

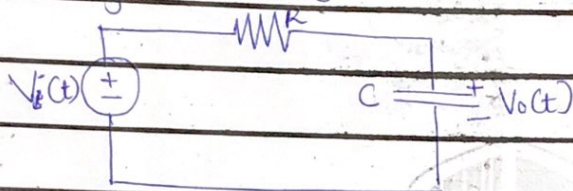
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ASSIGNMENT

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



Solution:

(a) It's lowpass filter

(b) The transfer function:

$$H(\omega) = \frac{V_o}{V_i} = \frac{1/j\omega C}{R + 1/j\omega C}$$

$$H(\omega) = \frac{1}{1 + j\omega RC}$$

$$|H(\omega)| = \frac{1}{\sqrt{1 + \omega^2 R^2 C^2}} = \frac{1}{\sqrt{2}} \quad (\text{magnitude of } H(\omega) \text{ is equated } \frac{1}{\sqrt{2}} \text{ to } \frac{1}{\sqrt{2}} \text{ to obtain the cut-off frequency})$$

Square both sides

$$\frac{1}{1 + \omega^2 R^2 C^2} = \frac{1}{2}$$

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

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

$$1 = \omega^2 R^2 C^2$$

$$\omega^2 = \frac{1}{R^2 C^2}$$

$$\omega_c = \frac{1}{RC} \quad \text{Find } \therefore \text{Square root of both sides}$$