- **시스템의 출력 (영입력 응답 + 영상태 응답)**

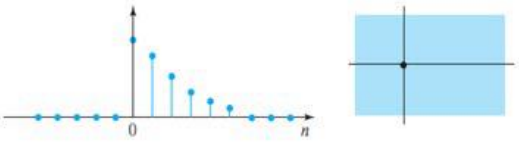
$$y(n) = y_{ZI}(n) + y_{ZS}(n) = (C_0\lambda_0^n + C_1\lambda_1^n + \cdots)u(n) + h(n) * x(n)$$

$$\mathrm{a}^n u(n) * b^n u(n) = \frac{a^{n+1} - b^{n+1}}{a - b} u(n)$$

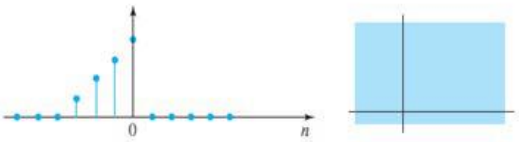
- **z-Transform**

$$\mathcal{Z}\{x(n)\} = X(z) = \sum_{n=-\infty}^{\infty} x(n) z^{-n}$$

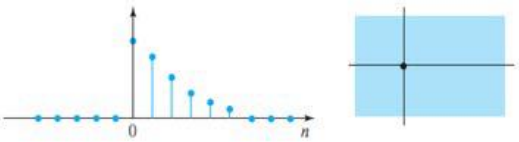
- **ROC**



Causal: All z-plane except $z = 0$



Non-causal: All z-plane except $z = \infty$



Causal & Non-causal: All z-plane except $z = 0$ and ∞

- **Properties of z-T**

$\mathcal{Z}\{a_1x_1(n) + a_2x_2(t)\}$	=	$a_1X_1(z) + a_2X_2(x)$
$\mathcal{Z}\{x(n-k)\}$	=	$z^{-k}X(z)$
$\mathcal{Z}\{a^n x(n)\}$	=	$X(a^{-1}z)$
$\mathcal{Z}\{nx(n)\}$	=	$-z\frac{d}{dz}X(z)$
$\mathcal{Z}\{x_1(n) * x_2(n)\}$	=	$X_1(z)X_2(z)$

- **z-T Table**

$\mathcal{Z}\{\delta(n)\}$	=	1
$\mathcal{Z}\{\delta(n-m)\}$	=	z^{-m}
$\mathcal{Z}\{u(n)\}$	=	$\frac{z}{z-1}$
$\mathcal{Z}\{a^n\}$	=	$\frac{z}{z-a}$

- **Transfer Function**

$$y(n) = h(n) * x(n) \xrightarrow{Z} Y(z) = H(z)X(z) \rightarrow H(z) = \frac{Y(z)}{X(z)}$$

- **z-T Zero(영점) Pole(극점)**

Zero: $H(z) = 0$ 을 만족하는 z값들

Pole: $H(z) = \infty$ 를 만족하는 z값들

- **단방향 Properties of z-T**

$$\mathcal{Z}\{x(n-k)\} = z^{-k}\left[X(z) + \sum_{n=1}^{k} x(-n)z^n\right], k > 0$$

$$\mathcal{Z}\{x(n+k)\} = z^{k}\left[X(z) - \sum_{n=1}^{k-1} x(n)z^{-n}\right], k > 0$$

- **연속시간 Fourier Series**

$$x(t) = \sum_{k=-\infty}^{\infty} c_k e^{j2\pi k F_0 t}$$

$$c_k = \frac{1}{T}\int_{-0.5T}^{0.5T} x(t)e^{-j2\pi F_0 t}dt$$

- **Power Spectrum Density (PSD)**

$$\mathrm{P} = \frac{1}{T}\int_{-0.5T}^{0.5T} |x(t)|^2 dt = \sum_{k=-\infty}^{\infty} |c_k|^2$$

- **a**
- **a**
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