

V_{IN} is applied to a series RC circuit
calculate the power dissipated in R

$$\frac{V_{RES}}{V_{IN}} = \frac{R}{R + \frac{1}{j\omega C}}$$

$$\frac{V_{RES}}{V_{IN}} = \frac{j\omega CR}{1 + j\omega CR}$$

$$\left| \frac{V_{RES}}{V_{IN}} \right| = \frac{\omega CR}{\sqrt{1 + (\omega CR)^2}}$$

$$|V_{RES}| = \frac{V_{IN} \cdot \omega CR}{\sqrt{1 + (\omega CR)^2}}$$

$$Power = \frac{|V_{RES}|^2}{R} = \frac{(\omega CV_{IN})^2 \cdot R}{1 + (\omega CR)^2}$$

convert to Hertz: $\omega = 2\pi f$

$$Power = \frac{|V_{RES}|^2}{R} = \frac{(2\pi f CV_{IN})^2 \cdot R}{1 + (2\pi f CR)^2}$$