**Chapter 5: Cauchy’s Integral Formulas and Related Theorems**

Table of Contents

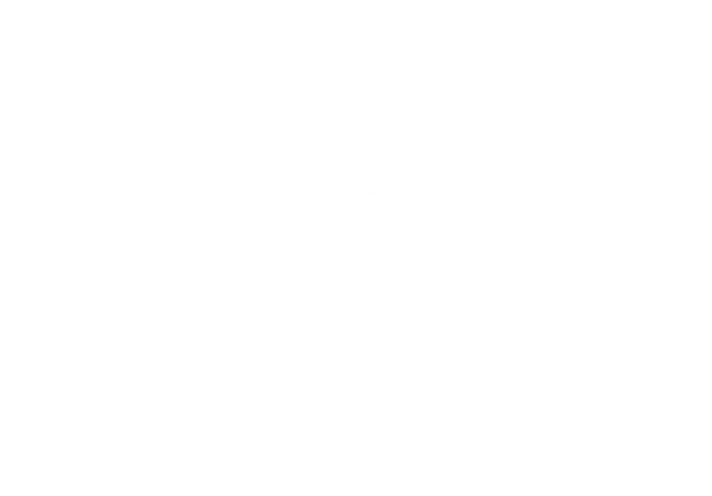
[5.1 Cauchy’s Integral Formulas 2](#_Toc82188870)

[Proof 3](#_Toc82188871)

## 5.1 Cauchy’s Integral Formulas

Suppose is **analytic** inside and on a simple closed curve, . Let be any point inside . In this scenario,

where is traversed in the **counter-clockwise** direction and is where .



The **th derivative** of at is given by:

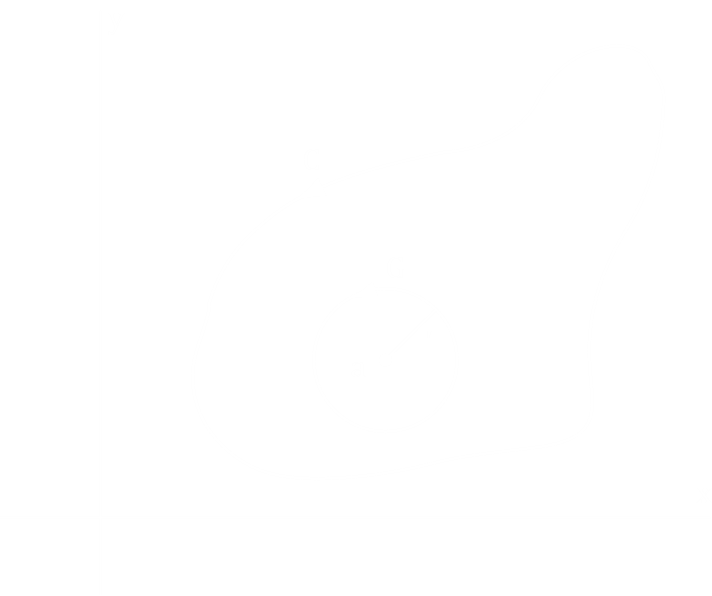
Here, . and is differentiated times at the point where .

The above equations are called **Cauchy’s integral formulas**. Using it, if a function is known **on** the simple curve , then the values of the function all its derivatives can be at all points **inside** the curve . Thus, if a function of a complex variable is **analytic** in a simple connected region, , all its higher derivates exist in . This is not necessarily true for real variables.

### Proof

Consider that is analytic inside and on the curve except at the point . Then,

where is a circle with radius with centre at . Then, an equation for is



From here, we can see that . Substituting this,

Taking the limit on both sides,

[since ]