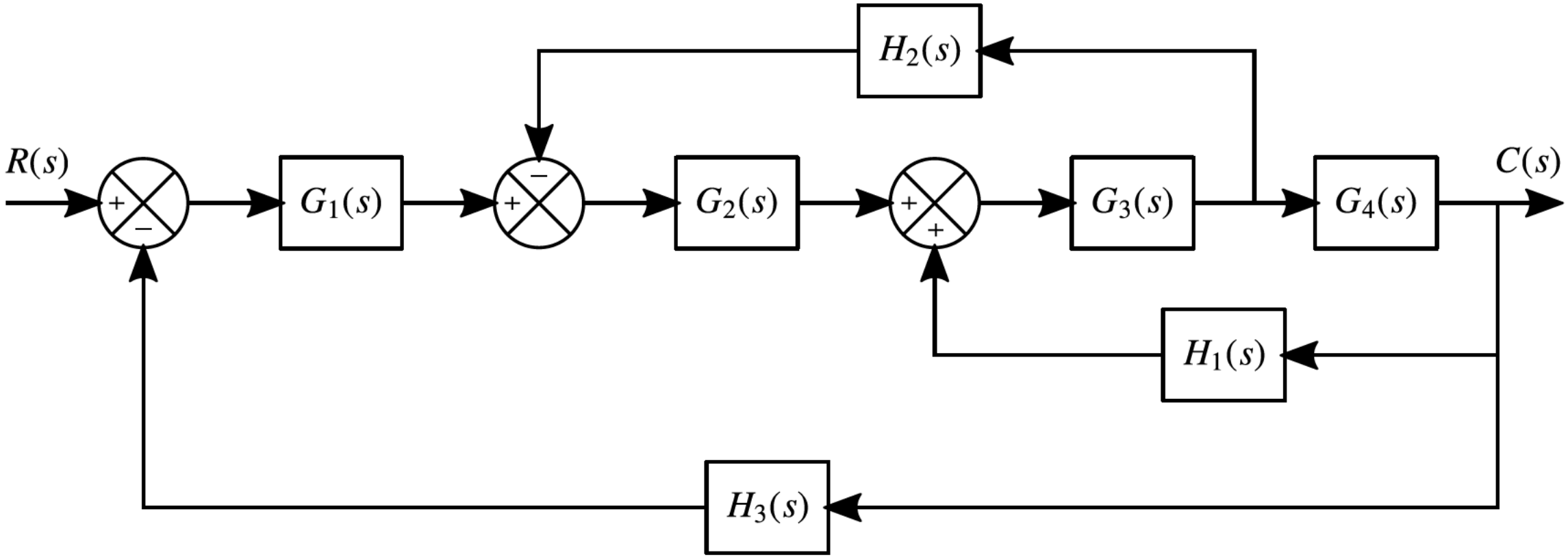
Rules for block diagram reduction - Summary

Rule	Original	Equivalent
1. Cascaded blocks		
2. Summing two signals		
3. Moving a summing point behind a block		
4. Moving a summing point ahead of a block		
5. Moving a branch point ahead of a block		
6. Moving a branch point behind a block		
7. Eliminating a feedback loop		

Example: Derive the overall transfer function

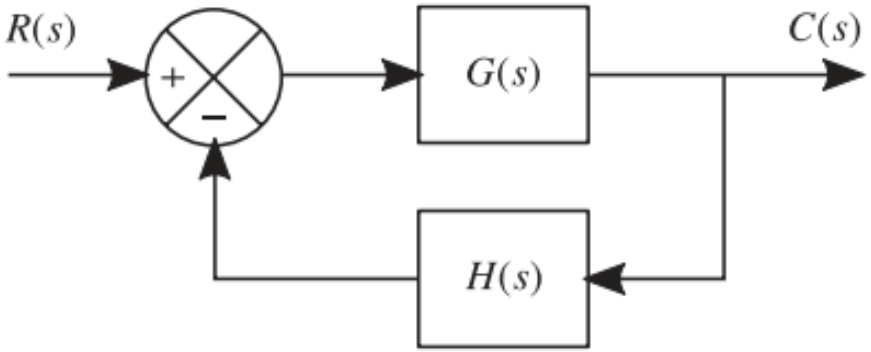


Exercise: Derive the overall transfer function



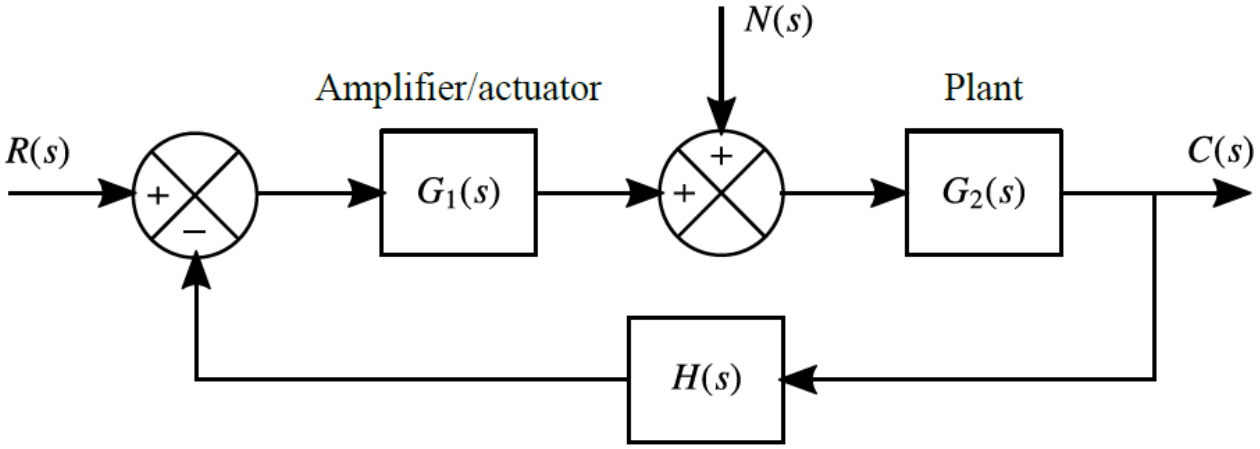
Closed-Loop Control System Subjected to a Disturbance

- Suppress disturbances in the steady state operation of the plant.
- Disturbance to the plant is incorporated by splitting the transfer function



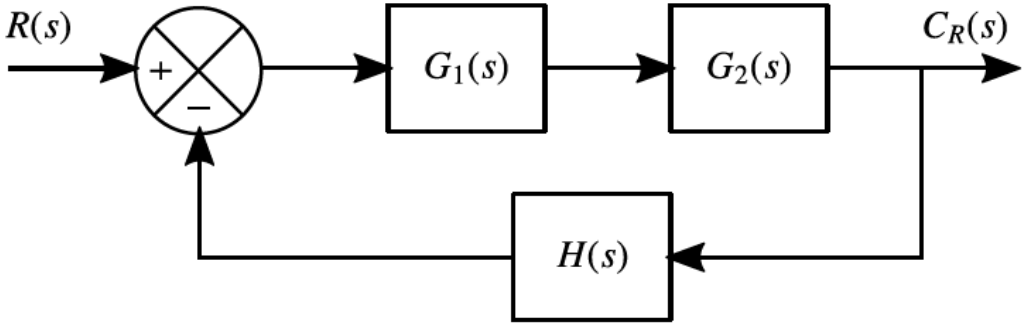
Closed-Loop Control System Subjected to a Disturbance cont.

- Response to inputs and disturbances can be evaluated individually

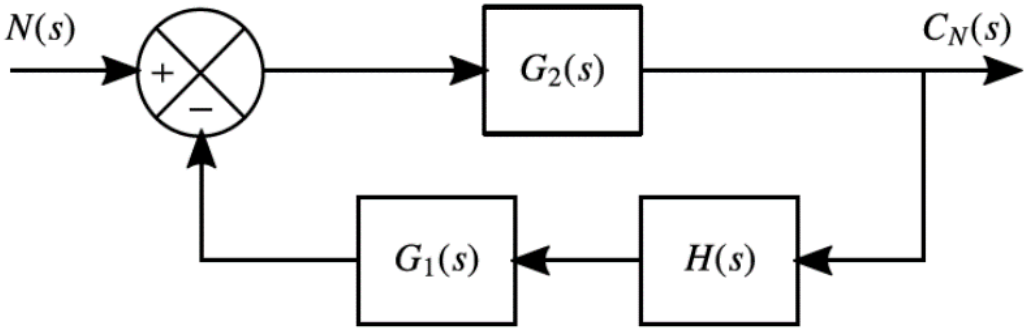


C/L Control System Subjected to a Disturbance cont.

- No external disturbance



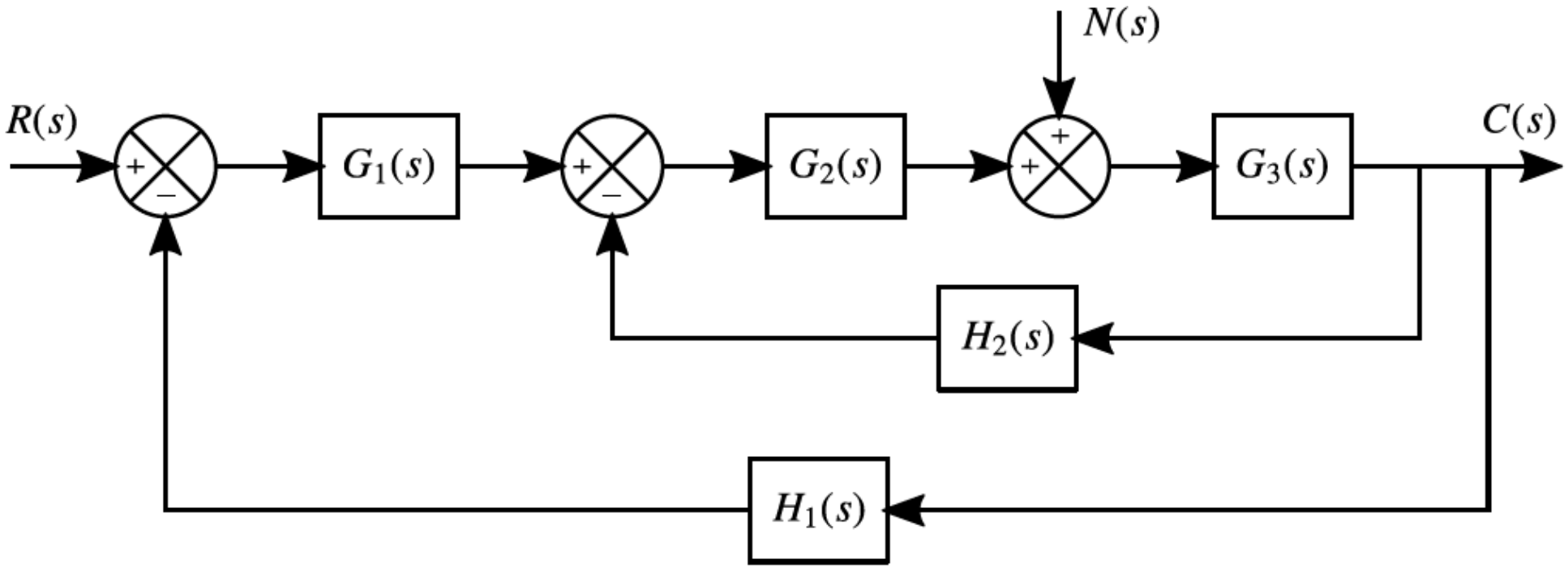
- No reference input



C/L System Subjected to a Disturbance cont.

- Overall transfer function: $C(s) = C_R(s) + C_N(s)$

Exercise - Derive the overall transfer function



Summary

- Apply Block Diagram Rules to Derive Overall Transfer Function
- Overall Transfer Function of Control Systems Subjected to Disturbances

Reference:

-Control Systems Engineering, 7th Edition, N.S. Nise
-UESTC3001 2019/20 Notes, J. Le Kernec