COMPLEX NUMBERS: POWERS & ROOTS

Rectangular & Polar Forms

$$z = a + bi$$

$$z = r(\cos\theta + i\sin\theta) = re^{i\theta}$$

- Modulus: $r = \sqrt{(a^2 + b^2)}$
- Argument: $\theta = \tan^{-1}(b/a)$

Powers of i

- $i^1 = i$
- $i^2 = -1$
- $i^3 = -i$
- $i^4 = 1$

De Moivre's Theorem

For finding the n-th power of a complex number:

$$[r(\cos\theta + i\sin\theta)]^n = r^n(\cos n\theta + i\sin n\theta)$$

n-th Roots Formula

For k = 0, 1, 2, ..., n-1:

$$w_k = r^{1/n}\,[\cos(\theta+2k\pi/n) + i\sin(\theta+2k\pi/n)]$$

Quick Reference Table

Operation	Formula
Multiplication	$r_1r_2\,[\cos(\theta_1+\theta_2) + i\sin(\theta_1+\theta_2)]$
Division	$(r_1/r_2)\,[\cos(\theta_1-\theta_2) + i\sin(\theta_1-\theta_2)]$