

بخش ۷-۱- تکینگیها

مسائل صفحه ۵۴۴

۷-۱-۱ بسط سری لوران تابع $f(z)$ نشان می‌دهد که این تابع یک قطب مرتبه m در $Z = Z_0$ دارد نشان دهید که a_{-1} ضریب $(z - z_0)^{-1}$ از رابطه زیر بدست می‌آید.

$$a_{-1} = \frac{1}{(m-1)!} \frac{d^{m-1}}{dz^{m-1}} \left[(z - z_0)^m f(z) \right]_{z=z_0}$$

که اگر این قطب یک قطب ساده ($m=1$) باشد خواهیم داشت

$$a_{-1} = \left[(z - z_0) f(z) \right]_{z=z_0}$$

این معادله برای a_{-1} در تعیین مانده‌ای که در بخش بعد در قضیه مانده‌ها بکار می‌رود بسیار سودمند است.

$$f(z) = \sum_{n=-\infty}^{\infty} a_n (z - z_0)^n \quad f(z) = \frac{a_m}{(z - z_0)^m} + \frac{a_{m-1}}{(z - z_0)^{m-1}} + \dots + \frac{a_{-1}}{(z - z_0)^1} \quad \text{کحل}$$

طرفین را در $(z - z_0)^m$ ضرب می‌کنیم.

$$(z - z_0)^m f(z) = a_m + a_{m-1} (z - z_0) + \dots + a_{-1} (z - z_0)^{m-1} + \dots$$

حال مشتق‌گیری می‌کنیم

$$\frac{d^{m-1}}{dz^{m-1}} \left[(z - z_0)^m f(z) \right] = (m-1)! a_{-1} \Rightarrow$$

$$a_{-1} = \frac{1}{(m-1)!} \frac{d^{m-1}}{dz^{m-1}} \left[(z - z_0)^m f(z) \right]$$

۷-۱-۲ تابع $f(z)$ را می‌توان به کمک رابطه زیر نشان داد.

$$f(z) = \frac{f_1(z)}{f_2(z)}$$

که در آن $f_1(z)$ و $f_2(z)$ تحلیلی‌اند. $f_2(z)$ در مخرج در $z = z_0$ صفر می‌شود از اینجا پی می‌بریم که $f(z)$ در $z = z_0$ یک قطب دارد. ولی $f_1(z) \neq 0$ و $f_2'(z_0) \neq 0$ نشان دهید که a_{-1} ضریب $(z - z_0)^{-1}$ در بسط لوران تابع $f(z)$ به ازای $z = z_0$ از رابطه زیر بدست می‌آید.

$$a_{-1} = \frac{f_1(z_0)}{f_2'(z_0)}$$

این نتیجه به قضیه بسط هویساید در بخش ۱۵-۱۲ می‌انجامد.

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