UNIT *10*

IMPLEMENTATION OF THE SYSTEM IN

Z DOMAIN

PhD. Nguyễn Hồng Quang

Assoc Prof. Trịnh Văn Loan

PhD. Đoàn Phong Tùng
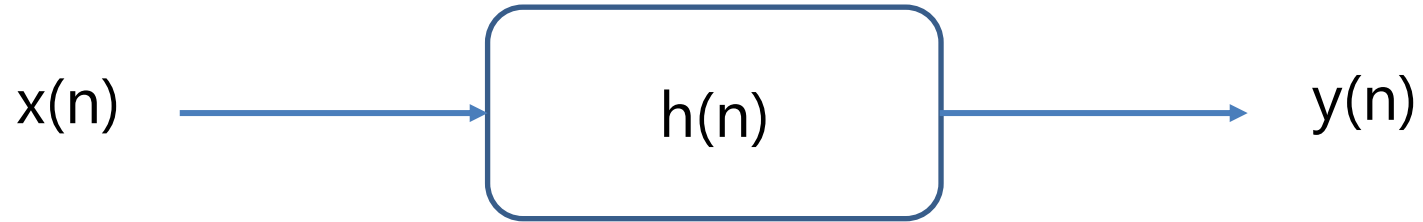
Department of Computer Engineering

❑ Contents

1. Series connection of two systems in Z domain

2. Parallel connecting of two systems in Z domain

3. Feedback connection of systems in Z domain

❑ **Objectives learning**

Sau khi học xong bài này, các em sẽ nắm được những vấn đề sau:

- ▪ Methods for implementation of the system in Z domain

- ▪ Determine transfer function of composite systems formed by connecting components in series, in parallel and in feedback
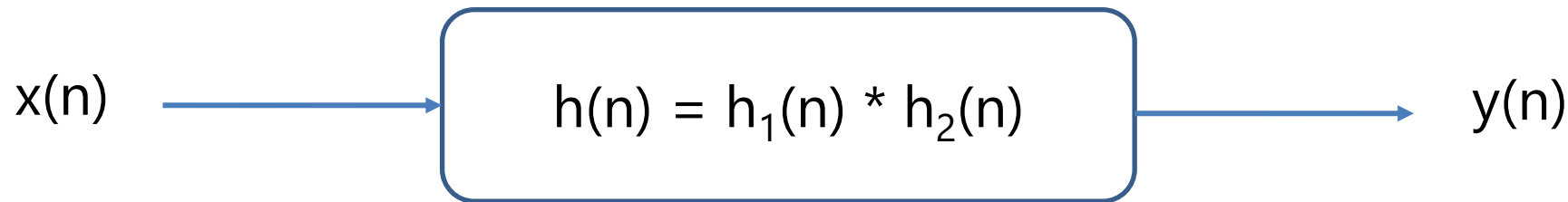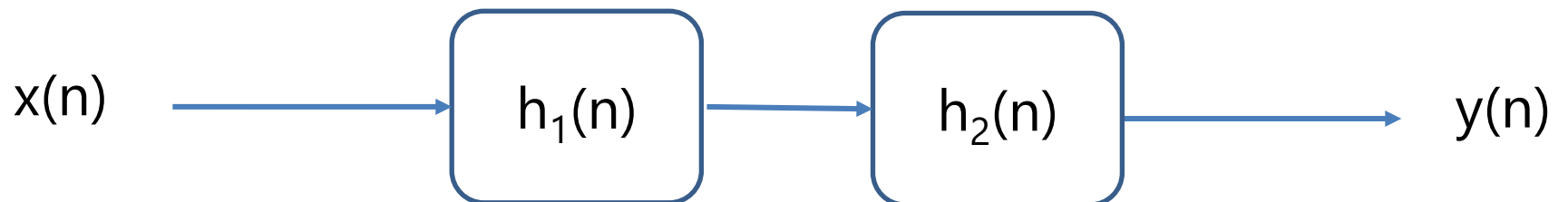
1. Transfer function

$$x(n) \longrightarrow \boxed{h(n)} \longrightarrow y(n)$$

$$y(n) = x(n) * h(n) \rightarrow Y(z) = X(Z).H(Z)$$
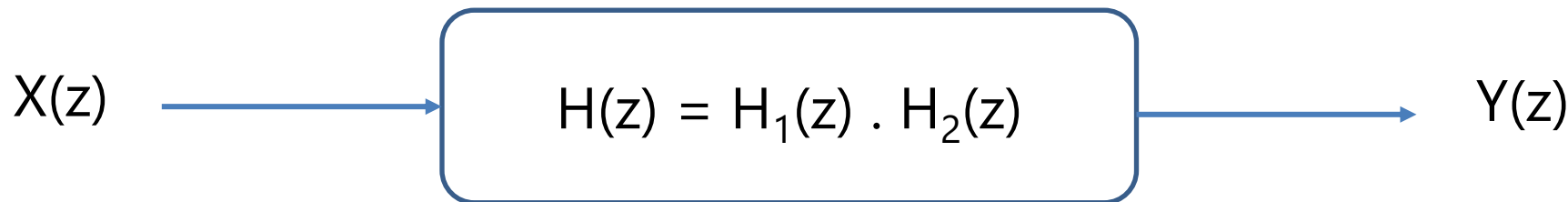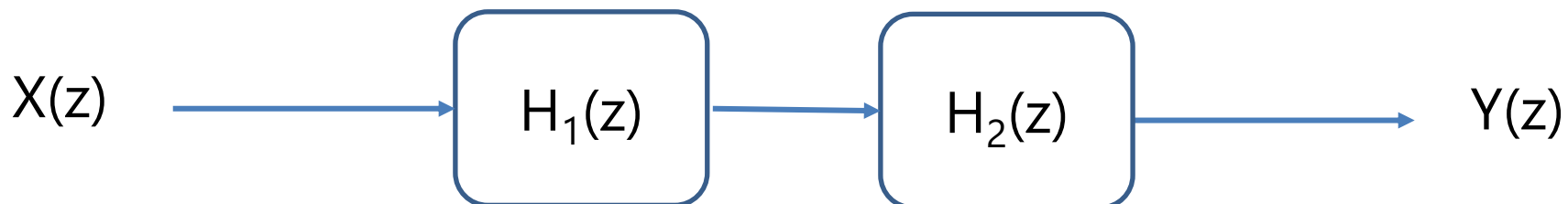
- $H(z)$: Transfer function

$$H(z) = \frac{Y(z)}{X(z)}$$

2. Series connection of two systems in Z domain

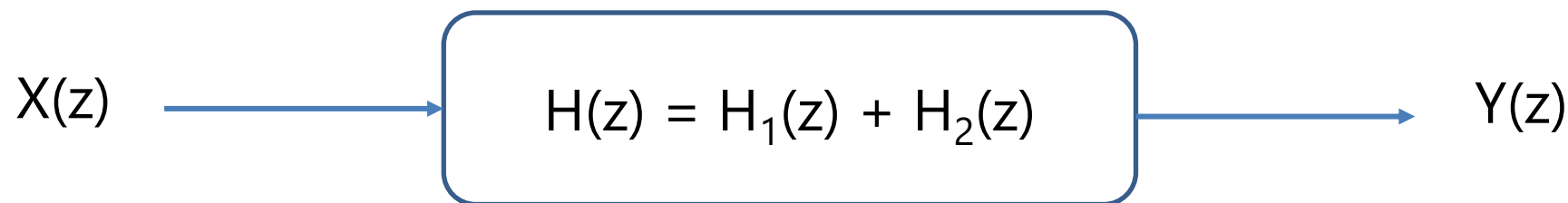- Series connection of two systems in the time domain

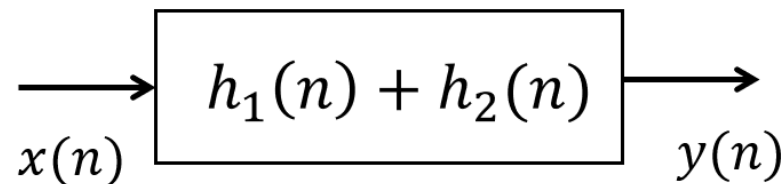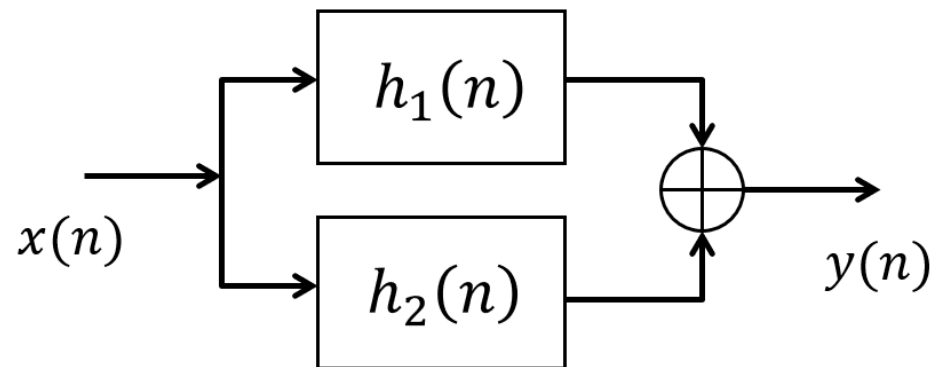- Taking the Z-transform of the two component systems:

$x(n) \longrightarrow \boxed{h_1(n)} \longrightarrow \boxed{h_2(n)} \longrightarrow y(n)$

$x(n) \longrightarrow \boxed{h(n) = h_1(n) * h_2(n)} \longrightarrow y(n)$

$X(z) \longrightarrow \boxed{H_1(z)} \longrightarrow \boxed{H_2(z)} \longrightarrow Y(z)$

$X(z) \longrightarrow \boxed{H(z) = H_1(z) \cdot H_2(z)} \longrightarrow Y(z)$
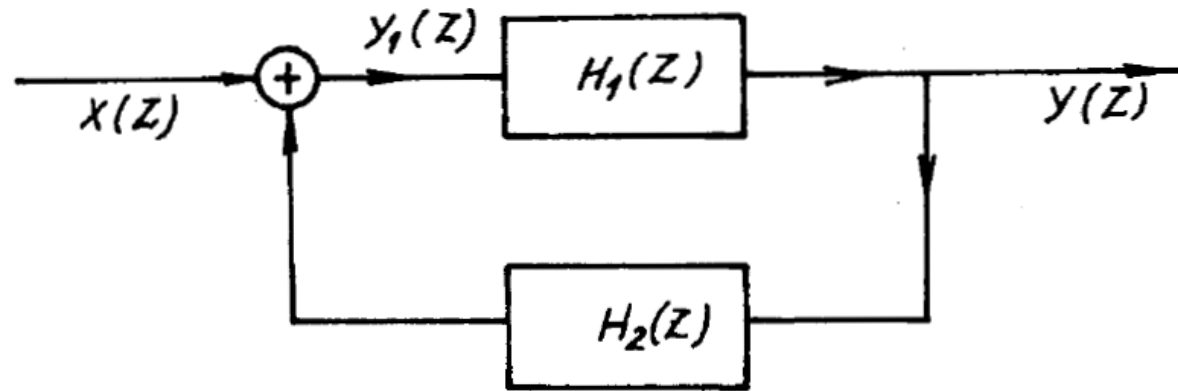
3. Parallel connection of two systems in Z domain

- Parallel connection of two systems in the time domain

- Taking the Z-transform of the two component systems:

$X(z)$ → $H(z) = H_1(z) + H_2(z)$ → $Y(z)$

3. Feedback connection of two systems in Z domain

- We have: $Y(z) = Y_1(z) . H_1(z)$

  $Y_1(z) = X(z) + Y(z). H_2(z) \implies Y(z) = (X(z) + Y(z). H_2(z)). H_1(z)$

  $\implies Y(z) (1 - H_1(z).H_2(z)) = X(z).H_1(z)$

 $$\implies H(z) = \frac{Y(z)}{X(z)} = \frac{H_1(z)}{1 - H_1(z).H_2(x)}$$

4. Summary

- The transfer function of composite systems formed by connecting component systems in series, in parallel, and in feedback can be determined by performing elementary operations on the transfer functions of the component systems..

- This facilitates the analysis of the components of the Z-domain system
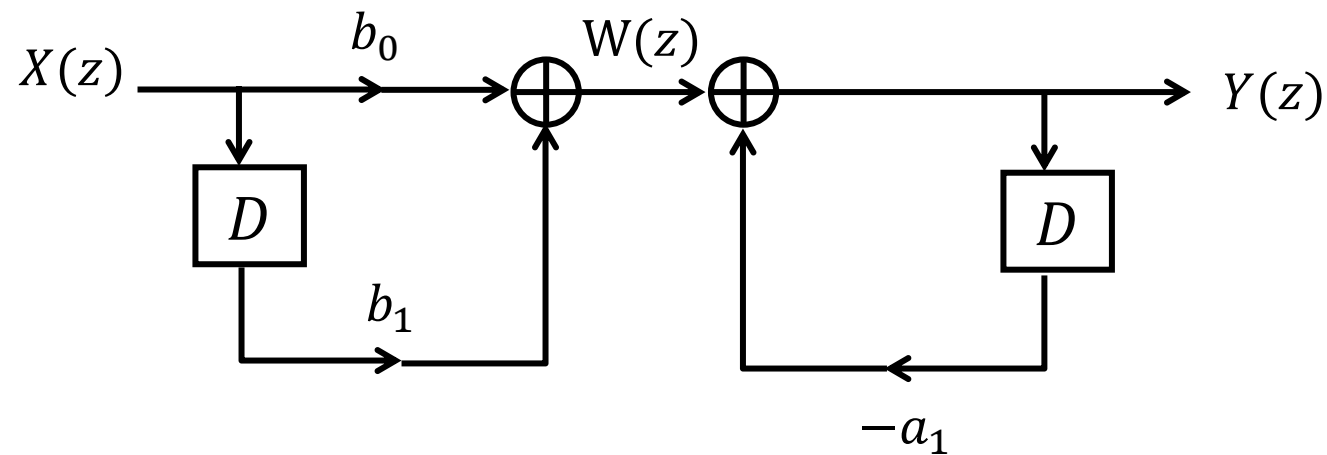
5. Assignment

- Exercise 1

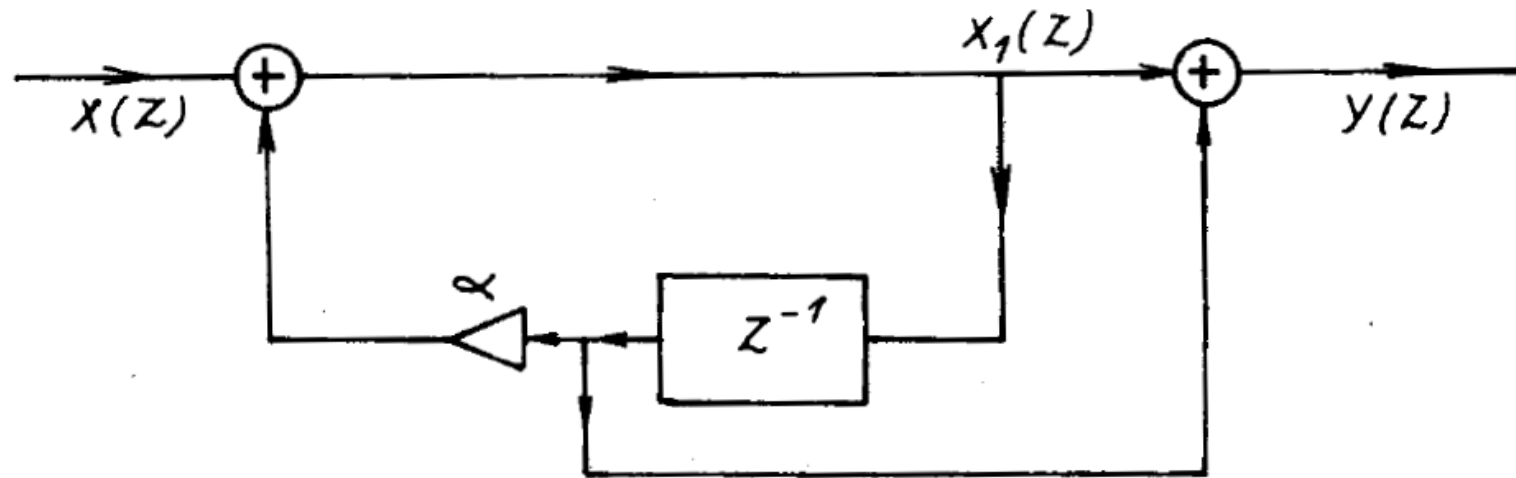 ❑ Determine transfer function H(Z) of the following system:
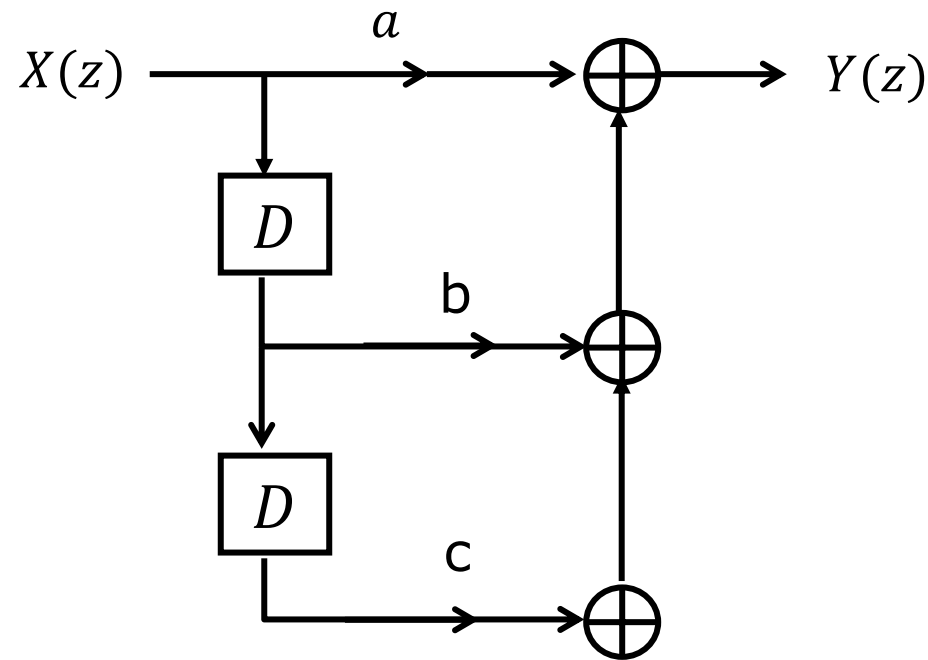
5. Assignment

● Exercise 2

❑ Determine transfer function H(Z) of the following system:

5. Assignment

- Exercise 3

  ❑ Determine transfer function H(Z) and impulse response h(n) of the following system:

The next unit **11**

TRANSFER FUNCTION

References:
- *Nguyễn Quốc Trung (2008), Xử lý tín hiệu và lọc số, Tập 1, Nhà xuất bản Khoa học và Kỹ thuật, Chương 1 Tín hiệu và hệ thống rời rạc.*
- *J.G. Proakis, D.G. Manolakis (2007), Digital Signal Processing, Principles, Algorithms, and Applications, 4th Ed, Prentice Hall, Chapter 1 Introduction.*

SCHOOL OF INFORMATION AND COMMUNICATION TECHNOLOGY

Wishing you all the best in your studies!