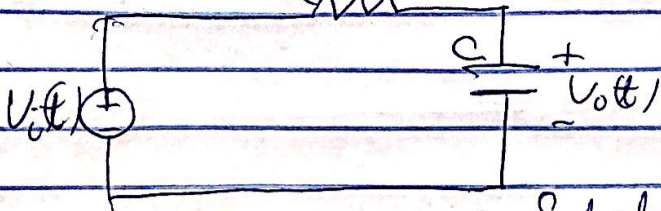


Determine the type of filter shown below and show that its cut-off frequency is $\omega_c = \frac{1}{RC}$



Solution

The figure shows a LOW PASS filter to obtain its cut-off frequency ω_c

$$\frac{V_{o(s)}}{V_{i(s)}} = \frac{V_{sC}}{R + \frac{1}{sC}} = \frac{1/j\omega C}{R + 1/j\omega C}$$

$$H(\omega) = \frac{1}{1 + Rj\omega C}$$

cut-off frequency is obtained by setting the magnitude of $H(\omega) = \frac{1}{\sqrt{2}}$

$$|H(\omega)| = \frac{\sqrt{1^2}}{\sqrt{1^2 + (Rj\omega C)^2}} = \frac{1}{\sqrt{2}}$$

$$H(\omega) = \frac{1}{\sqrt{1 + \omega_c^2 R^2 C^2}} = \frac{1}{\sqrt{2}}$$

$$\sqrt{2} = \sqrt{1 + \omega_c^2 R^2 C^2}$$

$$2 = 1 + \omega_c^2 R^2 C^2$$

$$2 - 1 = \omega_c^2 R^2 C^2$$

$$1 = \omega_c^2$$

$$R^2 C^2$$

$$\frac{1}{RC} = \omega_c$$

$$\omega_c = \frac{1}{RC}$$

← (square both sides)

(take square root of both sides)