In a series RC circuit with an AC source, R = 300 Ω, C = 25 μF, ε_0 = 50 V and $\nu = 50/\pi$ Hz. Find the peak current and the average power dissipated in the circuit.

In the given series RC circuit with AC source.

$R = 300\,\Omega$, $C = 25\,\mu F = 25 \times 10^{-6}\,F$, $\mathcal{E}_0 = 50\,V$, $\nu = \frac{50}{\pi}\,Hz$

$\therefore \omega = 2\pi\nu$

$= (2\pi)\left(\frac{50}{\pi}\right) \Rightarrow 100\ rad/s$

$\therefore X_C = \frac{1}{\omega C} \Rightarrow \frac{1}{(100)(25\times10^{-6})} \Rightarrow 400\,\Omega$

$\therefore Z = \sqrt{R^2 + X_C^2}$

$= \sqrt{(300)^2 + (400)^2}$

$\boxed{Z = 500\,\Omega}$

$\therefore$ Peak current $(i_0) = \frac{\mathcal{E}_0}{Z}$

$= \frac{50}{500}$

$\boxed{i_0 = 0.10\,A}$

$\therefore P_{\text{average dissipated}} = (\mathcal{E}_{rms})(I_{rms}) \cos\phi$

$= \left(\frac{\mathcal{E}_0}{\sqrt{2}}\right)\left(\frac{I_0}{\sqrt{2}}\right)\left(\frac{R}{Z}\right) \quad \left(\because \cos\phi = \frac{R}{Z}\right)$

$\Rightarrow \left(\frac{50}{\sqrt{2}}\right)\left(\frac{0.16}{\sqrt{2}}\right)\left(\frac{300}{4.500}\right)$

$\boxed{P_{\text{average dissipated}} \Rightarrow 1.5\ W}$