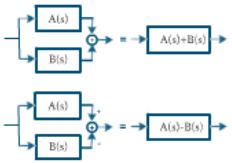
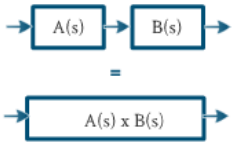
Block Diagram Manipulation and Reduction

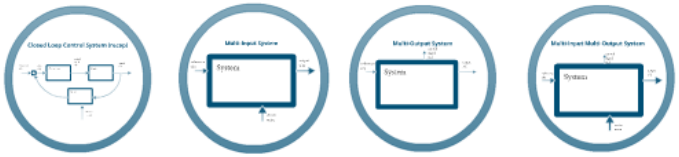
Parallel Connections



Series Connection



Equivalent Representations



Systems can have multiple inputs and multiple outputs
Linearity means that we can decouple the input-output pairs

ELEC 207 Part B

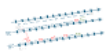
Control Theory Lecture 3: Control System Modelling (2)

Prof Simon Maskell
CHAD-G68
s.maskell@liverpool.ac.uk
0151 794 4573

UNIVERSITY OF LIVERPOOL

This lecture covers:

- Single-input single-output and multi-input multi-output systems
- Components and the underpinning mathematics of block diagrams
- Block diagram manipulation and reduction
- Closed-loop transfer function of a negative feedback system



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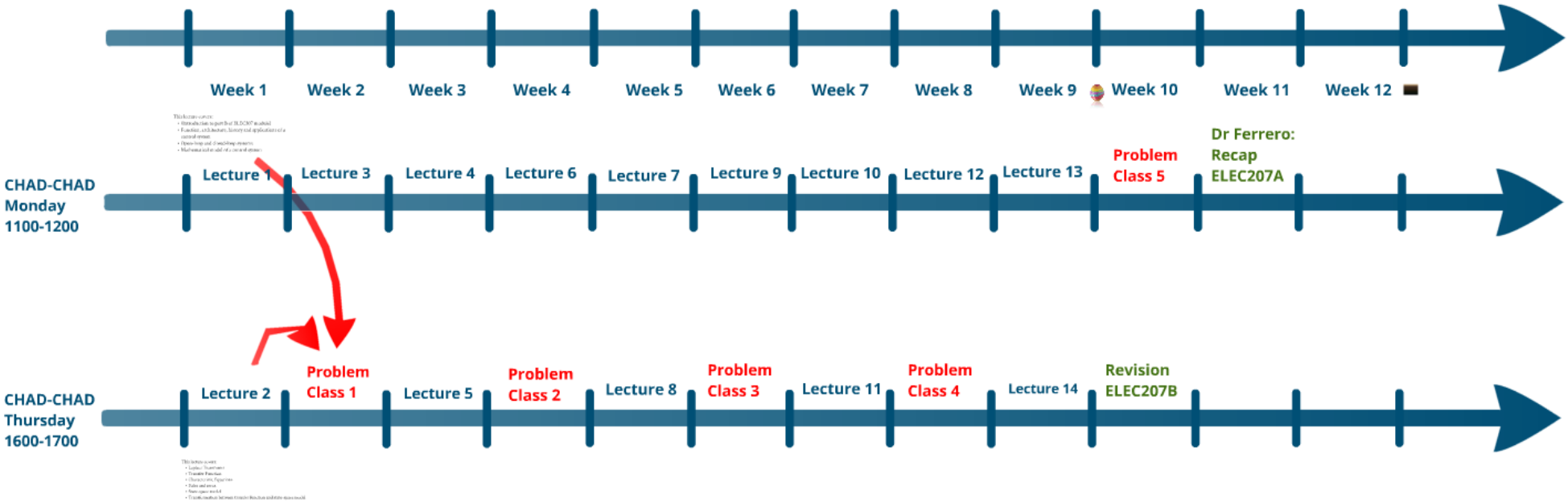

Week 1
Week 2
Week 3
Week 4
Week 5
Week 6
Week 7
Week 8
Week 9
Week 10
Week 11
Week 12
CHAD-CHAD
Monday
1100-1200
Lecture 1
Lecture 3
Lecture 4
Lecture 6
Lecture 7
Lecture 9
Lecture 10
Lecture 12
Lecture 13
Problem
Class 5
Dr Ferrero:
Recap
ELEC207A
CHAD-CHAD
Thursday
1600-1700
Lecture 2
Problem
Class 1
Lecture 5
Problem
Class 2
Lecture 8
Problem
Class 3
Lecture 11
Problem
Class 4
Lecture 14
Revision
ELEC207B

This lecture covers:

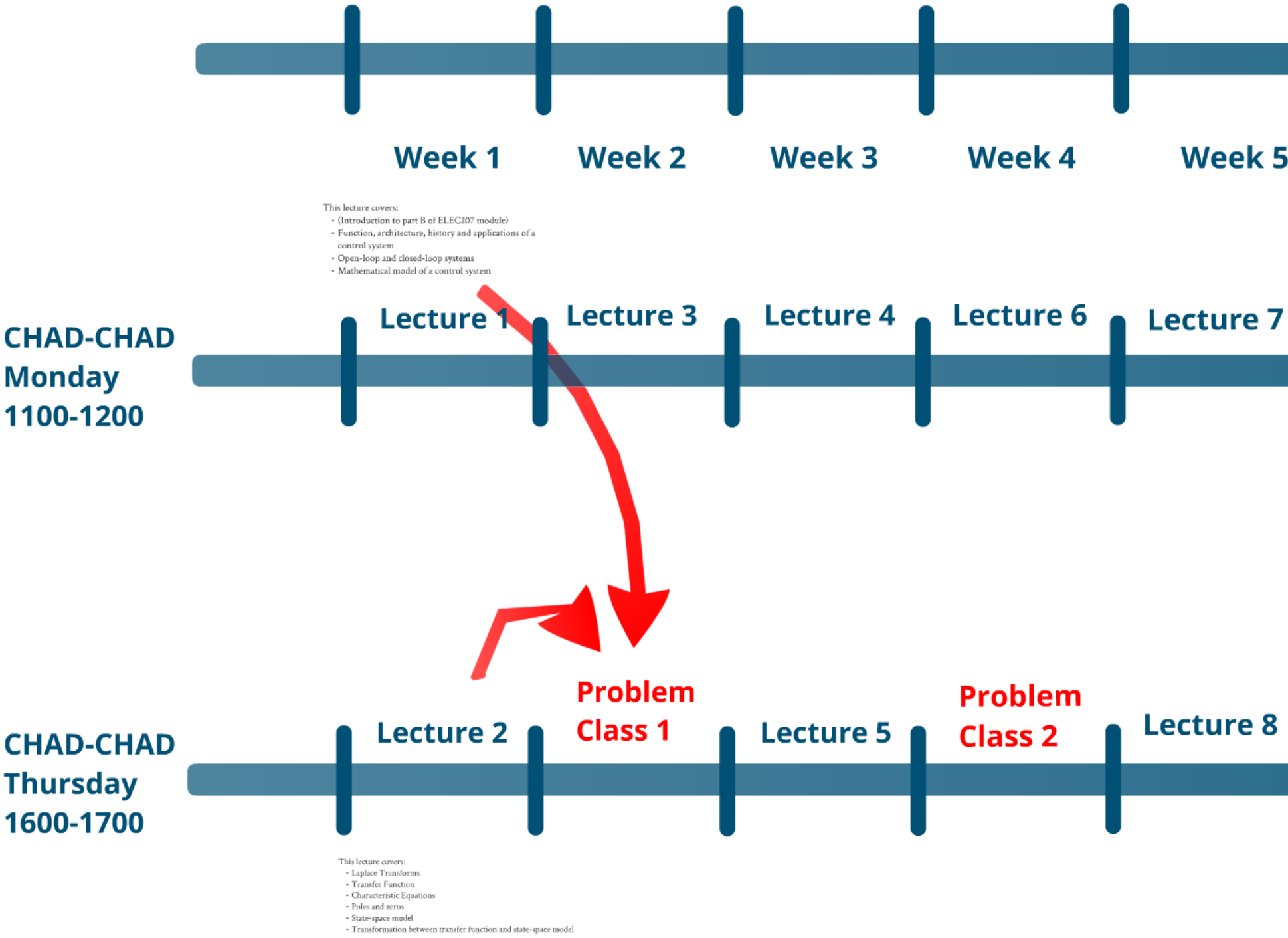
- (Introduction to part B of ELEC207 module)
- Function, architecture, history and applications of a control system
- Open-loop and closed-loop systems
- Mathematical model of a control system

Lecture 2

Proble
Class

This lecture covers:

- Laplace Transforms
- Transfer Function
- Characteristic Equations
- Poles and zeros
- State-space model
- Transformation between transfer function and state-space model


Week 1
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Lecture 1
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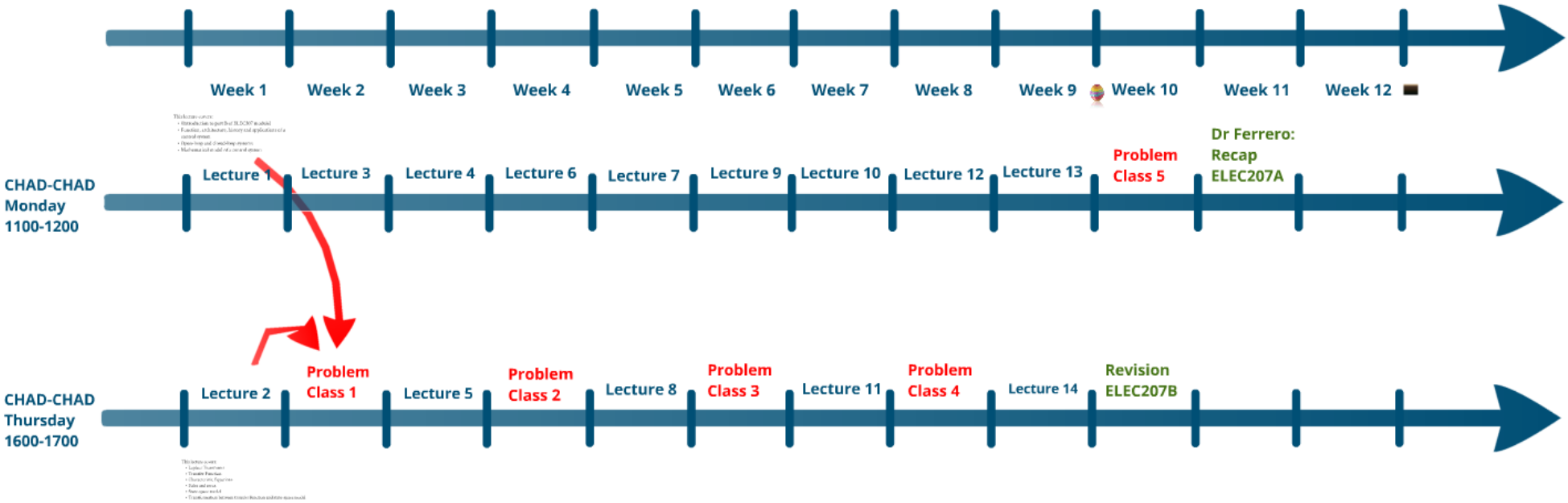
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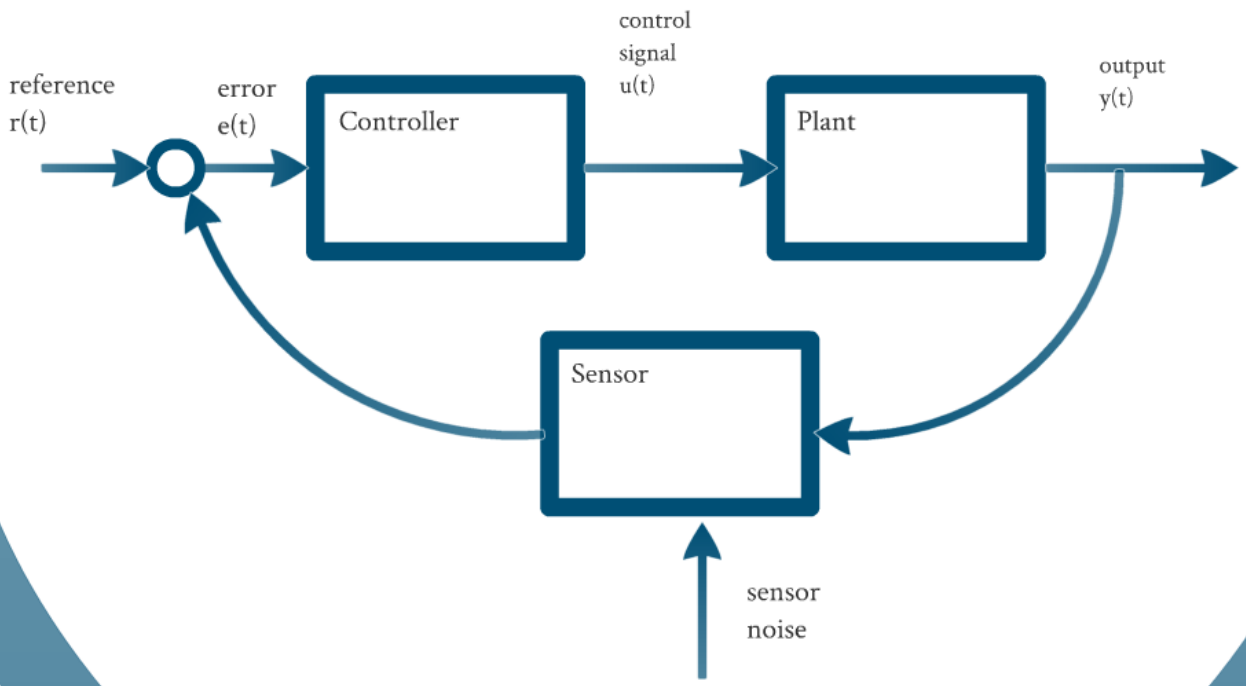
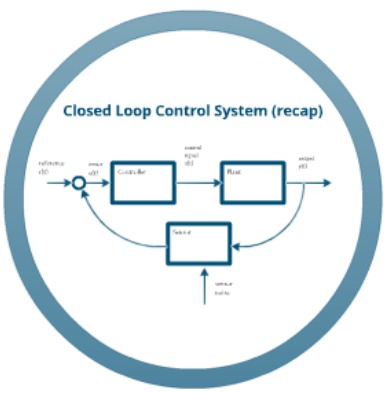
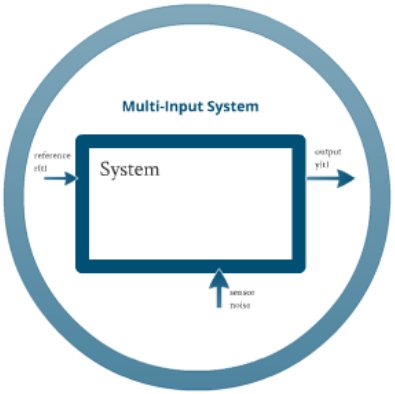
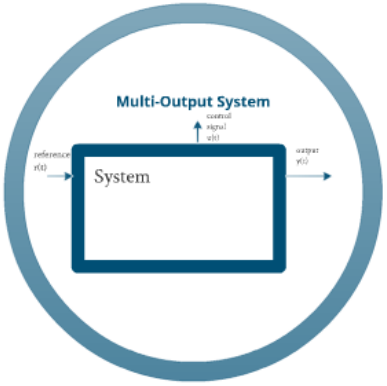
Closed Loop Control System (recap)

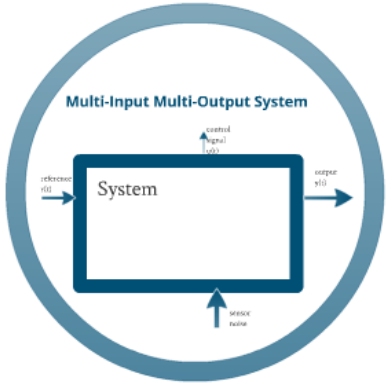


Equivalent Representations









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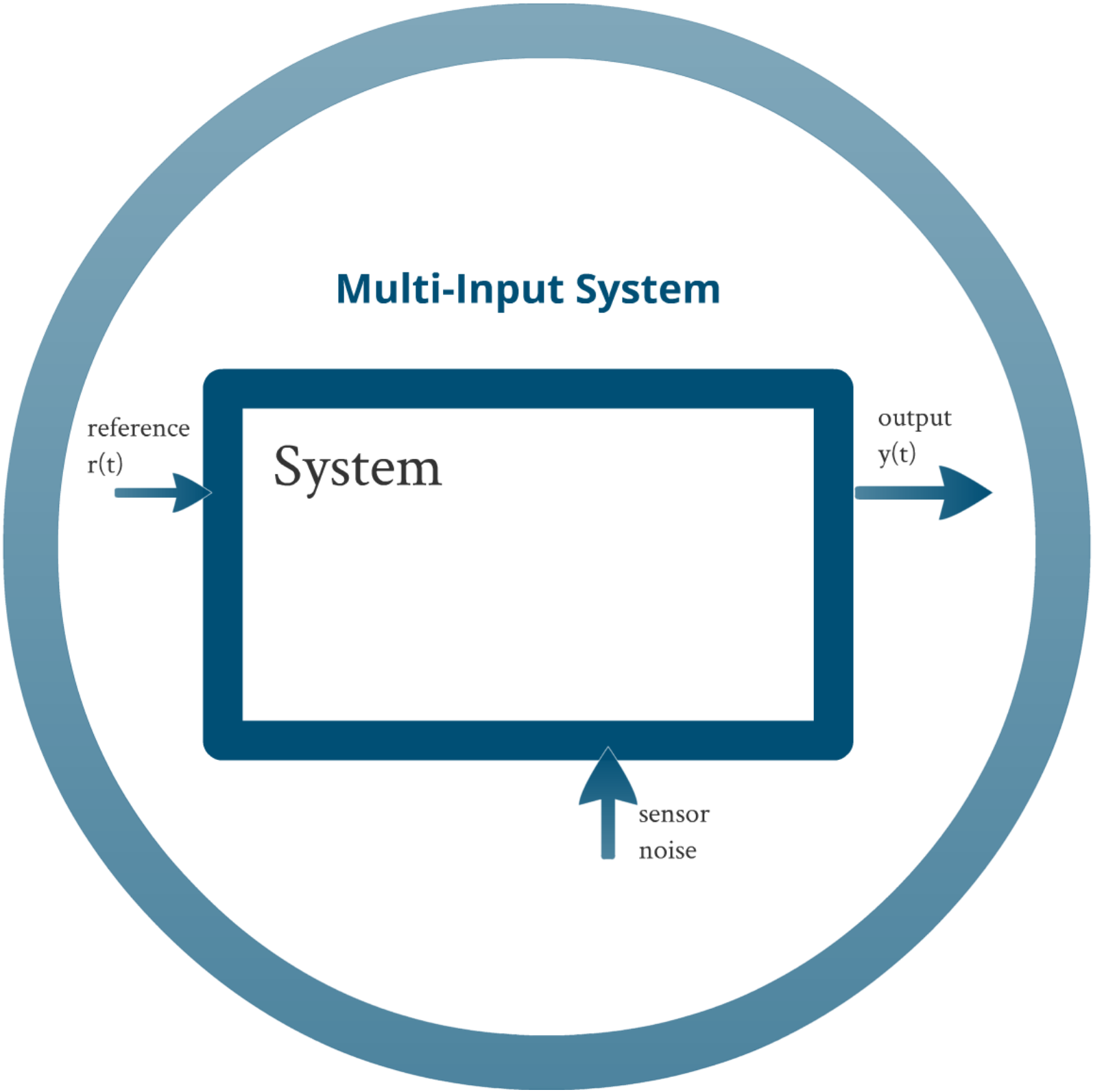
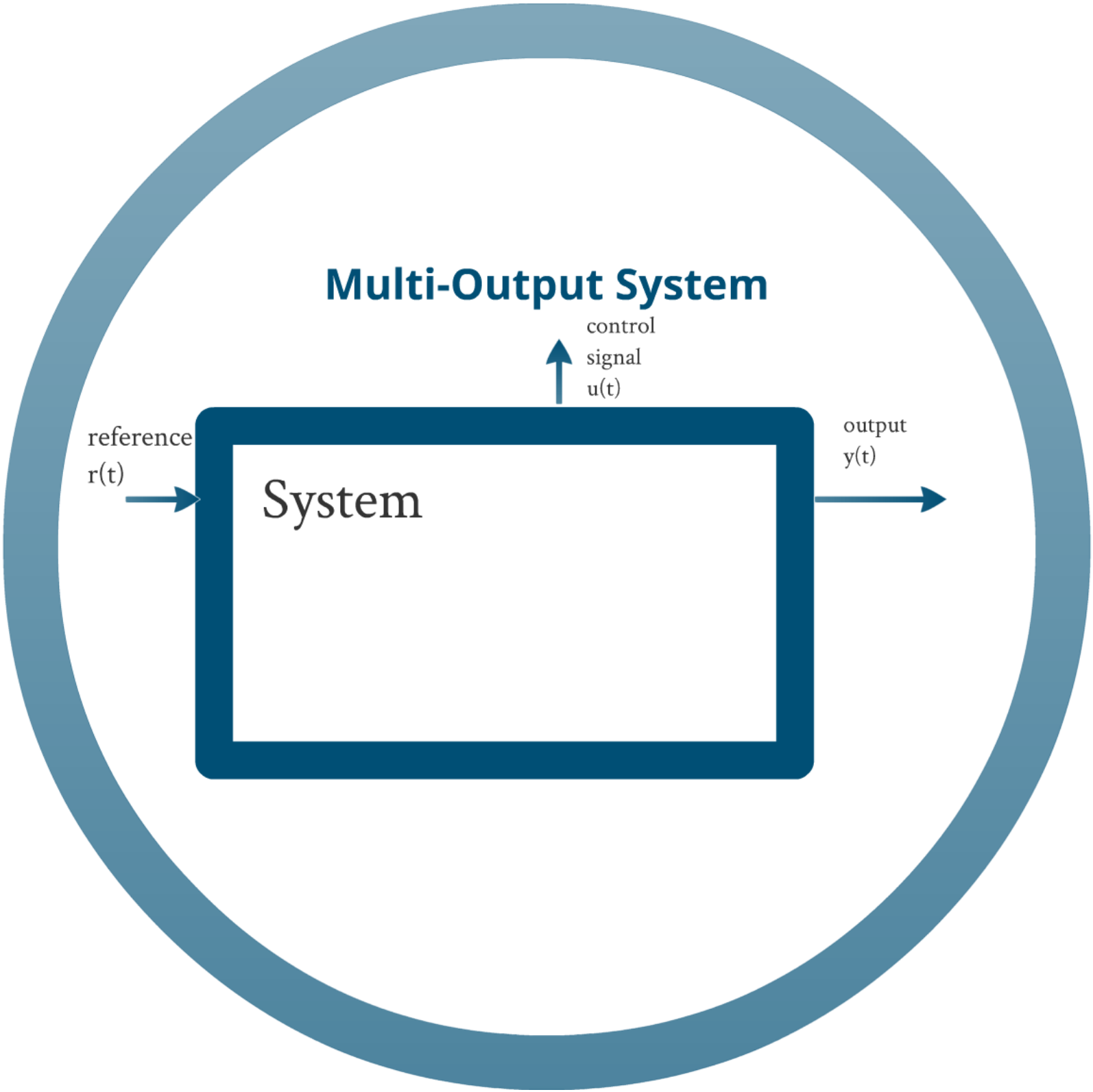
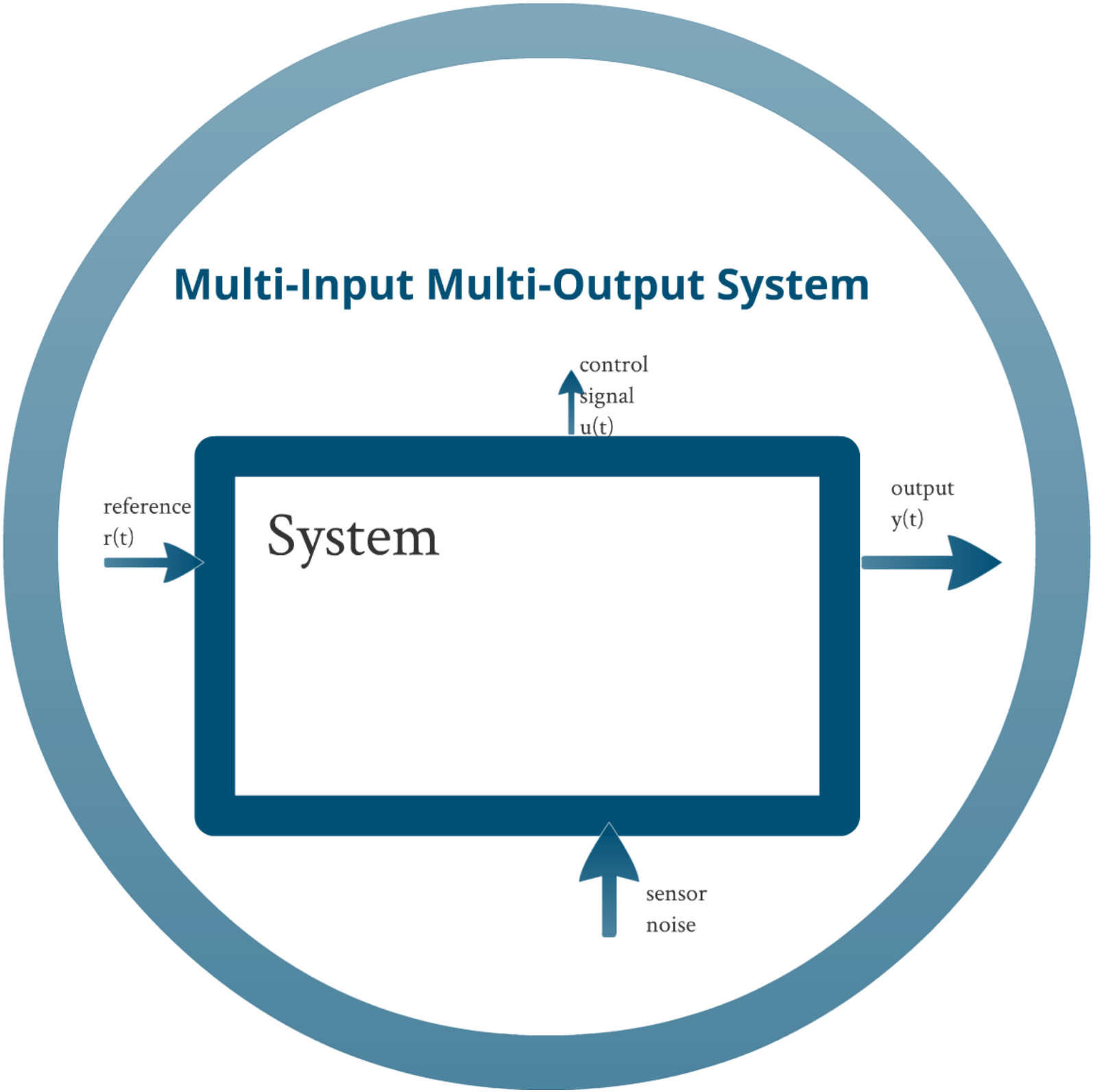

Multi-Input System
reference
r(t)
System
output
y(t)
sensor
noise


Multi-Output System
control
signal
u(t)
reference
r(t)
System
output
y(t)


Multi-Input Multi-Output System
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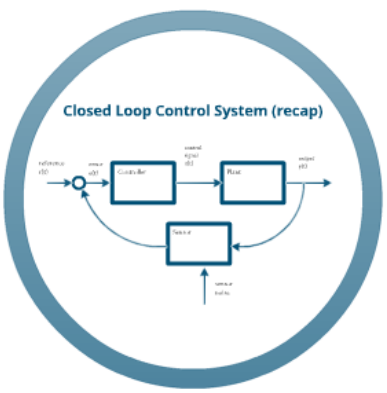

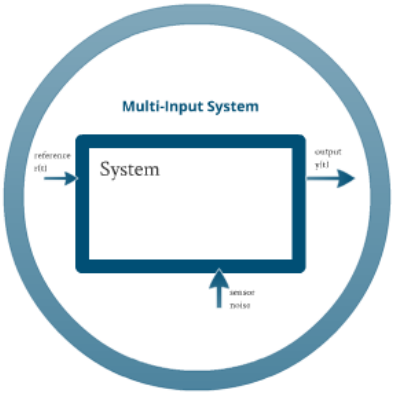

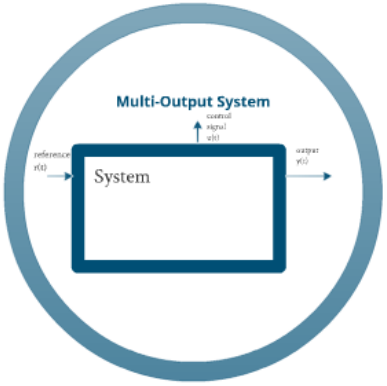

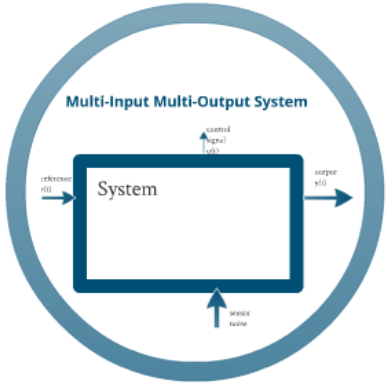

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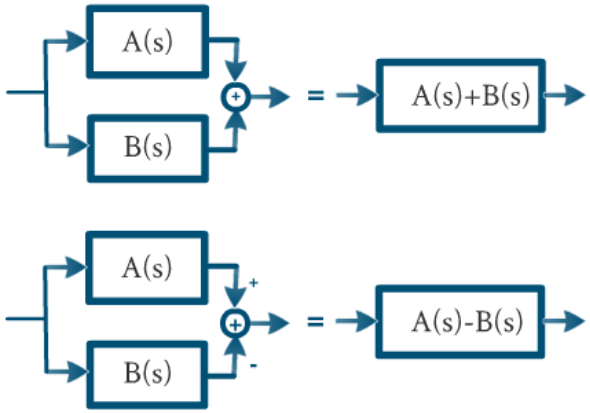
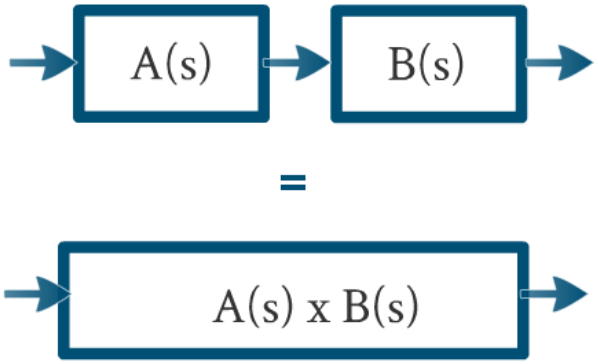
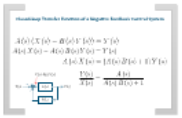
Block Diagram Manipulation and Reduction

Parallel Connections



Series Connection





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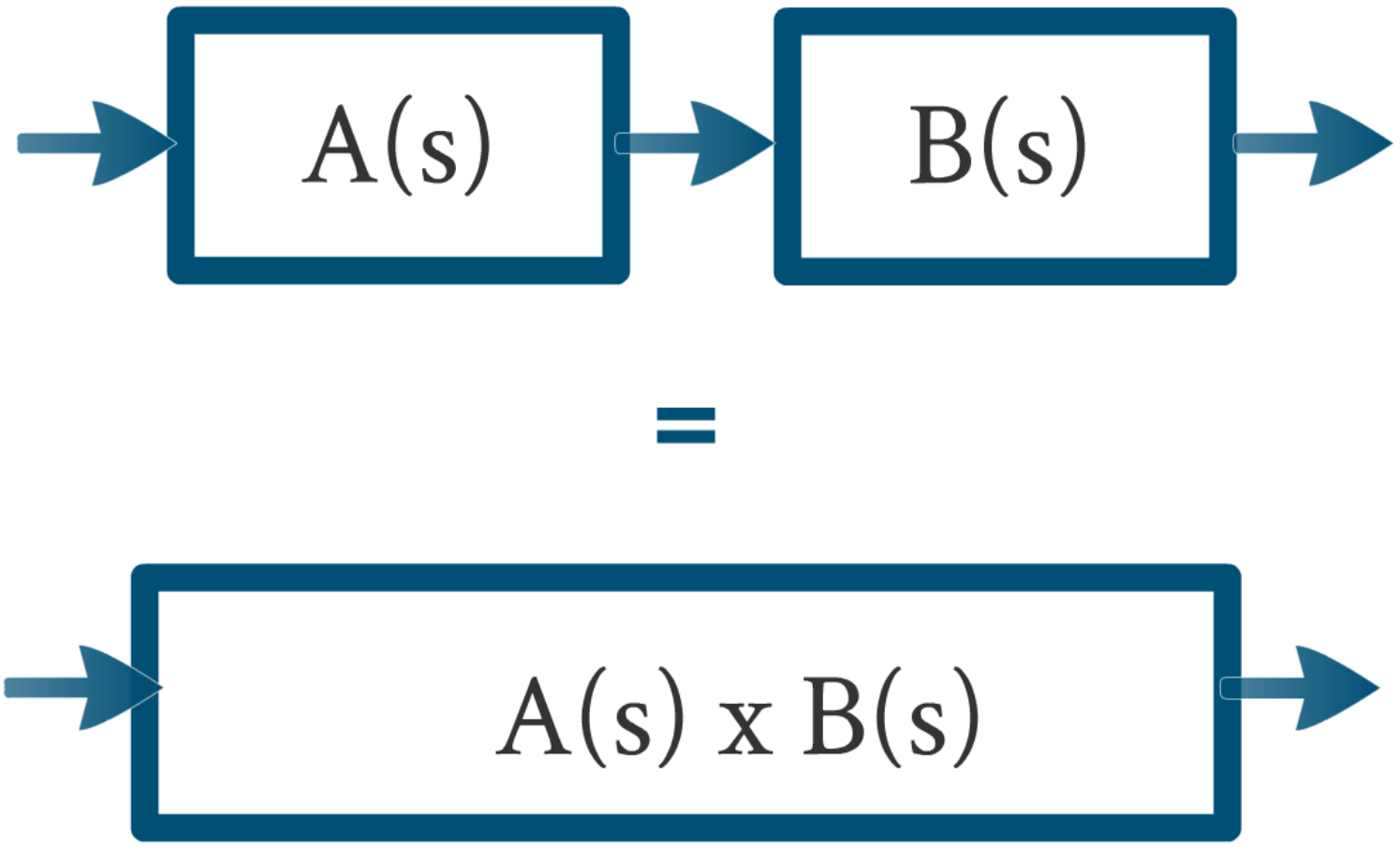

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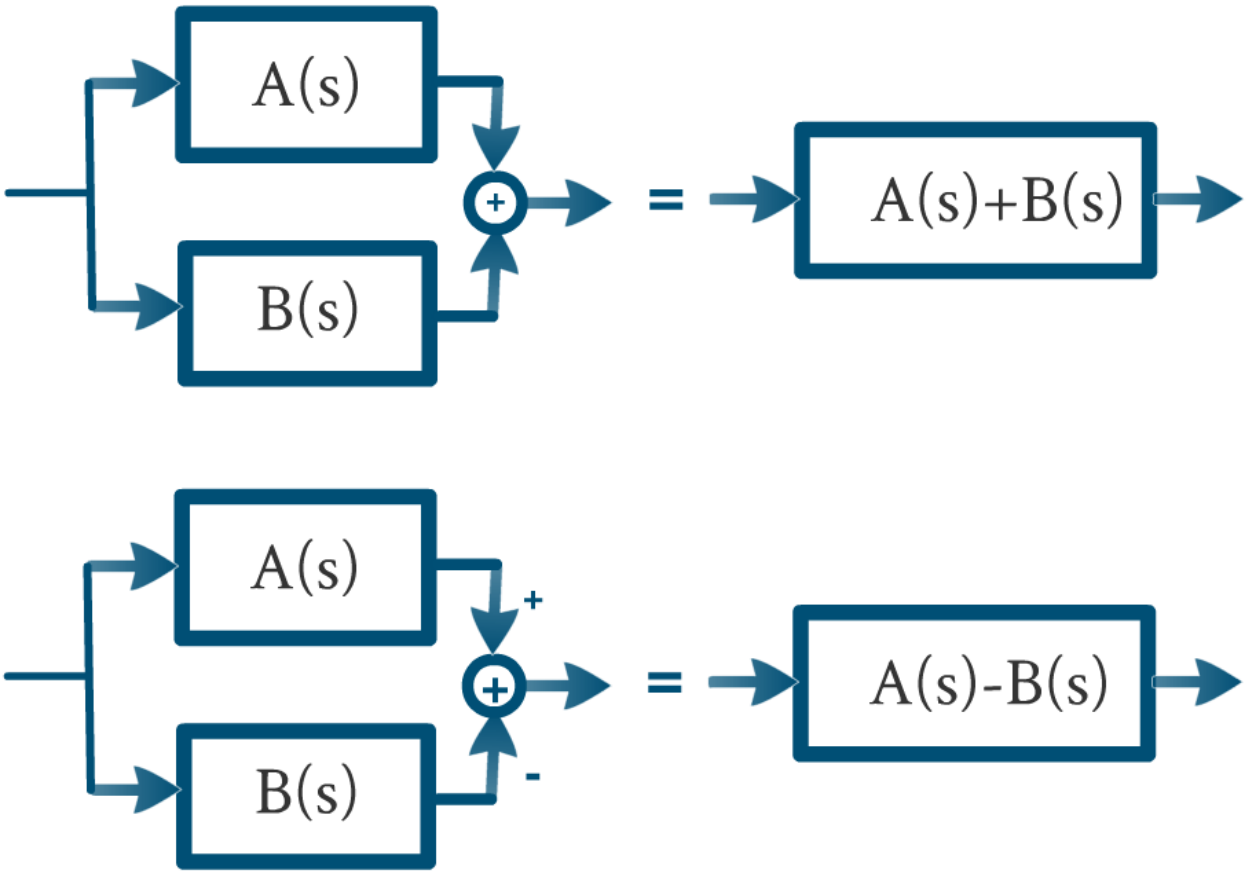

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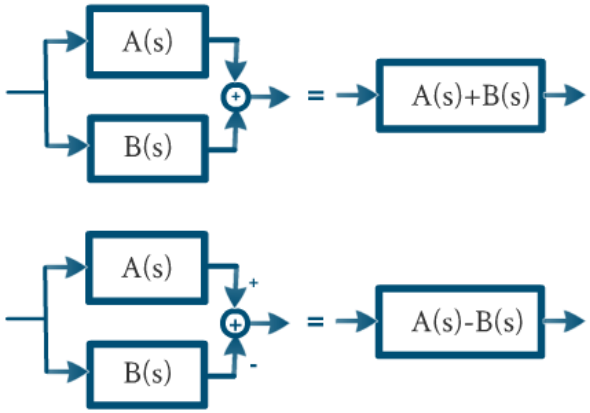

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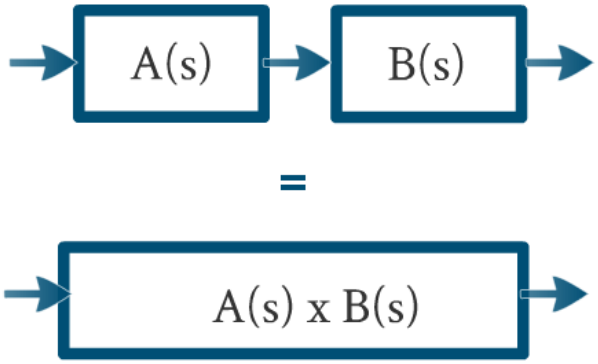
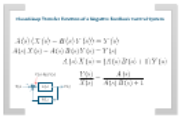
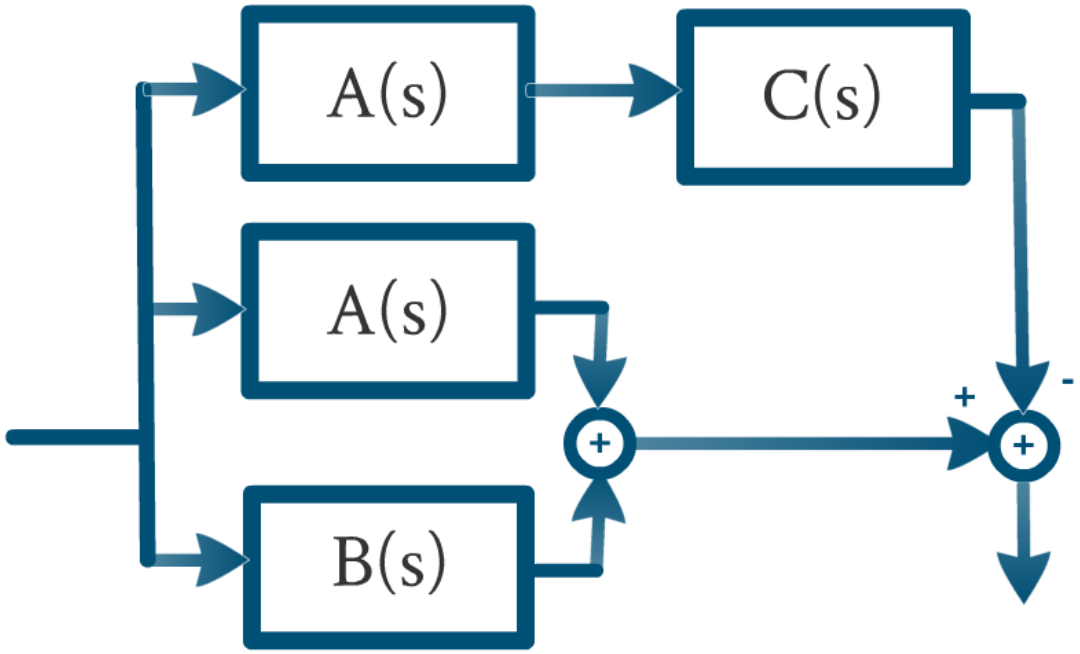




Example



$$A(s)+B(s)-(A(s)\ x\ C(s))$$

Block Diagram Manipulation and Reduction

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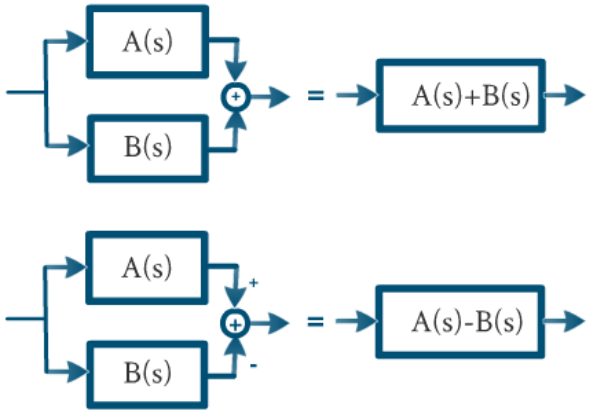

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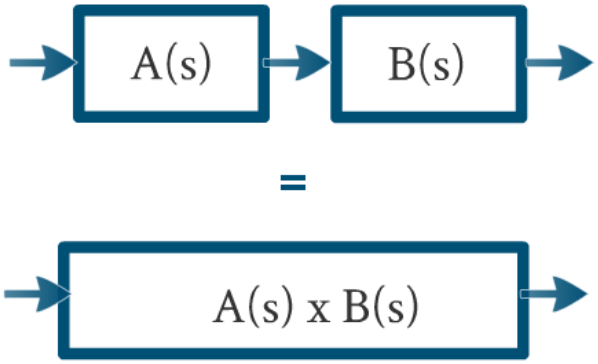
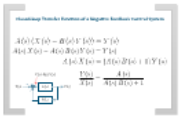


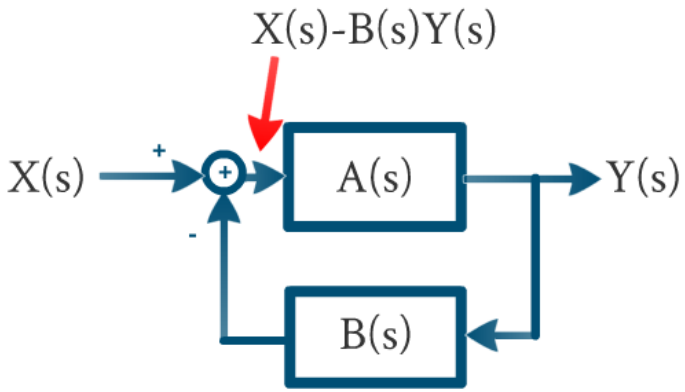


Closed-loop Transfer Function of a Negative Feedback Control System

$$A(s)\left(X(s)-B(s)Y(s)\right)=Y(s)$$

$$A(s)X(s)-A(s)B(s)Y(s)=Y(s)$$

$$A(s)X(s)=\left(A(s)B(s)+1\right)Y(s)$$



$$\frac{Y(s)}{X(s)}=\frac{A(s)}{A(s)B(s)+1}$$

Block Diagram Manipulation and Reduction

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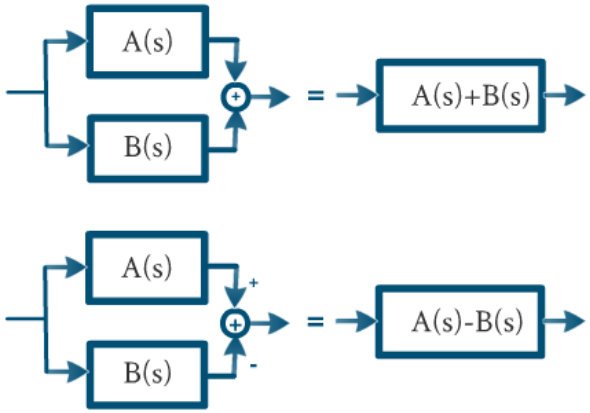

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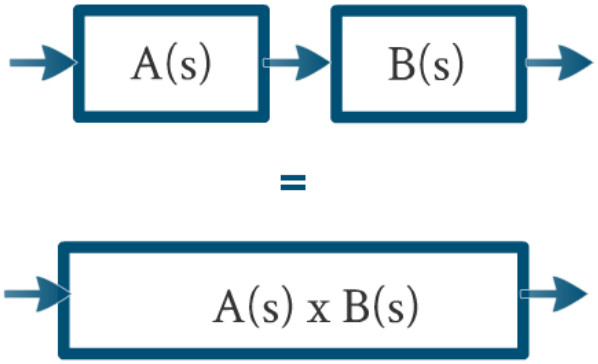

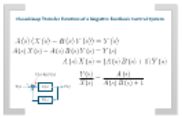

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