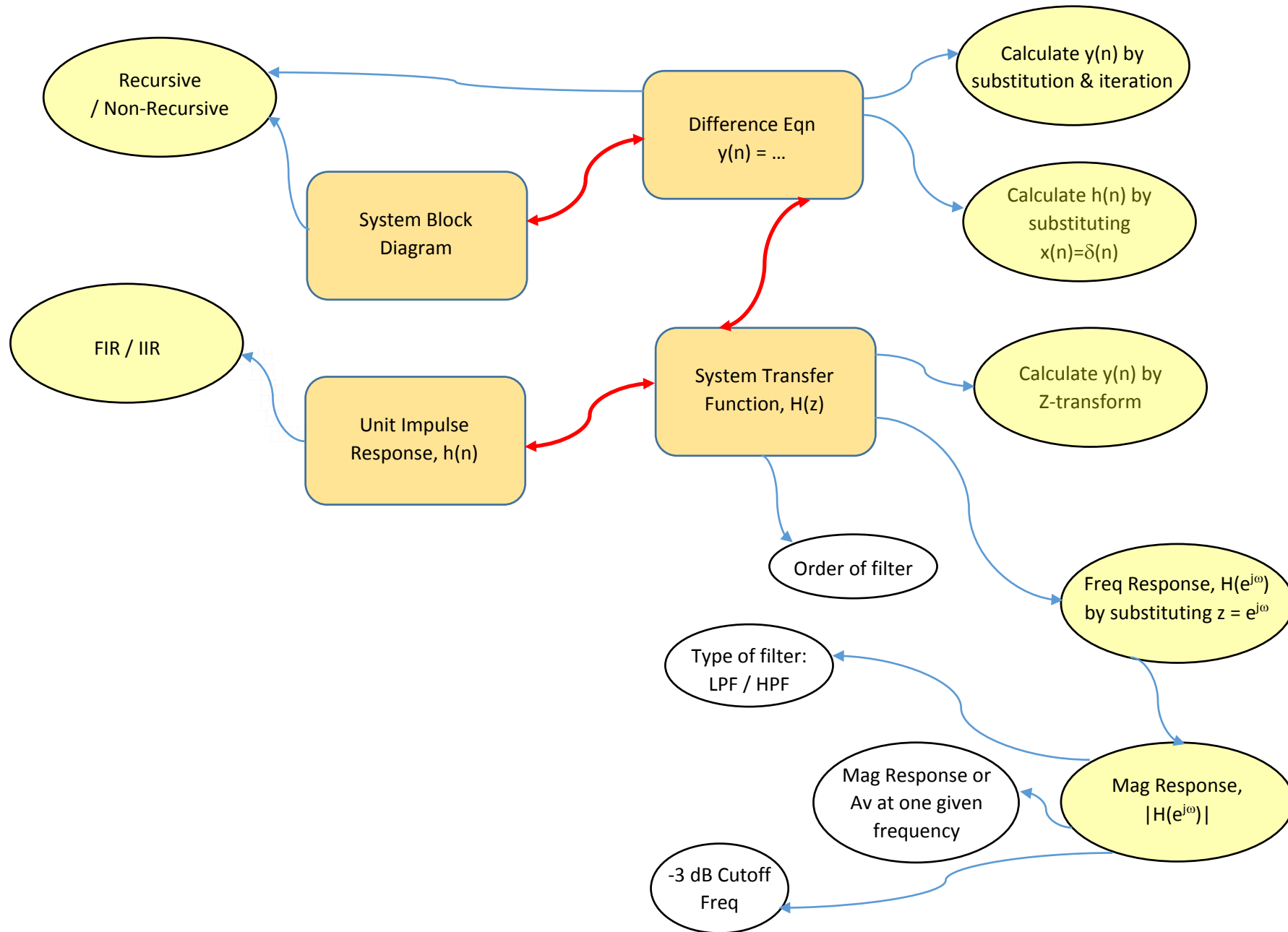


Mind Map of Overall Picture



Briefing

{A briefing video about using this interactive document}

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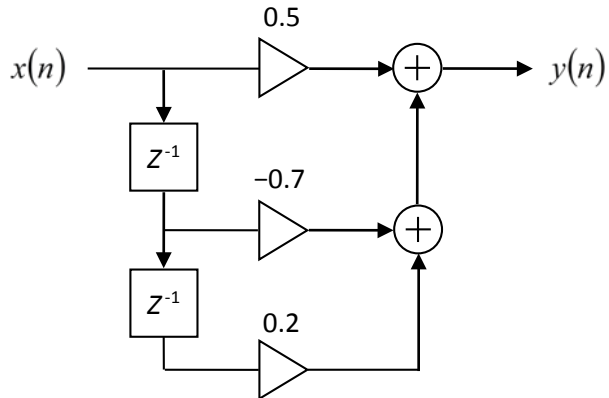
1 System Block Diagram \leftrightarrow Difference Equation

1.1 System Block Diagram \rightarrow Difference Equation

1.1.1 Worked Example

Example 1

What is the difference equation of the system?

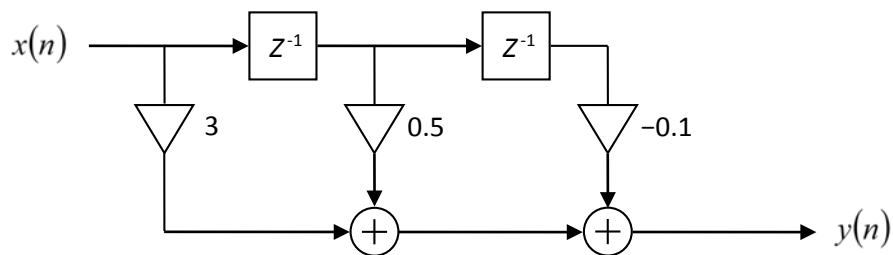


Solution

$$y(n) = 0.5x(n) - 0.7x(n - 1) + 0.2x(n - 2) \quad \text{Explanation}$$

Example 2

What is the difference equation of the system?

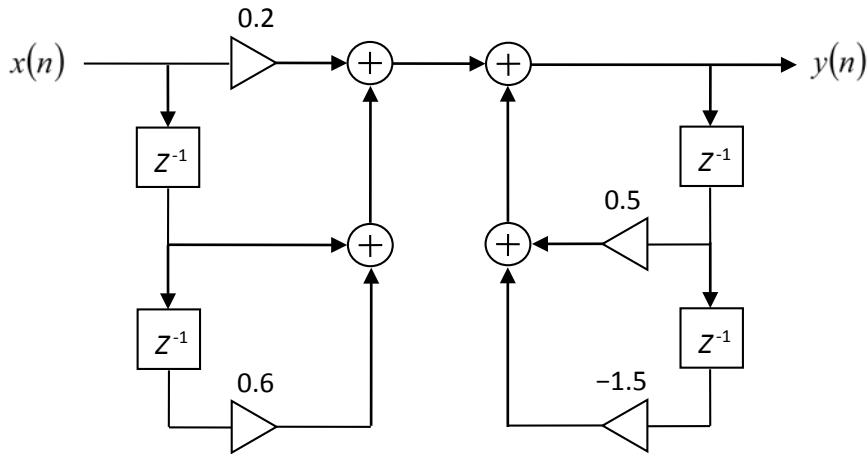


Solution

$$y(n) = 3x(n) + 0.5x(n - 1) - 0.1x(n - 2) \quad \text{Explanation}$$

Example 3

Derive the difference equation of the system.

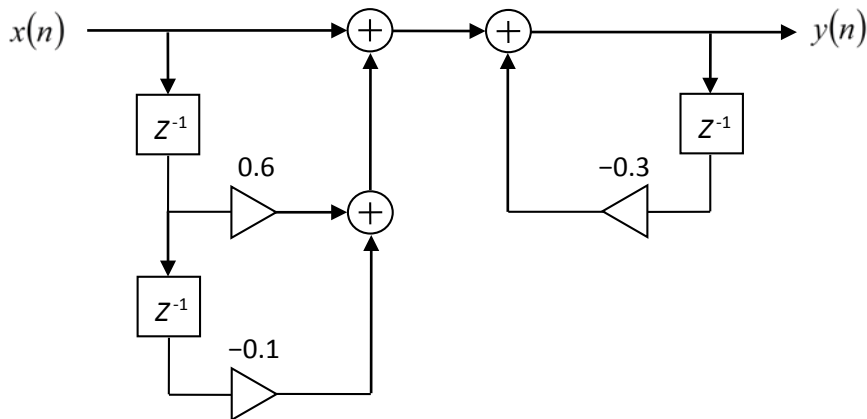


Solution

$y(n) = 0.2x(n) + x(n - 1) + 0.6x(n - 2) + 0.5y(n - 1) - 1.5y(n - 2)$ Explanation

Example 4

What is the difference equation of the system?

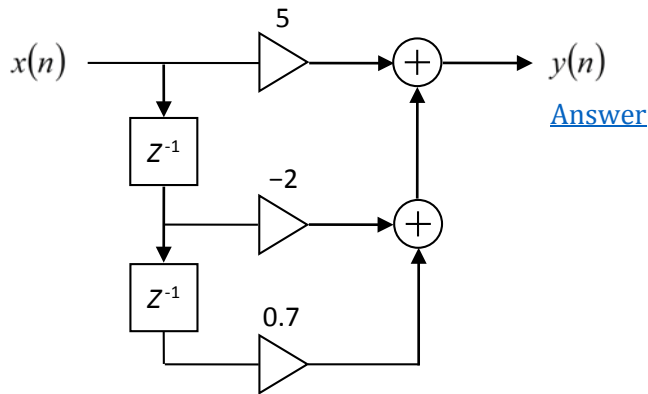


Solution

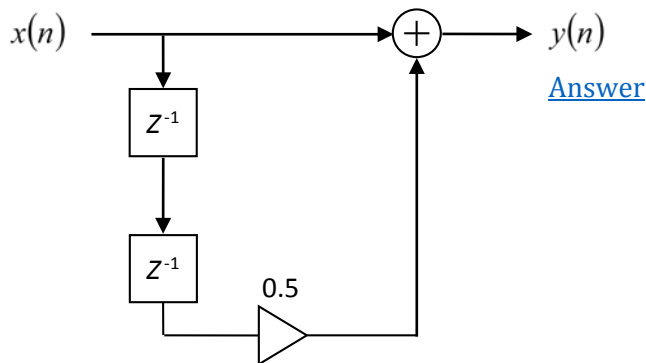
$y(n) = x(n) + 0.6x(n - 1) - 0.1x(n - 2) - 0.3y(n - 1)$ Explanation

1.1.2 Problem

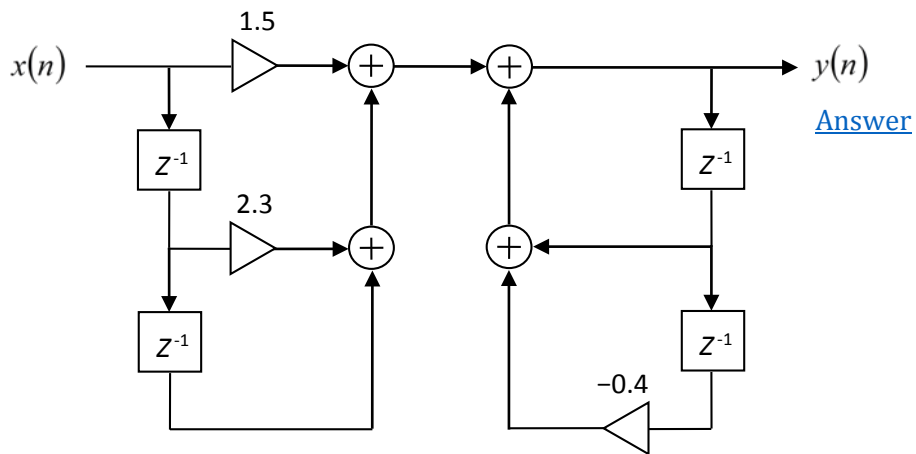
P1. Derive the difference equation of the system.



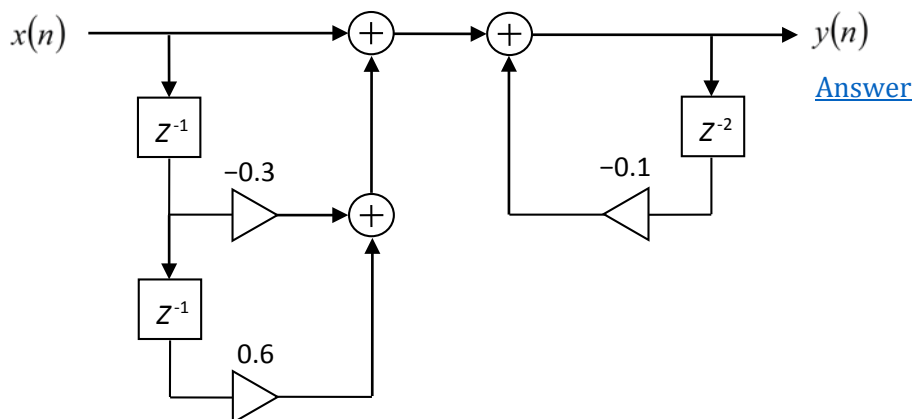
P2. What is the difference equation of the system below?



P3. What is the difference equation of the system below?



P4. What is the difference equation of the system below?



1.1.3 Related Past Examination Question

15/16 s2 B5, 15/16 s1 B5, 14/15 s1 B6, 13/14 s2 B5, 12/13 s2 B5, 10/11 s2 B6

1.2 System Block Diagram ← Difference Equation

1.2.1 Worked Example

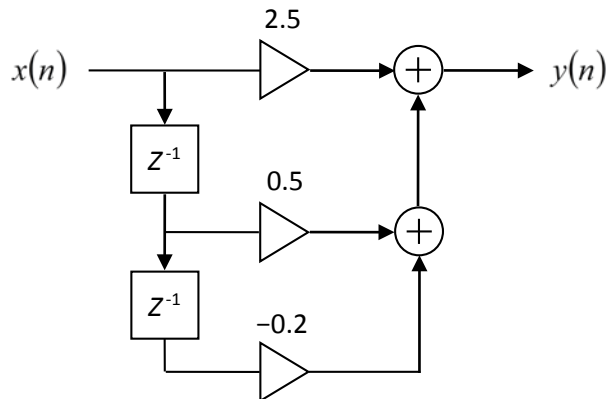
Example 1

The difference equation of a discrete-time system is

$$y(n] = 2.5x[n] + 0.5x[n - 1] - 0.2x[n - 2]$$

Draw the system block diagram of the system.

Solution



Explanation

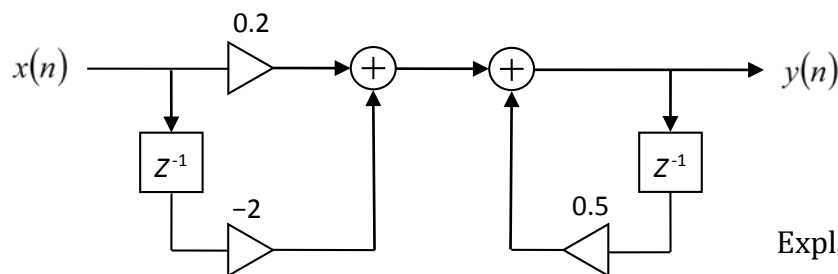
Example 2

The difference equation of a discrete-time system is

$$y[n] = 0.2x[n] - 2x[n - 1] + 0.5y[n - 1]$$

Draw the system block diagram of the system.

Solution



Explanation

1.2.2 Problem

P1. The difference equation of a system of a system is

$$y(n] = 0.5x(n) - 0.7x(n - 1) + 0.2x(n - 2)$$

Draw the system block diagram of the system. [Answer](#)

P2. The difference equation of a system of a system is

$$y(n] = 0.2x(n) + 0.6x(n - 1) + 0.5y(n - 1) - 1.5y(n - 2)$$

Draw the system block diagram of the system. [Answer](#)

P3. The difference equation of a system of a system is

$$y(n] = x(n) + 0.5x(n - 1) - 1.2y(n - 1)$$

Draw the system block diagram of the system. [Answer](#)

1.2.3 Related Past Examination Question

08/09 s2 B3, 07/08 s2 B3

1.3 Answer

1.3.1 Answer of Section 1.1.2

[Go back to Problem](#)

P1. $y(n] = 5x(n) - 2x(n - 1) + 0.7x(n - 2)$

P2. $y(n] = x(n) + 0.5x(n - 2)$

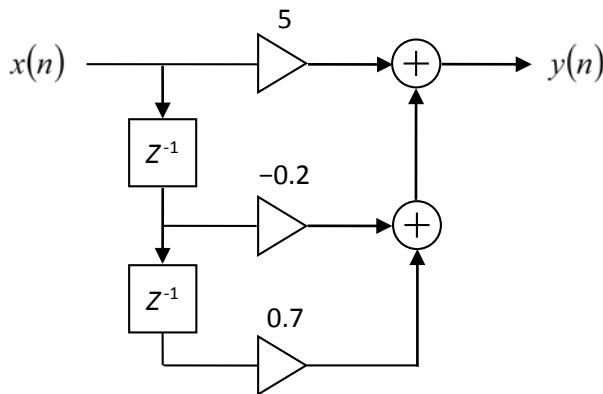
P3. $y(n] = 1.5x(n) + 2.3x(n - 1) + x(n - 2) + y(n - 1) - 0.4y(n - 2)$

P4. $y(n] = x(n) - 0.3x(n - 1) + 0.6x(n - 2) - 0.1y(n - 2)$

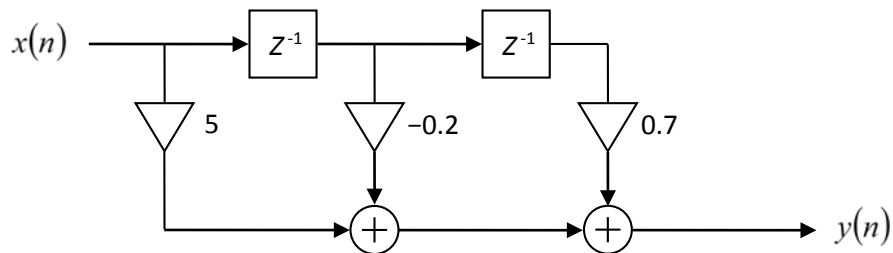
1.3.2 Answer of Section 1.2.2

[Go back to Problem](#)

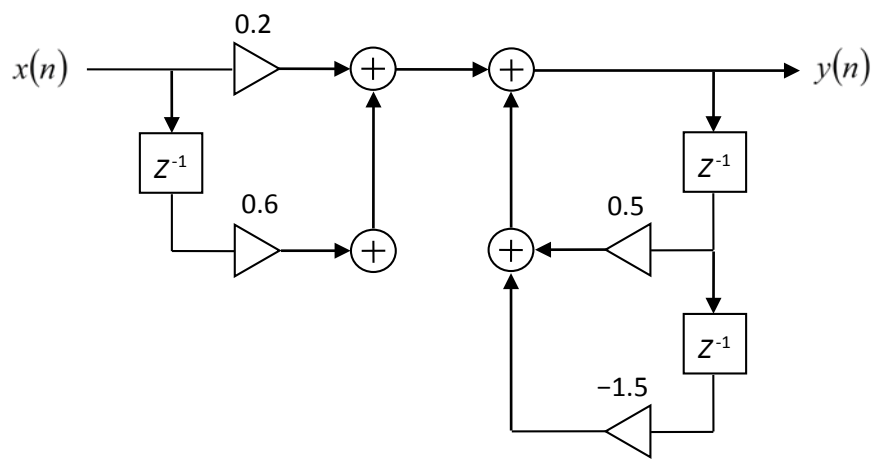
P1.



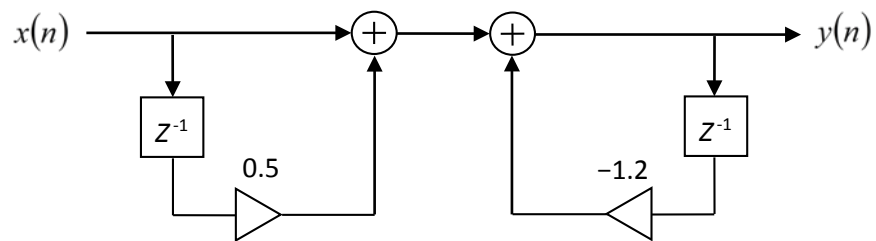
Alternative Answer



P2.



P3.



2 Difference Equation \leftrightarrow System Transfer Function, (z)

2.1 Difference Equation \rightarrow System Transfer Function, (z)

2.1.1 Worked Example

Example 1

The difference equation of a discrete-time system is

$$y(n) = 0.3x(n)$$

What is the system transform function of the system?

Solution

$$y(n) = 0.3x(n)$$

$$Y(z) = 0.3X(z)$$

$$H(z) = 0.3$$

Explanation

2.1.2 Problem

2.1.3 Related Past Examination Question

2.2 Difference Equation \leftarrow System Transfer Function, (z)

2.2.1 Worked Example

2.2.2 Problem

2.2.3 Related Past Examination Question

2.3 Answer

3 System Transfer Function, (z) \leftrightarrow Unit Impulse Response, $h(n)$

3.1 System Transfer Function, (z) \rightarrow Unit Impulse Response, $h(n)$

3.1.1 Worked Example

3.1.2 Problem

3.1.3 Related Past Examination Question

3.2 System Transfer Function, (z) \leftarrow Unit Impulse Response, $h(n)$

3.2.1 Worked Example

3.2.2 Problem

3.2.3 Related Past Examination Question

3.3 Answer

4 System Transfer Function, (z) \rightarrow Order of System

4.1 Worked Example

4.2 Problem

4.3 Related Past Examination Question

4.4 Answer

5 Unit Impulse Response, $h(n)$ \rightarrow FIR / IIR

5.1 Unit Impulse Response, $h(n)$ \rightarrow FIR

5.1.1 Worked Example

5.1.2 Problem

5.1.3 Related Past Examination Question

5.2 Unit Impulse Response, $h(n) \rightarrow$ IIR

5.2.1 Worked Example

5.2.2 Problem

5.2.3 Related Past Examination Question

5.3 Answer

6 Recursive / Non-Recursive System

6.1 System Block Diagram \rightarrow Non-Recursive System

6.1.1 Worked Example

6.1.2 Problem

6.1.3 Related Past Examination Question

6.2 System Block Diagram \rightarrow Recursive

6.2.1 Worked Example

6.2.2 Problem

6.2.3 Related Past Examination Question

6.3 Difference Equation \rightarrow Non-Recursive System

6.3.1 Worked Example

6.3.2 Problem

6.3.3 Related Past Examination Question

6.4 Difference Equation \rightarrow Recursive

6.4.1 Worked Example

6.4.2 Problem

6.4.3 Related Past Examination Question

6.5 Answer

7 Difference Equation \rightarrow Calculate $y(n)$ by substitution & iteration

7.1 Worked Example

7.2 Problem

7.3 Related Past Examination Question

7.4 Answer

8 Difference Equation \rightarrow Calculate $h(n)$ by substituting $x(n) = \delta(n)$

8.1 Worked Example

8.2 Problem

8.3 Related Past Examination Question

8.4 Answer

9 System Transfer Function, $(z) \rightarrow$ Calculate $y(n)$ by Z-transform

9.1 Worked Example

9.2 Problem

9.3 Related Past Examination Question

9.4 Answer

10 System Transfer Function, $(z) \rightarrow$ Frequency Response, $(e^{j\omega})$

10.1 Worked Example

10.2 Problem

10.3 Related Past Examination Question

10.4 Answer

11 Frequency Response, $(e^{j\omega}) \rightarrow$ Magnitude Response, $|(e^{j\omega})|$

11.1 Worked Example

11.2 Problem

11.3 Related Past Examination Question

11.4 Answer

12 Magnitude Response, $|(e^{j\omega})| \rightarrow$ Type of Filter (LPF/HPF)

12.1 Worked Example

12.2 Problem

12.3 Related Past Examination Question

12.4 Answer

13 Magnitude Response, $|(e^{j\omega})| \rightarrow$ Calculate Magnitude Response at a given frequency.

13.1 Worked Example

13.2 Problem

13.3 Related Past Examination Question

13.4 Answer

14 Magnitude Response, $|(e^{j\omega})| \rightarrow$ Calculate -3 dB Cutoff Frequency

14.1 Worked Example

14.2 Problem

14.3 Related Past Examination Question

14.4 Answer

15 Formula Sheet