and $\dim \mathcal{O}_{B,p} = \dim \left(\mathcal{O}_p / I_p \right) = 4$ see p669

More explicitly, $\mathcal{O} / I$,

$I = \{ xy, \ (x-y)(x-ry) \}$

$\Rightarrow \displaystyle\int \frac{d\,xy}{xy} \wedge \frac{d(x-y)(x-ry)}{(x-y)(x-ry)} = 4$? $\Rightarrow$ We will show this below.

Clearly if we consider

$$\mathbb{C}^2 \xrightarrow{f} \mathbb{C}^2$$

$$(x, y) \longmapsto (xy, \ (x-y)(x-ry))$$

$\Rightarrow \quad xy = a \quad (x-y)(x-ry) = b$

$\quad x^2 - (1+r)xy + ry^2 = b$

$\Rightarrow \quad x^2 - a(1+r) - b + r\dfrac{a^2}{x^2} = 0$

$\quad x^4 - (a + ar + b)x^2 + ra^2 = 0$

For general a & b, there are 4 distinct roots. $\Rightarrow \deg f = 4 = \dim \left(\mathcal{O}_p / I_p \right)$ by 670.