Subject محاضرات التحليل العقدي 2 موضوع الدرس

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Ch. 5

Sequnces and Series

In this chapter, we study how to use series to represent analytic fuctions. The best known series are Taylor and laurent series which represent analytic fuctions in appropriate domains. In addition, we ~~study~~ will study singular points of fuctions of a complex variable in more details.

ملاحظات: اهمية هذا الموضوع يستخدم لإيجاد التكاملات العقدية، لكن في البداية يجب ان نتكلم قليلاً عن المتتابعات والمتسلسلات العقدية.

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Convergence of sequences and series

Def: (1) An infinite seq. of complex numbers is a function from N to $\mathbb{C}$, $\{Z_n\} = \{Z_1, Z_2, \dots\}$.

(2) let $\{Z_n\}$ be a seq of complex numbers, we say that $\{Z_n\}$ has a limit Z, if for each $\epsilon > 0$ there exists a positive integer n_0 s.t.

$$|Z_n - Z| < \epsilon \quad , \forall n > n_0 .$$

(3) If a seq. of complex numbers $\{Z_n\}$ has a limit Z, then we say that the seq converges to Z and we write $\boxed{\lim_{n\to\infty} Z_n = Z}$

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④ If a seq. of complex number $\{Z_n\}$ does not have a limit, then we say that it diverges.

Theorem: Let $\{Z_n\}$ be a seq. of complex numbers and let Z be a complex numbers s.t. $Z_n = x_n + i y_n$ and $Z = x + iy$ then $\lim_{n\to\infty} Z_n = Z = x + iy$ if and only if

$\lim_{n\to\infty} x_n = x$ & $\lim_{n\to\infty} y_n = y$.

proof: $\Rightarrow$ let $\lim_{n\to\infty} Z_n = Z$

$\Rightarrow \lim_{n\to\infty} (x_n + i y_n) = (x + iy)$

$\Rightarrow \lim_{n\to\infty} x_n = x$ & $\lim_{n\to\infty} y_n = y$

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~~that~~ $\lim_{n\to\infty} x_n = x$ & $\lim_{n\to\infty} y_n = y$

T.P $\lim_{n\to\infty} z_n = z$

$\because \lim_{n\to\infty} x_n = x \Rightarrow \exists\, n_1 > 0$ s.t.

$|x_n - x| < \frac{\epsilon}{2} \quad \forall n > n_1$

$\because \lim_{n\to\infty} y_n = y \Rightarrow \exists\, n_2 > 0$ s.t.

$|y_n - y| < \frac{\epsilon}{2} \quad \forall n > n_2$

then $|z_n - z| = |x_n - x + i(y_n - y)|$

$\leq |x_n - x| + |y_n - y|$

$< \frac{\epsilon}{2} + \frac{\epsilon}{2} = \epsilon \quad \forall n > n_0$