(*) First Shifting Theorem (Frequency Shifting)

1) If $z[f(t)] = F(z)$, then $z[e^{-at} f(t)] = F[ze^{aT}]$

i.e., $z[e^{-at} f(t)] = \{F(z)\}_{z \to ze^{aT}}$

$$z[e^{at} f(t)] = \{F(z)\}_{z \to ze^{-aT}}$$

(*) Differentiation in Z-Domain

$$z[n f(n)] = -z \frac{d}{dz}\{F(z)\}.$$

(*) Recurrence formula:

$$z[n^k] = z[n \cdot n^{k-1}] = -z \frac{d}{dz} z[n^{k-1}]$$

(*) Damping Rule (or) Scaling in Z-Domain (or) Multiplication by a^n.

$$z[a^n f(n)] = F\left(\frac{z}{a}\right), \quad F(z) = z[f(n)].$$

(*) Second Shifting Theorem:

(*) $z[f(n+1)] = zF(z) - zf(0)$

(*) Z-Transform of Unit Impulse Function

A discrete unit Impulse function is defined by

$$\delta(k) = \begin{cases} 1, & k = 0 \\ 0, & k \neq 0 \end{cases}$$

Now $\delta(n-k)$ is defined by

$$\delta(n-k) = \begin{cases} 1, & n = k \\ 0, & n \neq k. \end{cases}$$

(*) Unit Step Function:

A discrete unit step function is defined as

$$u(k) = \begin{cases} 1, & k \geq 0 \\ 0, & k < 0 \end{cases}$$

Initial Value Theorem :

(*). If $z[f(n)] = F(z)$, then $\lim_{z \to \infty} F(z) = f(0)$

i.e., If $z[f(t)] = F(z)$ then

$$\lim_{z \to \infty} F(z) = \lim_{t \to 0} f(t)$$

Final Value Theorem :

(*) If $z[f(t)] = F(z)$ then

$$\lim_{t \to \infty} f(t) = \lim_{z \to 1} (z-1) F(z).$$