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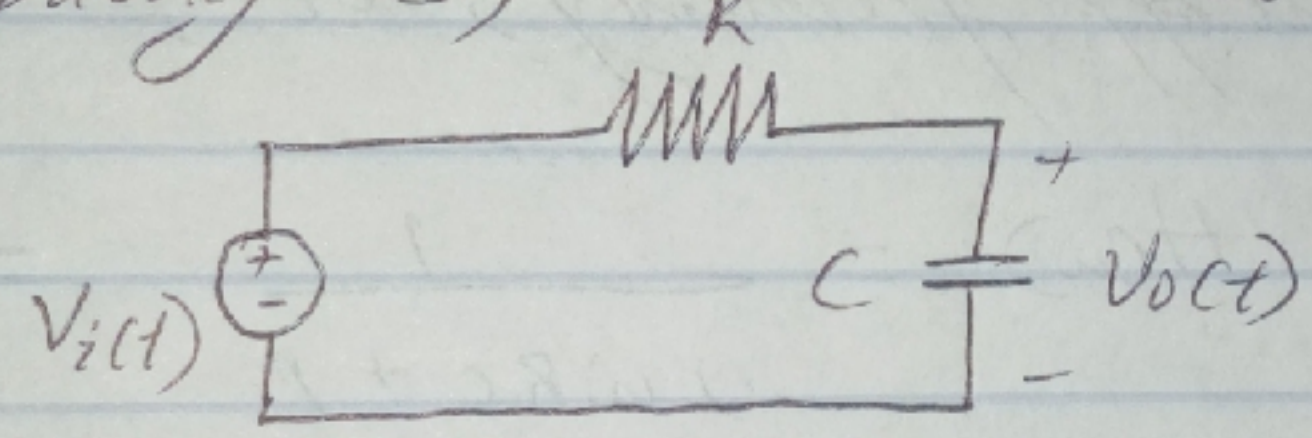
Electrical / Electronics
EEE 322 : Circuit theory.

Assignment

Determine the type of filter shown below, & show that it's cut-off frequency is; $\omega_c = 1/RC$.



$$T_f = \frac{1}{j\omega C}$$

$$V_o = \frac{1}{j\omega C}, \quad V_i = R + \frac{1}{j\omega C}.$$

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

$$\frac{V_o}{V_i} = \left[\frac{\frac{1}{j\omega C}}{R + \frac{1}{j\omega C}}\right] V_i$$

$$= \frac{1}{j\omega C} \times R + \frac{1}{j\omega C}$$

$$= \frac{1}{j\omega RC + 1}$$

when $(H_\omega) = 0$, $H = 1$

when $(\omega) = \infty$, $H = 0$

∴ Cut off frequency, ω_c ;

$$H(\omega) = \frac{1}{j\omega RC + 1} = \frac{1}{\sqrt{2}}$$

(ω_c is the magnitude of $H(\omega)$ to $\frac{1}{\sqrt{2}}$)

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

$$= \frac{1}{\sqrt{2}}$$

$$\Rightarrow 2 = \sqrt{1 + \omega^2 R^2 C^2}.$$

Squaring both sides.

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

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

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

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

$$\omega = \omega_c.$$

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

It is a low pass filter & its an RLC circuit.

$$s^{2x} = 2.$$

$$x = 2/5.$$

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