Fundamental Theoroem Of Alegbra

✓ Every n^{th} order Polynomial has exactly 'n' roots (complex)

<u>Poly</u>:

$$p(x) = a_n x^n + a_{n-1} x^{n-1} + \dots + a_1 x + a_0$$

$$\triangleq \sum_{i=0}^{n} a_i x^i$$

It can be rewritten as

$$p(x) = a_n (x - z_n)(x - z_{n-1}) \cdots (x - z_2)(x - z_1)$$

$$\triangleq a_n \prod_{i=1}^{n} (x - z_i)$$

where z_i are polynomial roots can be real or complex.

i) $x(n) = \delta(n) - a\,\delta(n-1)$ → ROC ENTIRE z plane

$$X(z) = \sum_{\forall n} \delta(n) - a\,\delta(n-1)\; z^{-n}$$

$$X(z) = 1 - a z^{-1}$$; for $|z|$ all over not including 0. i.e, $z = 0$

ii) $x(n) = a^n u[n]$

$$X(z) = \sum_{\forall n} a^n u[n]\, z^{-n}$$

$$= \sum_{n=0}^{\infty} \left(a^n z^{-n}\right) = \underbrace{\sum_{n=0}^{\infty} (a z^{-1})^n}_{GS}$$ → ROC outside ⊙le of radius 'a'

$$X(z) = \frac{1}{1 - a z^{-1}} \; ; \; |z| > |a|$$

iii) $x(n) = -b^n u[-n-1]$

$$X(z) = \frac{1}{1 - b z^{-1}} \; ; \; |z| < |b|$$

→ ROC in the annular ring bet 'a' & 'b' radii

iv) $x(n) = a^n u(n) - b^n u[-n-1)$

$$X(z) = \frac{1}{1 - a z^{-1}} + \frac{1}{1 - b z^{-1}} , \; |a| < |z| < |b|$$