BSM307
İşaretler ve Sistemler

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Ters z-Dönüşümü

İçerik

- Ters z-Dönüşümü
- z-Domeninde Sistem Analizi

Ters z-Dönüşümü

- $\mathcal{Z}^{-1}\{X(z)\} = x(n)$
- Residü Yöntemi
- Kuvvet Seri Açılımı
- Kısmi Kesirlere Ayırma

Residü Yöntemi

- Kutup
  - ♦ Fonksiyonun paydasını sıfır yapan değişken değeri
- Sıfır
  - ♦ Fonksiyonun payını sıfır yapan değişken değeri

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   - p_i’ ler tek katlı
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   - $\mathrm{Res}_j = \frac{1}{(k-1)!}\frac{\partial^{k-1}}{\partial z^{k-1}}\left.\left(\left(z-p_j\right)^k \frac{A(z)z^{n-1}}{\left(z-p_j\right)^k \prod_i (z-p_i)}\right)\right|_{z=p_j}$, p_j, k katlı

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5. $x(n) = \mathrm{Res}_j + \sum_i \mathrm{Res}_i$

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- $n = -2$ için $x(n) = x(-2) = \mathrm{Res}_a + \mathrm{Res}_0 = \frac{1}{a^2} - \frac{1}{a^2} = 0$
- $n < 0$ iken $x(n) = 0$

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- $X(z) = \frac{1}{1-az^{-1}}$ ise $x(n) = ?$
- $n \geq 0$ iken $x(n) = a^n$
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Kuvvet Seri Açılımı

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- Fonksiyon bölmesi $\begin{array}{l|l} A(z) & B(z) \\ \hline & C(z) \end{array}$
- YB' ye göre $C(z)$ bulunur.
  - YB: $|z| > |\alpha|$ ise $C(z)$, z^{-}' li terimlerden oluşmalı.
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- $C(z) = \sum_n x(n)\, z^{-n}$ şeklinde örüntü varsa
- Örüntü yoksa, terimlerin ayrı ayrı tersi alınır.

Örnek 2

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- $X(z) = \frac{1}{1-az^{-1}}$ ve YB: $|z| > |a|$ ise $x(n) =?$
- YB: $|z| > |a| \;\lesssim x(n)$ sağ taraflı
    - ♦ $X(z) = \sum_{n\geq 0} x(n)z^{-n} = \cdots + x(k)z^{-k} + \cdots$

Örnek 2

- $X(z) = \frac{1}{1-az^{-1}}$ ve YB: $|z| > |a|$ ise $x(n) =?$
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$$\begin{array}{l|l} 1 & 1 - az^{-1} \\ \hline & \end{array}$$

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$$
\begin{array}{l|l}
1 & 1 - az^{-1} \\ \cline{2-2}
1 - az^{-1} & 1 \\ \hline
az^{-1} &
\end{array}
$$

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$$
\begin{array}{l|l}
1 & 1 - az^{-1} \\ \cline{2-2}
1 - az^{-1} & 1 + az^{-1} \\ \cline{1-1}
az^{-1} & \\
az^{-1} - a^2z^{-2} & \\ \cline{1-1}
a^2z^{-2} &
\end{array}
$$

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1 & 1 - az^{-1} \\
\cline{2-2}
1 - az^{-1} & 1 + az^{-1} + a^2z^{-2} \\
\hline
az^{-1} & \\
az^{-1} - a^2z^{-2} & \\
\hline
a^2z^{-2} & \\
a^2z^{-2} - a^3z^{-3} & \\
\hline
a^3z^{-3} &
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a^2z^{-2} & \\
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a^3z^{-3} & \\
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az^{-1} & \\
az^{-1} - a^2z^{-2} & \\ \cline{1-1}
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az^{-1} - a^2 z^{-2} & \\ \cline{1-1}
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\vdots &
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az^{-1} & \\
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a^2z^{-2} & \\
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a^3z^{-3} & \\
\vdots &
\end{array}
$$

- $X(z) = 1 + az^{-1} + a^2z^{-2} + a^3z^{-3} + \cdots$
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\cline{1-1}
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- $x(n) = a^n u(n)$

Örnek 3

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$$1 \quad \big| \; \underline{-az^{-1} + 1}$$

Örnek 3

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$$\begin{array}{l|l}
1 & -az^{-1} + 1 \\ \cline{2-2}
1 - a^{-1}z & -a^{-1}z \\ \cline{1-1}
a^{-1}z &
\end{array}$$

Örnek 3

- $X(z) = \frac{1}{1-az^{-1}}$ ve YB: $|z| < |a|$ ise $x(n) =?$
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$$
\begin{array}{l|l}
1 & -az^{-1} + 1 \\ \cline{2-2}
1 - a^{-1}z & -a^{-1}z - a^{-2}z^{2} \\ \cline{1-1}
a^{-1}z & \\
a^{-1}z - a^{-2}z^{2} & \\ \cline{1-1}
a^{-2}z^{2} &
\end{array}
$$

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$$
\begin{array}{l|l}
1 & -az^{-1} + 1 \\ \cline{2-2}
1 - a^{-1}z & -a^{-1}z - a^{-2}z^2 - a^{-3}z^3 \\ \hline
a^{-1}z & \\
a^{-1}z - a^{-2}z^2 & \\ \hline
a^{-2}z^2 & \\
a^{-2}z^2 - a^{-3}z^3 & \\ \hline
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a^{-1}z & \\
a^{-1}z - a^{-2}z^{2} & \\ \cline{1-1}
a^{-2}z^{2} & \\
a^{-2}z^{2} - a^{-3}z^{3} & \\ \cline{1-1}
a^{-3}z^{3} & \\
\vdots &
\end{array}
$$

- $X(z) = -a^{-1}z - a^{-2}z^{2} - a^{-3}z^{3} + \cdots$
- $X(z) = \sum_{n=-1}^{-\infty} \boxed{}\, z^{-n}$

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\end{array}
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$$
\begin{array}{l|l}
1 & -az^{-1} + 1 \\
\underline{1 - a^{-1}z} & \overline{-a^{-1}z - a^{-2}z^2 - a^{-3}z^3 + \cdots} \\
a^{-1}z & \\
\underline{a^{-1}z - a^{-2}z^2} & \\
a^{-2}z^2 & \\
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a^{-3}z^3 & \\
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1 & -az^{-1} + 1 \\ \hline
1 - a^{-1}z & -a^{-1}z - a^{-2}z^{2} - a^{-3}z^{3} + \cdots \\ \cline{1-1}
a^{-1}z & \\
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1 - a^{-1}z & -a^{-1}z - a^{-2}z^{2} - a^{-3}z^{3} + \cdots \\ \cline{1-1}
a^{-1}z & \\
a^{-1}z - a^{-2}z^{2} & \\ \cline{1-1}
a^{-2}z^{2} & \\
a^{-2}z^{2} - a^{-3}z^{3} & \\ \cline{1-1}
a^{-3}z^{3} & \\
\vdots &
\end{array}$$

- $X(z) = -a^{-1}z - a^{-2}z^{2} - a^{-3}z^{3} + \cdots$
- $X(z) = \sum_{n=-1}^{-\infty} -(a)^{n} z^{-n} = \sum_{n} x(n)z^{-n}$
- $x(n) = -(a)^{n}$

Örnek 3

- $X(z) = \frac{1}{1-az^{-1}}$ ve YB: $|z| < |a|$ ise $x(n) =?$
- YB: $|z| < |a| \precsim x(n)$ sol taraflı
  - ♦ $X(z) = \sum_{n<0} x(n)z^{-n} = \cdots + x(k)z^{k} + \cdots$
- Fonksiyon bölmesi en küçük dereceli terimden başlar.

$$
\begin{array}{l|l}
1 & -az^{-1} + 1 \\
\cline{2-2}
1 - a^{-1}z & -a^{-1}z - a^{-2}z^{2} - a^{-3}z^{3} + \cdots \\
\cline{1-1}
a^{-1}z & \\
a^{-1}z - a^{-2}z^{2} & \\
\cline{1-1}
a^{-2}z^{2} & \\
a^{-2}z^{2} - a^{-3}z^{3} & \\
\cline{1-1}
a^{-3}z^{3} & \\
\vdots &
\end{array}
$$

- $X(z) = -a^{-1}z - a^{-2}z^{2} - a^{-3}z^{3} + \cdots$
- $X(z) = \sum_{n=-1}^{-\infty} -(a)^{n}z^{-n} = \sum_{n} x(n)z^{-n}$
- $x(n) = -(a)^{n}$

Örnek 3

- $X(z) = \frac{1}{1-az^{-1}}$ ve YB: $|z| < |a|$ ise $x(n) =?$
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- Fonksiyon bölmesi en küçük dereceli terimden başlar.

$$
\begin{array}{l|l}
1 & -az^{-1} + 1 \\ \cline{2-2}
1 - a^{-1}z & -a^{-1}z - a^{-2}z^2 - a^{-3}z^3 + \cdots \\ \cline{1-1}
a^{-1}z & \\
a^{-1}z - a^{-2}z^2 & \\ \cline{1-1}
a^{-2}z^2 & \\
a^{-2}z^2 - a^{-3}z^3 & \\ \cline{1-1}
a^{-3}z^3 & \\
\vdots &
\end{array}
$$

- $X(z) = -a^{-1}z - a^{-2}z^2 - a^{-3}z^3 + \cdots$
- $X(z) = \sum_{n=-1}^{-\infty} -(a)^n z^{-n} = \sum_n x(n)z^{-n}$
- $x(n) = -(a)^n u(-n-1)$

Örnek 4

- $X(z) = \frac{1}{1-\frac{3}{2}z^{-1}+\frac{1}{2}z^{-2}}$ ve YB: $|z| > 1$ ise $x(n) =$?

Örnek 4

- $X(z) = \dfrac{1}{1-\frac{3}{2}z^{-1}+\frac{1}{2}z^{-2}}$ ve YB: $|z| > 1$ ise $x(n) =?$

$$
\begin{array}{l|l}
1 & 1-\frac{3}{2}z^{-1}+\frac{1}{2}z^{-2} \\
1-\frac{3}{2}z^{-1}+\frac{1}{2}z^{-2} & \\
\hline
\frac{3}{2}z^{-1}-\frac{1}{2}z^{-2} & 1+\frac{3}{2}z^{-1}+\frac{7}{4}z^{-2}+\frac{15}{8}z^{-3}+\cdots \\
\frac{3}{2}z^{-1}-\frac{9}{4}z^{-2}+\frac{3}{4}z^{-3} & \\
\hline
\frac{7}{4}z^{-2}-\frac{3}{4}z^{-3} & \\
\frac{7}{4}z^{-2}-\frac{21}{8}z^{-3}+\frac{7}{8}z^{-4} & \\
\hline
\frac{15}{8}z^{-3}-\frac{7}{8}z^{-4} & \\
\vdots &
\end{array}
$$

Örnek 4

- $X(z) = \dfrac{1}{1-\frac{3}{2}z^{-1}+\frac{1}{2}z^{-2}}$ ve YB: $|z| > 1$ ise $x(n) =?$

$$
\begin{array}{l|l}
1 & 1-\frac{3}{2}z^{-1}+\frac{1}{2}z^{-2} \\
\underline{1-\frac{3}{2}z^{-1}+\frac{1}{2}z^{-2}} & \hline \\
\frac{3}{2}z^{-1}-\frac{1}{2}z^{-2} & 1+\frac{3}{2}z^{-1}+\frac{7}{4}z^{-2}+\frac{15}{8}z^{-3}+\cdots \\
\underline{\frac{3}{2}z^{-1}-\frac{9}{4}z^{-2}+\frac{3}{4}z^{-3}} & \\
\frac{7}{4}z^{-2}-\frac{3}{4}z^{-3} & \\
\underline{\frac{7}{4}z^{-2}-\frac{21}{8}z^{-3}+\frac{7}{8}z^{-4}} & \\
\frac{15}{8}z^{-3}-\frac{7}{8}z^{-4} & \\
\vdots &
\end{array}
$$

- $X(z) = 1+\frac{3}{2}z^{-1}+\frac{7}{4}z^{-2}+\frac{15}{8}z^{-3}+\cdots$

Örnek 4

- $X(z) = \dfrac{1}{1-\frac{3}{2}z^{-1}+\frac{1}{2}z^{-2}}$ ve YB: $|z| > 1$ ise $x(n) =?$

$$1$$
$$1-\frac{3}{2}z^{-1}+\frac{1}{2}z^{-2}$$
$$\frac{3}{2}z^{-1}-\frac{1}{2}z^{-2}$$
$$\frac{3}{2}z^{-1}-\frac{9}{4}z^{-2}+\frac{3}{4}z^{-3}$$
$$\frac{7}{4}z^{-2}-\frac{3}{4}z^{-3}$$
$$\frac{7}{4}z^{-2}-\frac{21}{8}z^{-3}+\frac{7}{8}z^{-4}$$
$$\frac{15}{8}z^{-3}-\frac{7}{8}z^{-4}$$
$$\vdots$$

$$1-\frac{3}{2}z^{-1}+\frac{1}{2}z^{-2}$$
$$1+\frac{3}{2}z^{-1}+\frac{7}{4}z^{-2}+\frac{15}{8}z^{-3}+\cdots$$

- $X(z) = 1+\frac{3}{2}z^{-1}+\frac{7}{4}z^{-2}+\frac{15}{8}z^{-3}+\cdots$
- $X(z) = \sum_{n=0}^{\infty} \square \, z^{-n}$

Örnek 4

- $X(z) = \dfrac{1}{1-\frac{3}{2}z^{-1}+\frac{1}{2}z^{-2}}$ ve YB: $|z| > 1$ ise $x(n) = ?$

$$
\begin{array}{l|l}
1 & 1-\frac{3}{2}z^{-1}+\frac{1}{2}z^{-2} \\
1-\frac{3}{2}z^{-1}+\frac{1}{2}z^{-2} & \\
\hline
\frac{3}{2}z^{-1}-\frac{1}{2}z^{-2} & 1+\frac{3}{2}z^{-1}+\frac{7}{4}z^{-2}+\frac{15}{8}z^{-3}+\cdots \\
\frac{3}{2}z^{-1}-\frac{9}{4}z^{-2}+\frac{3}{4}z^{-3} & \\
\hline
\frac{7}{4}z^{-2}-\frac{3}{4}z^{-3} & \\
\frac{7}{4}z^{-2}-\frac{21}{8}z^{-3}+\frac{7}{8}z^{-4} & \\
\hline
\frac{15}{8}z^{-3}-\frac{7}{8}z^{-4} & \\
\vdots &
\end{array}
$$

- $X(z) = 1+\frac{3}{2}z^{-1}+\frac{7}{4}z^{-2}+\frac{15}{8}z^{-3}+\cdots$
- $X(z) = \sum_{n=0}^{\infty} \frac{2^{n+1}-1}{2^n} z^{-n}$

Örnek 4

- $X(z) = \dfrac{1}{1-\frac{3}{2}z^{-1}+\frac{1}{2}z^{-2}}$ ve YB: $|z| > 1$ ise $x(n) = ?$

$$
\begin{array}{l|l}
1 & 1-\frac{3}{2}z^{-1}+\frac{1}{2}z^{-2} \\
1-\frac{3}{2}z^{-1}+\frac{1}{2}z^{-2} & \\
\hline
\frac{3}{2}z^{-1}-\frac{1}{2}z^{-2} & 1+\frac{3}{2}z^{-1}+\frac{7}{4}z^{-2}+\frac{15}{8}z^{-3}+\cdots \\
\frac{3}{2}z^{-1}-\frac{9}{4}z^{-2}+\frac{3}{4}z^{-3} & \\
\hline
\frac{7}{4}z^{-2}-\frac{3}{4}z^{-3} & \\
\frac{7}{4}z^{-2}-\frac{21}{8}z^{-3}+\frac{7}{8}z^{-4} & \\
\hline
\frac{15}{8}z^{-3}-\frac{7}{8}z^{-4} & \\
\vdots &
\end{array}
$$

- $X(z) = 1+\frac{3}{2}z^{-1}+\frac{7}{4}z^{-2}+\frac{15}{8}z^{-3}+\cdots$
- $X(z) = \sum_{n=0}^{\infty}\frac{2^{n+1}-1}{2^n}z^{-n}$
- $x(n) = \left(2-\left(\frac{1}{2}\right)^n\right)u(n)$

Örnek 5

- $X(z) = \frac{1}{1-\frac{3}{2}z^{-1}+\frac{1}{2}z^{-2}}$ ve YB: $|z| < \frac{1}{2}$ ise $x(n) =?$
- $x(n) = (2^n - 2)u(-n-2)$

Kısmi Kesirlere Ayırma

- $X(z) = \dfrac{A(z)}{(1-a_1 z^{-1})(1-a_2 z^{-1})\cdots\left(1-a_j z^{-1}\right)}$

Kısmi Kesirlere Ayırma

- $X(z) = \dfrac{A(z)}{(1-a_1 z^{-1})(1-a_2 z^{-1})\cdots(1-a_j z^{-1})}$
- $X(z) = \dfrac{A_1}{(1-a_1 z^{-1})} + \dfrac{A_2}{(1-a_2 z^{-1})} + \cdots + \dfrac{A_j}{(1-a_j z^{-1})}$

Kısmi Kesirlere Ayırma

- $X(z) = \frac{A(z)}{(1-a_1 z^{-1})(1-a_2 z^{-1})\cdots(1-a_j z^{-1})}$
- $X(z) = \frac{A_1}{(1-a_1 z^{-1})} + \frac{A_2}{(1-a_2 z^{-1})} + \cdots + \frac{A_j}{(1-a_j z^{-1})}$
- $A_j = (1 - a_j z^{-1}) X(z)\Big|_{z=a_j}$

Kısmi Kesirlere Ayırma

- $X(z) = \dfrac{A(z)}{(1-a_1z^{-1})(1-a_2z^{-1})\cdots(1-a_jz^{-1})}$

- $X(z) = \dfrac{A_1}{(1-a_1z^{-1})} + \dfrac{A_2}{(1-a_2z^{-1})} + \cdots + \underbrace{\dfrac{A_j}{(1-a_jz^{-1})}}_{X_j(z)}$

- $A_j = (1 - a_jz^{-1})X(z)\Big|_{z=a_j}$

Kısmi Kesirlere Ayırma

- $X(z) = \dfrac{A(z)}{(1-a_1 z^{-1})(1-a_2 z^{-1})\cdots(1-a_j z^{-1})}$

- $X(z) = \dfrac{A_1}{(1-a_1 z^{-1})} + \dfrac{A_2}{(1-a_2 z^{-1})} + \cdots + \underbrace{\dfrac{A_j}{(1-a_j z^{-1})}}_{X_j(z)}$

- $A_j = (1 - a_j z^{-1}) X(z)\big|_{z=a_j}$

- $X_j(z) \rightarrow$ YB: $|z| > |a_j|$ ya da $|z| < |a_j|$

Kısmi Kesirlere Ayırma

- $X(z) = \dfrac{A(z)}{(1-a_1 z^{-1})(1-a_2 z^{-1})\cdots(1-a_j z^{-1})}$

- $X(z) = \dfrac{A_1}{(1-a_1 z^{-1})} + \dfrac{A_2}{(1-a_2 z^{-1})} + \cdots + \underbrace{\dfrac{A_j}{(1-a_j z^{-1})}}_{X_j(z)}$

- $A_j = (1 - a_j z^{-1}) X(z)\big|_{z=a_j}$
- $X_j(z)$ → YBj: $|z| > |a_j|$ ya da $|z| < |a_j|$
- YB'ler belirlenir
  - YB1 ∩ YB2 ∩ ⋯ ∩ YBj

Kısmi Kesirlere Ayırma

- $X(z) = \dfrac{A(z)}{(1-a_1z^{-1})(1-a_2z^{-1})\cdots(1-a_jz^{-1})}$
- $X(z) = \dfrac{A_1}{(1-a_1z^{-1})} + \dfrac{A_2}{(1-a_2z^{-1})} + \cdots + \underbrace{\dfrac{A_j}{(1-a_jz^{-1})}}_{X_j(z)}$
- $A_j = (1 - a_j z^{-1})X(z)\big|_{z=a_j}$
- $X_j(z)$ → YBj: $|z| > |a_j|$ ya da $|z| < |a_j|$
- YB'ler belirlenir
  - YB1 ∩ YB2 ∩ ⋯ ∩ YBj ≡ Verilen YB olmalıdır.

Kısmi Kesirlere Ayırma

- $X(z) = \frac{A(z)}{(1-a_1z^{-1})(1-a_2z^{-1})\cdots(1-a_jz^{-1})}$
- $X(z) = \frac{A_1}{(1-a_1z^{-1})} + \frac{A_2}{(1-a_2z^{-1})} + \cdots + \underbrace{\frac{A_j}{(1-a_jz^{-1})}}_{X_j(z)}$
- $A_j = (1 - a_jz^{-1})X(z)\big|_{z=a_j}$
- $X_j(z)$ $\rightarrow$ YBj: $|z| > |a_j|$ ya da $|z| < |a_j|$
- YB'leri belirlenir
  - ♦ YB1 ∩ YB2 ∩ ⋯ ∩ YBj ≡ Verilen YB olmalıdır.
- $x_j(n) = \begin{cases} A_j(a_j)^n u(n), & |z| > |a_j| \\ & \end{cases}$

Kısmi Kesirlere Ayırma

- $X(z) = \dfrac{A(z)}{(1-a_1 z^{-1})(1-a_2 z^{-1})\cdots(1-a_j z^{-1})}$
- $X(z) = \dfrac{A_1}{(1-a_1 z^{-1})} + \dfrac{A_2}{(1-a_2 z^{-1})} + \cdots + \underbrace{\dfrac{A_j}{(1-a_j z^{-1})}}_{X_j(z)}$
- $A_j = (1 - a_j z^{-1}) X(z)\big|_{z=a_j}$
- $X_j(z)$ → YBj: $|z| > |a_j|$ ya da $|z| < |a_j|$
- YB'leri belirlenir
  - YB1 ∩ YB2 ∩ ⋯ ∩ YBj ≡ Verilen YB olmalıdır.
- $x_j(n) = \begin{cases} A_j (a_j)^n u(n), & |z| > |a_j| \\ -A_j (a_j)^n u(-n-1), & |z| < |a_j| \end{cases}$

Kısmi Kesirlere Ayırma

- $X(z) = \frac{A(z)}{(1-a_1 z^{-1})(1-a_2 z^{-1})\cdots(1-a_j z^{-1})}$
- $X(z) = \frac{A_1}{(1-a_1 z^{-1})} + \frac{A_2}{(1-a_2 z^{-1})} + \cdots + \underbrace{\frac{A_j}{(1-a_j z^{-1})}}_{X_j(z)}$
- $A_j = (1 - a_j z^{-1}) X(z)\big|_{z=a_j}$
- $X_j(z)$ $\rightarrow$ YBj: $|z| > |a_j|$ ya da $|z| < |a_j|$
- YB'leri belirlenir
  - ♦ YB1 ∩ YB2 ∩ ⋯ ∩ YBj ≡ Verilen YB olmalıdır.
- $x_j(n) = \begin{cases} A_j (a_j)^n u(n), & |z| > |a_j| \\ -A_j (a_j)^n u(-n-1), & |z| < |a_j| \end{cases}$
- $x(n) = \sum_j x_j(n)$

Kısmi Kesirlere Ayırma

- $X(z) = \dfrac{A(z)}{(1-bz^{-1})^r(1-a_1z^{-1})(1-a_2z^{-1})\cdots\left(1-a_jz^{-1}\right)}$
- $X(z) =$

Kısmi Kesirlere Ayırma

- $X(z) = \dfrac{A(z)}{(1-bz^{-1})^r(1-a_1z^{-1})(1-a_2z^{-1})\cdots(1-a_jz^{-1})}$
- $X(z) = \dfrac{B_0}{(1-bz^{-1})^r} + \dfrac{B_1}{(1-bz^{-1})^{r-1}} + \cdots + \dfrac{B_{r-1}}{(1-bz^{-1})}$

$$+\frac{A_1}{(1-a_1z^{-1})} + \frac{A_2}{(1-a_2z^{-1})} + \cdots + \underbrace{\frac{A_j}{(1-a_jz^{-1})}}_{X_j(z)}$$

Kısmi Kesirlere Ayırma

- $X(z) = \dfrac{A(z)}{(1-bz^{-1})^r(1-a_1z^{-1})(1-a_2z^{-1})\cdots(1-a_jz^{-1})}$
- $X(z) = \dfrac{B_0}{(1-bz^{-1})^r} + \dfrac{B_1}{(1-bz^{-1})^{r-1}} + \cdots + \dfrac{B_{r-1}}{(1-bz^{-1})}$
$$+ \frac{A_1}{(1-a_1z^{-1})} + \frac{A_2}{(1-a_2z^{-1})} + \cdots + \underbrace{\frac{A_j}{(1-a_jz^{-1})}}_{X_j(z)}$$
- $B_0 = (1-bz^{-1})^r X(z)\big|_{z=b}$

Kısmi Kesirlere Ayırma

- $X(z) = \frac{A(z)}{(1-bz^{-1})^r(1-a_1z^{-1})(1-a_2z^{-1})\cdots(1-a_jz^{-1})}$
- $X(z) = \frac{B_0}{(1-bz^{-1})^r} + \frac{B_1}{(1-bz^{-1})^{r-1}} + \cdots + \frac{B_{r-1}}{(1-bz^{-1})}$
$$+\frac{A_1}{(1-a_1z^{-1})} + \frac{A_2}{(1-a_2z^{-1})} + \cdots + \underbrace{\frac{A_j}{(1-a_jz^{-1})}}_{X_j(z)}$$
- $B_0 = (1-bz^{-1})^r X(z)\big|_{z=b}$
- $B_1 = \left.\frac{\partial(B_0(z))}{\partial z}\right|_{z=b}$

Kısmi Kesirlere Ayırma

- $X(z) = \dfrac{A(z)}{(1-bz^{-1})^r(1-a_1z^{-1})(1-a_2z^{-1})\cdots(1-a_jz^{-1})}$
- $X(z) = \dfrac{B_0}{(1-bz^{-1})^r} + \dfrac{B_1}{(1-bz^{-1})^{r-1}} + \cdots + \dfrac{B_{r-1}}{(1-bz^{-1})}$
$$+ \frac{A_1}{(1-a_1z^{-1})} + \frac{A_2}{(1-a_2z^{-1})} + \cdots + \underbrace{\frac{A_j}{(1-a_jz^{-1})}}_{X_j(z)}$$
- $B_0 = (1-bz^{-1})^r X(z)\big|_{z=b}$
- $B_1 = \left.\dfrac{\partial\left(B_0(z)\right)}{\partial z}\right|_{z=b}$
- $B_k = \left.\dfrac{1}{k}\dfrac{\partial\left(B_{k-1}(z)\right)}{\partial z}\right|_{z=b}$

Kısmi Kesirlere Ayırma

- $X(z) = \frac{A(z)}{B(z)}$
- En Küçük Dereceli Terim: EKDT
- $A(z)_{EKDT} > B(z)_{EKDT}$ olmalıdır.

Kısmi Kesirlere Ayırma

$$\begin{array}{r|l} A(z) & B(z) \\ \cline{2-2} & C(z) \\ \cline{1-1} D(z) & \end{array}$$

- $X(z) = \dfrac{A(z)}{B(z)}$
- En Küçük Dereceli Terim: EKDT
- $A(z)_{EKDT} > B(z)_{EKDT}$ olmalıdır.
- $A(z)_{EKDT} \leq B(z)_{EKDT}$ ise fonksiyon bölmesi yapılmalıdır.
  - Bölme: YB' den bağımsız EKDT' den başlanmalı
    - Kuvvet Seri Açılımından farklı
  - Bölme $D(z)_{EKDT} > B(z)_{EKDT}$ olana kadar devam eder.

Kısmi Kesirlere Ayırma

- $X(z) = \frac{A(z)}{B(z)} = C(z) + \frac{D(z)}{B(z)}$
- En Küçük Dereceli Terim: EKDT
- $A(z)_{EKDT} > B(z)_{EKDT}$ olmalıdır.
- $A(z)_{EKDT} \leq B(z)_{EKDT}$ ise fonksiyon bölmesi yapılmalıdır.
  - Bölme: YB’ den bağımsız EKDT’ den başlanmalı
    - Kuvvet Seri Açılımından farklı
  - Bölme $D(z)_{EKDT} > B(z)_{EKDT}$ olana kadar devam eder.
  - Kalan kısmında elde edilen fonksiyon, $\frac{D(z)}{B(z)}$ kısmi kesirlere ayrılır.
    - Ters dönüşüm YB’ ye göre yapılır.

$$\begin{array}{r|l} A(z) & B(z) \\ \cline{2-2} & C(z) \\ \cline{1-1} D(z) & \end{array}$$

Örnek 5

- $X(z) = \frac{z^{-1}}{1-\frac{1}{4}z^{-1}}$ ve YB: $|z| > \frac{1}{4}$ ise $x(n) =$?

Örnek 5

- $X(z) = \dfrac{z^{-1}}{1-\frac{1}{4}z^{-1}}$ ve YB: $|z| > \frac{1}{4}$ ise $x(n) =?$

$$
\begin{array}{l|l}
z^{-1} & -\frac{1}{4}z^{-1} + 1 \\
z^{-1} - 4 & \\
\hline
4 & -4
\end{array}
$$

Örnek 5

- $X(z) = \dfrac{z^{-1}}{1-\frac{1}{4}z^{-1}}$ ve YB: $|z| > \frac{1}{4}$ ise $x(n)$ =?

$$\begin{array}{l|l} z^{-1} & \\ z^{-1}-4 & -\frac{1}{4}z^{-1}+1 \\ \hline 4 & -4 \end{array}$$

- $X(z) =$

Örnek 5

- $X(z) = \dfrac{z^{-1}}{1-\frac{1}{4}z^{-1}}$ ve YB: $|z| > \dfrac{1}{4}$ ise $x(n) =?$

$$
\begin{array}{l|l}
z^{-1} & -\frac{1}{4}z^{-1} + 1 \\
z^{-1} - 4 & \\
\hline
4 & -4
\end{array}
$$

- $X(z) = -4 + \dfrac{4}{1-\frac{1}{4}z^{-1}}$

Örnek 5

- $X(z) = \dfrac{z^{-1}}{1-\frac{1}{4}z^{-1}}$ ve YB: $|z| > \dfrac{1}{4}$ ise $x(n) = ?$

$$
\begin{array}{l|l}
z^{-1} & -\frac{1}{4}z^{-1} + 1 \\
z^{-1} - 4 & \\
\hline
4 & -4
\end{array}
$$

- $X(z) = -4 + \underbrace{\dfrac{4}{1-\frac{1}{4}z^{-1}}}_{X_1(z)}$

Örnek 5

- $X(z) = \dfrac{z^{-1}}{1-\frac{1}{4}z^{-1}}$ ve YB: $|z| > \dfrac{1}{4}$ ise $x(n) =?$

$$
\begin{array}{l|l}
z^{-1} & -\frac{1}{4}z^{-1} + 1 \\
z^{-1} - 4 & \\
\hline
4 & -4
\end{array}
$$

- $X(z) = -4 + \underbrace{\dfrac{4}{1-\frac{1}{4}z^{-1}}}_{X_1(z)}$

- $X_1(z) = 4\dfrac{1}{1-\frac{1}{4}z^{-1}} \rightarrow x_1(n) =$

Örnek 5

- $X(z) = \frac{z^{-1}}{1-\frac{1}{4}z^{-1}}$ ve YB: $|z| > \frac{1}{4}$ ise $x(n) =?$

$$
\begin{array}{l|l}
z^{-1} & -\frac{1}{4}z^{-1} + 1 \\
z^{-1} - 4 & \\
\hline
4 & -4
\end{array}
$$

- $X(z) = -4 + \underbrace{\frac{4}{1-\frac{1}{4}z^{-1}}}_{X_1(z)}$

- $X_1(z) = 4\frac{1}{1-\frac{1}{4}z^{-1}} \rightarrow x_1(n) = 4\left(\frac{1}{4}\right)^n u(n) = \left(\frac{1}{4}\right)^{n-1} u(n)$

Örnek 5

- $X(z) = \dfrac{z^{-1}}{1-\frac{1}{4}z^{-1}}$ ve YB: $|z| > \frac{1}{4}$ ise $x(n) = ?$

$$
\begin{array}{l|l}
z^{-1} & -\frac{1}{4}z^{-1} + 1 \\
\underline{z^{-1} - 4} & \overline{} \\
4 & -4
\end{array}
$$

- $X(z) = -4 + \underbrace{\dfrac{4}{1-\frac{1}{4}z^{-1}}}_{X_1(z)}$

- $X_1(z) = 4\dfrac{1}{1-\frac{1}{4}z^{-1}} \rightarrow x_1(n) = 4\left(\frac{1}{4}\right)^{n} u(n) = \left(\frac{1}{4}\right)^{n-1} u(n)$

- $x(n) = \boxed{} + \left(\frac{1}{4}\right)^{n-1} u(n)$

Örnek 5

- $X(z) = \frac{z^{-1}}{1-\frac{1}{4}z^{-1}}$ ve YB: $|z| > \frac{1}{4}$ ise $x(n) = ?$

$$
\begin{array}{l|l}
z^{-1} & -\frac{1}{4}z^{-1} + 1 \\
z^{-1} - 4 & \\
\hline
4 & -4
\end{array}
$$

- $X(z) = -4 + \underbrace{\frac{4}{1-\frac{1}{4}z^{-1}}}_{X_1(z)}$

- $X_1(z) = 4\frac{1}{1-\frac{1}{4}z^{-1}} \rightarrow x_1(n) = 4\left(\frac{1}{4}\right)^{n} u(n) = \left(\frac{1}{4}\right)^{n-1} u(n)$

- $x(n) = -4\delta(n) + \left(\frac{1}{4}\right)^{n-1} u(n)$

Örnek 5

- $X(z) = \frac{z^{-1}}{1-\frac{1}{4}z^{-1}}$ ve YB: $|z| > \frac{1}{4}$ ise $x(n) = ?$

- $X(z) = -4 + \underbrace{\frac{4}{1-\frac{1}{4}z^{-1}}}_{X_1(z)}$

- $X_1(z) = 4\frac{1}{1-\frac{1}{4}z^{-1}} \rightarrow x_1(n) = 4\left(\frac{1}{4}\right)^n u(n) = \left(\frac{1}{4}\right)^{n-1} u(n)$

- $x(n) = -4\delta(n) + \left(\frac{1}{4}\right)^{n-1} u(n)$
- $|z| < \frac{1}{4}$ ise $x(n) =$

Örnek 5

- $X(z) = \frac{z^{-1}}{1-\frac{1}{4}z^{-1}}$ ve YB: $|z| > \frac{1}{4}$ ise $x(n) =?$

- $X(z) = -4 + \underbrace{\frac{4}{1-\frac{1}{4}z^{-1}}}_{X_1(z)}$

- $X_1(z) = 4\frac{1}{1-\frac{1}{4}z^{-1}} \rightarrow x_1(n) = 4\left(\frac{1}{4}\right)^{n} u(n) = \left(\frac{1}{4}\right)^{n-1} u(n)$

- $x(n) = -4\delta(n) + \left(\frac{1}{4}\right)^{n-1} u(n)$

- $|z| < \frac{1}{4}$ ise $x(n) = -4\delta(n) - \left(\frac{1}{4}\right)^{n-1} u(-n-1)$

Örnek 6

- $X(z) = \frac{4-\frac{7}{4}z^{-1}+\frac{1}{4}z^{-2}}{1-\frac{3}{4}z^{-1}+\frac{1}{8}z^{-2}}$ ve YB: $|z| > \frac{1}{2}$ ise $x(n) = ?$

Örnek 6

- $X(z) = \frac{4 - \frac{7}{4}z^{-1} + \frac{1}{4}z^{-2}}{1 - \frac{3}{4}z^{-1} + \frac{1}{8}z^{-2}}$ ve YB: $|z| > \frac{1}{2}$ ise $x(n) =?$

$$\begin{array}{r|l} \frac{1}{4}z^{-2} - \frac{7}{4}z^{-1} + 4 & \frac{1}{8}z^{-2} - \frac{3}{4}z^{-1} + 1 \\ \hline & \end{array}$$

Örnek 6

- $X(z) = \dfrac{4 - \frac{7}{4}z^{-1} + \frac{1}{4}z^{-2}}{1 - \frac{3}{4}z^{-1} + \frac{1}{8}z^{-2}}$ ve YB: $|z| > \dfrac{1}{2}$ ise $x(n) = ?$

$$
\begin{array}{l|l}
\frac{1}{4}z^{-2} - \frac{7}{4}z^{-1} + 4 & \frac{1}{8}z^{-2} - \frac{3}{4}z^{-1} + 1 \\
\frac{1}{4}z^{-2} - \frac{6}{4}z^{-1} + 2 & \\
\hline
-\frac{1}{4}z^{-1} + 2 & 2
\end{array}
$$

- $X(z) =$

Örnek 6

- $X(z) = \dfrac{4-\frac{7}{4}z^{-1}+\frac{1}{4}z^{-2}}{1-\frac{3}{4}z^{-1}+\frac{1}{8}z^{-2}}$ ve YB: $|z| > \dfrac{1}{2}$ ise $x(n) = ?$

$$
\begin{array}{l|l}
\frac{1}{4}z^{-2} - \frac{7}{4}z^{-1} + 4 & \frac{1}{8}z^{-2} - \frac{3}{4}z^{-1} + 1 \\
\frac{1}{4}z^{-2} - \frac{6}{4}z^{-1} + 2 & \\
\hline
-\frac{1}{4}z^{-1} + 2 & 2
\end{array}
$$

- $X(z) = 2 + \dfrac{2-\frac{1}{4}z^{-1}}{1-\frac{3}{4}z^{-1}+\frac{1}{8}z^{-2}}$

Örnek 6

- $X(z) = \dfrac{4 - \frac{7}{4}z^{-1} + \frac{1}{4}z^{-2}}{1 - \frac{3}{4}z^{-1} + \frac{1}{8}z^{-2}}$ ve YB: $|z| > \dfrac{1}{2}$ ise $x(n) = ?$

$$
\begin{array}{l|l}
\frac{1}{4}z^{-2} - \frac{7}{4}z^{-1} + 4 & \frac{1}{8}z^{-2} - \frac{3}{4}z^{-1} + 1 \\
\frac{1}{4}z^{-2} - \frac{6}{4}z^{-1} + 2 & \\
\hline
-\frac{1}{4}z^{-1} + 2 & 2
\end{array}
$$

- $X(z) = 2 + \dfrac{2 - \frac{1}{4}z^{-1}}{1 - \frac{3}{4}z^{-1} + \frac{1}{8}z^{-2}} = 2 + \dfrac{2 - \frac{1}{4}z^{-1}}{\left(1 - \frac{1}{2}z^{-1}\right)\left(1 - \frac{1}{4}z^{-1}\right)}$

Örnek 6

- $X(z) = \dfrac{4-\frac{7}{4}z^{-1}+\frac{1}{4}z^{-2}}{1-\frac{3}{4}z^{-1}+\frac{1}{8}z^{-2}}$ ve YB: $|z| > \dfrac{1}{2}$ ise $x(n)$ =?

$$
\begin{array}{l|l}
\frac{1}{4}z^{-2} - \frac{7}{4}z^{-1} + 4 & \frac{1}{8}z^{-2} - \frac{3}{4}z^{-1} + 1 \\
\frac{1}{4}z^{-2} - \frac{6}{4}z^{-1} + 2 & \\
\hline
-\frac{1}{4}z^{-1} + 2 & 2
\end{array}
$$

- $X(z) = 2 + \dfrac{2-\frac{1}{4}z^{-1}}{1-\frac{3}{4}z^{-1}+\frac{1}{8}z^{-2}} = 2 + \underbrace{\dfrac{2-\frac{1}{4}z^{-1}}{\left(1-\frac{1}{2}z^{-1}\right)\left(1-\frac{1}{4}z^{-1}\right)}}_{X_1(z)}$

Örnek 6

- $X(z) = \frac{4-\frac{7}{4}z^{-1}+\frac{1}{4}z^{-2}}{1-\frac{3}{4}z^{-1}+\frac{1}{8}z^{-2}}$ ve YB: $|z| > \frac{1}{2}$ ise $x(n) =?$

- $X(z) = 2 + \frac{2-\frac{1}{4}z^{-1}}{1-\frac{3}{4}z^{-1}+\frac{1}{8}z^{-2}} = 2 + \underbrace{\frac{2-\frac{1}{4}z^{-1}}{\left(1-\frac{1}{2}z^{-1}\right)\left(1-\frac{1}{4}z^{-1}\right)}}_{X_1(z)}$

- $X_1(z) = \frac{2-\frac{1}{4}z^{-1}}{\left(1-\frac{1}{2}z^{-1}\right)\left(1-\frac{1}{4}z^{-1}\right)} =$

Örnek 6

- $X(z) = \dfrac{4-\frac{7}{4}z^{-1}+\frac{1}{4}z^{-2}}{1-\frac{3}{4}z^{-1}+\frac{1}{8}z^{-2}}$ ve YB: $|z| > \frac{1}{2}$ ise $x(n) = ?$

- $X(z) = 2 + \dfrac{2-\frac{1}{4}z^{-1}}{1-\frac{3}{4}z^{-1}+\frac{1}{8}z^{-2}} = 2 + \underbrace{\dfrac{2-\frac{1}{4}z^{-1}}{\left(1-\frac{1}{2}z^{-1}\right)\left(1-\frac{1}{4}z^{-1}\right)}}_{X_1(z)}$

- $X_1(z) = \dfrac{2-\frac{1}{4}z^{-1}}{\left(1-\frac{1}{2}z^{-1}\right)\left(1-\frac{1}{4}z^{-1}\right)} = \dfrac{A}{\left(1-\frac{1}{2}z^{-1}\right)} + \dfrac{B}{\left(1-\frac{1}{4}z^{-1}\right)}$

Örnek 6

- $X_1(z) = \frac{2-\frac{1}{4}z^{-1}}{\left(1-\frac{1}{2}z^{-1}\right)\left(1-\frac{1}{4}z^{-1}\right)} = \frac{A}{\left(1-\frac{1}{2}z^{-1}\right)} + \frac{B}{\left(1-\frac{1}{4}z^{-1}\right)}$
- $A =$

Örnek 6

- $X_1(z) = \frac{2-\frac{1}{4}z^{-1}}{\left(1-\frac{1}{2}z^{-1}\right)\left(1-\frac{1}{4}z^{-1}\right)} = \frac{A}{\left(1-\frac{1}{2}z^{-1}\right)} + \frac{B}{\left(1-\frac{1}{4}z^{-1}\right)}$
- $A = \left(1-\frac{1}{2}z^{-1}\right)X_1(z)\Big|_{z^{-1}=2} =$

Örnek 6

- $X_1(z) = \dfrac{2-\frac{1}{4}z^{-1}}{\left(1-\frac{1}{2}z^{-1}\right)\left(1-\frac{1}{4}z^{-1}\right)} = \dfrac{A}{\left(1-\frac{1}{2}z^{-1}\right)} + \dfrac{B}{\left(1-\frac{1}{4}z^{-1}\right)}$
- $A = \left(1 - \frac{1}{2}z^{-1}\right)X_1(z)\Big|_{z^{-1}=2} = \dfrac{2-\frac{1}{4}z^{-1}}{\left(1-\frac{1}{4}z^{-1}\right)}\Bigg|_{z^{-1}=2} =$

Örnek 6

- $X_1(z) = \frac{2-\frac{1}{4}z^{-1}}{\left(1-\frac{1}{2}z^{-1}\right)\left(1-\frac{1}{4}z^{-1}\right)} = \frac{A}{\left(1-\frac{1}{2}z^{-1}\right)} + \frac{B}{\left(1-\frac{1}{4}z^{-1}\right)}$
- $A = \left(1 - \frac{1}{2}z^{-1}\right)X_1(z)\Big|_{z^{-1}=2} = \frac{2-\frac{1}{4}z^{-1}}{\left(1-\frac{1}{4}z^{-1}\right)}\Bigg|_{z^{-1}=2} = 3$
- $B =$

Örnek 6

- $X_1(z) = \frac{2-\frac{1}{4}z^{-1}}{\left(1-\frac{1}{2}z^{-1}\right)\left(1-\frac{1}{4}z^{-1}\right)} = \frac{A}{\left(1-\frac{1}{2}z^{-1}\right)} + \frac{B}{\left(1-\frac{1}{4}z^{-1}\right)}$
- $A = \left(1-\frac{1}{2}z^{-1}\right)X_1(z)\Big|_{z^{-1}=2} = \frac{2-\frac{1}{4}z^{-1}}{\left(1-\frac{1}{4}z^{-1}\right)}\Bigg|_{z^{-1}=2} = 3$
- $B = \left(1-\frac{1}{4}z^{-1}\right)X_1(z)\Big|_{z^{-1}=4} =$

Örnek 6

- $X_1(z) = \dfrac{2-\frac{1}{4}z^{-1}}{\left(1-\frac{1}{2}z^{-1}\right)\left(1-\frac{1}{4}z^{-1}\right)} = \dfrac{A}{\left(1-\frac{1}{2}z^{-1}\right)} + \dfrac{B}{\left(1-\frac{1}{4}z^{-1}\right)}$
- $A = \left(1-\frac{1}{2}z^{-1}\right)X_1(z)\Big|_{z^{-1}=2} = \left.\dfrac{2-\frac{1}{4}z^{-1}}{\left(1-\frac{1}{4}z^{-1}\right)}\right|_{z^{-1}=2} = 3$
- $B = \left(1-\frac{1}{4}z^{-1}\right)X_1(z)\Big|_{z^{-1}=4} = \left.\dfrac{2-\frac{1}{4}z^{-1}}{\left(1-\frac{1}{2}z^{-1}\right)}\right|_{z^{-1}=4} =$

Örnek 6

- $X_1(z) = \dfrac{2-\frac{1}{4}z^{-1}}{\left(1-\frac{1}{2}z^{-1}\right)\left(1-\frac{1}{4}z^{-1}\right)} = \dfrac{A}{\left(1-\frac{1}{2}z^{-1}\right)} + \dfrac{B}{\left(1-\frac{1}{4}z^{-1}\right)}$
- $A = \left(1-\frac{1}{2}z^{-1}\right)X_1(z)\Big|_{z^{-1}=2} = \dfrac{2-\frac{1}{4}z^{-1}}{\left(1-\frac{1}{4}z^{-1}\right)}\Bigg|_{z^{-1}=2} = 3$
- $B = \left(1-\frac{1}{4}z^{-1}\right)X_1(z)\Big|_{z^{-1}=4} = \dfrac{2-\frac{1}{4}z^{-1}}{\left(1-\frac{1}{2}z^{-1}\right)}\Bigg|_{z^{-1}=4} = -1$

Örnek 6

- $X_1(z) = \dfrac{2-\frac{1}{4}z^{-1}}{\left(1-\frac{1}{2}z^{-1}\right)\left(1-\frac{1}{4}z^{-1}\right)} = \dfrac{A}{\left(1-\frac{1}{2}z^{-1}\right)} + \dfrac{B}{\left(1-\frac{1}{4}z^{-1}\right)}$
- $A = \left(1-\frac{1}{2}z^{-1}\right)X_1(z)\Big|_{z^{-1}=2} = \left.\dfrac{2-\frac{1}{4}z^{-1}}{\left(1-\frac{1}{4}z^{-1}\right)}\right|_{z^{-1}=2} = 3$
- $B = \left(1-\frac{1}{4}z^{-1}\right)X_1(z)\Big|_{z^{-1}=4} = \left.\dfrac{2-\frac{1}{4}z^{-1}}{\left(1-\frac{1}{2}z^{-1}\right)}\right|_{z^{-1}=4} = -1$
- $X(z) = 2 + \dfrac{3}{\left(1-\frac{1}{2}z^{-1}\right)} + \dfrac{-1}{\left(1-\frac{1}{4}z^{-1}\right)}$

Örnek 6

- $X(z) = 2 + \frac{3}{\left(1-\frac{1}{2}z^{-1}\right)} + \frac{-1}{\left(1-\frac{1}{4}z^{-1}\right)}$, YB: $|z| > \frac{1}{2}$ idi.

Örnek 6

- $X(z) = 2 + \underbrace{\frac{3}{\left(1-\frac{1}{2}z^{-1}\right)}}_{\text{YB1}} + \underbrace{\frac{-1}{\left(1-\frac{1}{4}z^{-1}\right)}}_{\text{YB2}}$, YB: $|z| > \frac{1}{2}$ idi.

Örnek 6

- $X(z) = 2 + \underbrace{\frac{3}{\left(1-\frac{1}{2}z^{-1}\right)}}_{\text{YB1}} + \underbrace{\frac{-1}{\left(1-\frac{1}{4}z^{-1}\right)}}_{\text{YB2}}$, YB: $|z| > \frac{1}{2}$ idi.
- YB1 $\cap$ YB2 $\equiv |z| > \frac{1}{2}$ olmalıdır.

Örnek 6

- $X(z) = 2 + \underbrace{\frac{3}{\left(1-\frac{1}{2}z^{-1}\right)}}_{\mathrm{YB1}} + \underbrace{\frac{-1}{\left(1-\frac{1}{4}z^{-1}\right)}}_{\mathrm{YB2}}$, YB: $|z| > \frac{1}{2}$ idi.
- YB1 ∩ YB2 ≡ $|z| > \frac{1}{2}$ olmalıdır.
- YB1: $\begin{cases} |z| > \frac{1}{2} \\ |z| < \frac{1}{2} \end{cases}$ ve YB2: $\begin{cases} |z| > \frac{1}{4} \\ |z| < \frac{1}{4} \end{cases}$ olabilir

Örnek 6

- $X(z) = 2 + \underbrace{\frac{3}{\left(1-\frac{1}{2}z^{-1}\right)}}_{\text{YB1}} + \underbrace{\frac{-1}{\left(1-\frac{1}{4}z^{-1}\right)}}_{\text{YB2}}$, YB: $|z| > \frac{1}{2}$ idi.
- YB1 ∩ YB2 ≡ $|z| > \frac{1}{2}$ olmalıdır.
- YB1: $\begin{cases} {\color{red}|z| > \frac{1}{2}} \\ |z| < \frac{1}{2} \end{cases}$ ve YB2: $\begin{cases} {\color{red}|z| > \frac{1}{4}} \\ |z| < \frac{1}{4} \end{cases}$ olabilir

Örnek 6

- $X(z) = 2 + \underbrace{\frac{3}{\left(1-\frac{1}{2}z^{-1}\right)}}_{\text{YB1}} + \underbrace{\frac{-1}{\left(1-\frac{1}{4}z^{-1}\right)}}_{\text{YB2}}$, YB: $|z| > \frac{1}{2}$ idi.
- YB1 ∩ YB2 ≡ $|z| > \frac{1}{2}$ olmalıdır.
- YB1: $\begin{cases} |z| > \frac{1}{2} \\ |z| < \frac{1}{2} \end{cases}$ ve YB2: $\begin{cases} |z| > \frac{1}{4} \\ |z| < \frac{1}{4} \end{cases}$ olabilir
- $x(n) =$

Örnek 6

- $X(z) = 2 + \underbrace{\frac{3}{\left(1-\frac{1}{2}z^{-1}\right)}}_{\text{YB1}} + \underbrace{\frac{-1}{\left(1-\frac{1}{4}z^{-1}\right)}}_{\text{YB2}}$, YB: $|z| > \frac{1}{2}$ idi.
- YB1 ∩ YB2 ≡ $|z| > \frac{1}{2}$ olmalıdır.
- YB1: $\begin{cases} |z| > \frac{1}{2} \\ |z| < \frac{1}{2} \end{cases}$ ve YB2: $\begin{cases} |z| > \frac{1}{4} \\ |z| < \frac{1}{4} \end{cases}$ olabilir
- $x(n) = 2\delta(n) + \cdots$

Örnek 6

- $X(z) = 2 + \underbrace{\frac{3}{\left(1-\frac{1}{2}z^{-1}\right)}}_{\mathrm{YB1}} + \underbrace{\frac{-1}{\left(1-\frac{1}{4}z^{-1}\right)}}_{\mathrm{YB2}}$, YB: $|z| > \frac{1}{2}$ idi.
- YB1 ∩ YB2 ≡ $|z| > \frac{1}{2}$ olmalıdır.
- YB1: $\begin{cases} |z| > \frac{1}{2} \\ |z| < \frac{1}{2} \end{cases}$ ve YB2: $\begin{cases} |z| > \frac{1}{4} \\ |z| < \frac{1}{4} \end{cases}$ olabilir
- $x(n) = 2\delta(n) + 3\left(\frac{1}{2}\right)^n u(n) + \cdots$

Örnek 6

- $X(z) = 2 + \underbrace{\frac{3}{\left(1-\frac{1}{2}z^{-1}\right)}}_{\text{YB1}} + \underbrace{\frac{-1}{\left(1-\frac{1}{4}z^{-1}\right)}}_{\text{YB2}}$, YB: $|z| > \frac{1}{2}$ idi.
- YB1 ∩ YB2 ≡ $|z| > \frac{1}{2}$ olmalıdır.
- YB1: $\begin{cases} |z| > \frac{1}{2} \\ |z| < \frac{1}{2} \end{cases}$ ve YB2: $\begin{cases} |z| > \frac{1}{4} \\ |z| < \frac{1}{4} \end{cases}$ olabilir
- $x(n) = 2\delta(n) + 3\left(\frac{1}{2}\right)^n u(n) - \left(\frac{1}{4}\right)^n u(n)$

Örnek 6

- $X(z) = 2 + \underbrace{\frac{3}{\left(1-\frac{1}{2}z^{-1}\right)}}_{\text{YB1}} + \underbrace{\frac{-1}{\left(1-\frac{1}{4}z^{-1}\right)}}_{\text{YB2}},$
- YB:$|z| < \frac{1}{4}$ olsaydı
- YB1: $\begin{cases} |z| > \frac{1}{2} \\ |z| < \frac{1}{2} \end{cases}$ ve YB2: $\begin{cases} |z| > \frac{1}{4} \\ |z| < \frac{1}{4} \end{cases}$ olabilir
- $x(n) =$

Örnek 6

- $X(z) = 2 + \underbrace{\frac{3}{\left(1-\frac{1}{2}z^{-1}\right)}}_{\text{YB1}} + \underbrace{\frac{-1}{\left(1-\frac{1}{4}z^{-1}\right)}}_{\text{YB2}},$
- YB:$|z| < \frac{1}{4}$ olsaydı
- YB1: $\begin{cases} |z| > \frac{1}{2} \\ |z| < \frac{1}{2} \end{cases}$ ve YB2: $\begin{cases} |z| > \frac{1}{4} \\ |z| < \frac{1}{4} \end{cases}$ olabilir
- $x(n) =$

Örnek 6

- $X(z) = 2 + \underbrace{\frac{3}{\left(1-\frac{1}{2}z^{-1}\right)}}_{\mathrm{YB1}} + \underbrace{\frac{-1}{\left(1-\frac{1}{4}z^{-1}\right)}}_{\mathrm{YB2}},$
- YB:$|z| < \frac{1}{4}$ olsaydı
- YB1: $\begin{cases} |z| > \frac{1}{2} \\ |z| < \frac{1}{2} \end{cases}$ ve YB2: $\begin{cases} |z| > \frac{1}{4} \\ |z| < \frac{1}{4} \end{cases}$ olabilir
- $x(n) = 2\delta(n)$

Örnek 6

- $X(z) = 2 + \underbrace{\frac{3}{\left(1-\frac{1}{2}z^{-1}\right)}}_{\text{YB1}} + \underbrace{\frac{-1}{\left(1-\frac{1}{4}z^{-1}\right)}}_{\text{YB2}},$
- YB: $|z| < \frac{1}{4}$ olsaydı
- YB1: $\begin{cases} |z| > \frac{1}{2} \\ |z| < \frac{1}{2} \end{cases}$ ve YB2: $\begin{cases} |z| > \frac{1}{4} \\ |z| < \frac{1}{4} \end{cases}$ olabilir
- $x(n) = 2\delta(n) - 3\left(\frac{1}{2}\right)^n u(-n-1)$

Örnek 6

- $X(z) = 2 + \underbrace{\frac{3}{\left(1-\frac{1}{2}z^{-1}\right)}}_{\text{YB1}} + \underbrace{\frac{-1}{\left(1-\frac{1}{4}z^{-1}\right)}}_{\text{YB2}},$
- YB:$|z| < \frac{1}{4}$ olsaydı
- YB1: $\begin{cases} |z| > \frac{1}{2} \\ |z| < \frac{1}{2} \end{cases}$ ve YB2: $\begin{cases} |z| > \frac{1}{4} \\ |z| < \frac{1}{4} \end{cases}$ olabilir
- $x(n) = 2\delta(n) - 3\left(\frac{1}{2}\right)^n u(-n-1) + \left(\frac{1}{4}\right)^n u(-n-1)$

Örnek 7

- $X(z) = \frac{1}{(1-z^{-1})(1-z^{-2})}$, YB: $|z| > 1$ ise $x(n) =?$

Örnek 7

- $X(z) = \frac{1}{(1-z^{-1})(1-z^{-2})}$, YB: $|z| > 1$ ise $x(n) =?$
- $X(z) = \frac{1}{(1-z^{-1})(1-z^{-1})(1+z^{-1})} =$

Örnek 7

- $X(z) = \frac{1}{(1-z^{-1})(1-z^{-2})}$, YB: $|z| > 1$ ise $x(n) =?$
- $X(z) = \frac{1}{(1-z^{-1})(1-z^{-1})(1+z^{-1})} = \frac{1}{(1-z^{-1})^2(1+z^{-1})}$
- $X(z) =$

Örnek 7

- $X(z) = \frac{1}{(1-z^{-1})(1-z^{-2})}$, YB: $|z| > 1$ ise $x(n) =?$
- $X(z) = \frac{1}{(1-z^{-1})(1-z^{-1})(1+z^{-1})} = \frac{1}{(1-z^{-1})^2(1+z^{-1})}$
- $X(z) = \frac{A}{(1-z^{-1})^2} + \frac{B}{(1-z^{-1})} + \frac{C}{(1+z^{-1})}$

Örnek 7

- $X(z) = \frac{1}{(1-z^{-1})(1-z^{-2})}$, YB: $|z| > 1$ ise $x(n) = ?$
- $X(z) = \frac{1}{(1-z^{-1})(1-z^{-1})(1+z^{-1})} = \frac{1}{(1-z^{-1})^2(1+z^{-1})}$
- $X(z) = \frac{A}{(1-z^{-1})^2} + \frac{B}{(1-z^{-1})} + \frac{C}{(1+z^{-1})}$
- $C = (1 + z^{-1})X(z)|_{z^{-1}=-1} =$

Örnek 7

- $X(z) = \frac{1}{(1-z^{-1})(1-z^{-2})}$, YB: $|z| > 1$ ise $x(n) = ?$
- $X(z) = \frac{1}{(1-z^{-1})(1-z^{-1})(1+z^{-1})} = \frac{1}{(1-z^{-1})^2(1+z^{-1})}$
- $X(z) = \frac{A}{(1-z^{-1})^2} + \frac{B}{(1-z^{-1})} + \frac{C}{(1+z^{-1})}$
- $C = (1+z^{-1})X(z)\big|_{z^{-1}=-1} = \left.\frac{1}{(1-z^{-1})^2}\right|_{z^{-1}=-1} =$

Örnek 7

- $X(z) = \frac{1}{(1-z^{-1})(1-z^{-2})}$, YB: $|z| > 1$ ise $x(n) =?$
- $X(z) = \frac{1}{(1-z^{-1})(1-z^{-1})(1+z^{-1})} = \frac{1}{(1-z^{-1})^2(1+z^{-1})}$
- $X(z) = \frac{A}{(1-z^{-1})^2} + \frac{B}{(1-z^{-1})} + \frac{C}{(1+z^{-1})}$
- $C = (1 + z^{-1})X(z)|_{z^{-1}=-1} = \left.\frac{1}{(1-z^{-1})^2}\right|_{z^{-1}=-1} = \frac{1}{4}$
- $A = (1 - z^{-1})^2 X(z)|_{z^{-1}=1} =$

Örnek 7

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Örnek 7

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Örnek 7

- $X(z) = \frac{1}{2}\underbrace{\frac{1}{(1-z^{-1})^2}}_{X_3(z)} + \frac{1}{4}\underbrace{\frac{1}{(1-z^{-1})}}_{X_2(z)} + \frac{1}{4}\underbrace{\frac{1}{(1+z^{-1})}}_{X_1(z)}$, YB: $|z| > 1$

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- $X_3(z)$' yi $X_2(z)$ ile nasıl elde ederiz.

Örnek 7

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- $X_3(z)$' yi $X_2(z)$ ile nasıl elde ederiz.
- $\frac{\partial}{\partial z}\left(\frac{1}{1-z^{-1}}\right) = \frac{-z^{-2}}{(1-z^{-1})^2}$

Örnek 7

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- $X_3(z)$' yi $X_2(z)$ ile nasıl elde ederiz.
- $\frac{\partial}{\partial z}\left(\frac{1}{1-z^{-1}}\right) = \frac{-z^{-2}}{(1-z^{-1})^2}$
- $-z\frac{\partial}{\partial z}\left(\frac{1}{1-z^{-1}}\right) = \frac{z^{-1}}{(1-z^{-1})^2} \neq \frac{1}{(1-z^{-1})^2}$

Örnek 7

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- $-z\frac{\partial}{\partial z}\left(\frac{1}{1-z^{-1}}\right) = \frac{z^{-1}}{(1-z^{-1})^2} \neq \frac{1}{(1-z^{-1})^2}$
- $z\left[-z\frac{\partial}{\partial z}\left(\frac{1}{1-z^{-1}}\right)\right] = z\frac{z^{-1}}{(1-z^{-1})^2} = \frac{1}{(1-z^{-1})^2}$

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- $\underbrace{z\left[-z\frac{\partial}{\partial z}\underbrace{\left(\frac{1}{1-z^{-1}}\right)}_{u(n)}\right]}_{?} = z\frac{z^{-1}}{(1-z^{-1})^2} = \frac{1}{(1-z^{-1})^2}$

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- $\underbrace{z\underbrace{\left[-z\frac{\partial}{\partial z}\underbrace{\left(\frac{1}{1-z^{-1}}\right)}_{u(n)}\right]}_{nu(n)}}_{(n+1)u(n+1)} = z\frac{z^{-1}}{(1-z^{-1})^2} = \frac{1}{(1-z^{-1})^2}$

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- $(n+1)u(n+1) = \boxed{}, n = -1$

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- $(n+1)u(n+1) = 0, n = -1$
- $(n+1)u(n+1) = (n+1)u(n)$

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- YB: $|z| < 1$ ise
  - $x(n) =$

Örnek 7

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- $x(n) = \frac{1}{4}(-1)^n u(n) + \frac{1}{4}u(n) + \frac{1}{2}(n+1)u(n)$
- YB: $|z| < 1$ ise
  - $x(n) = -\frac{1}{4}(-1)^n u(-n-1) - \frac{1}{4}u(-n-1) - \frac{1}{2}(n+1)u(-n-1)$