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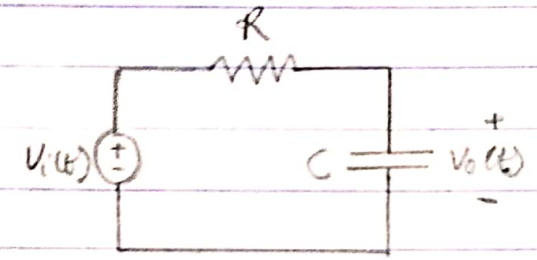
MATRIC NUMBER: 17/ENG02/061

DEPARTMENT: COMPUTER ENGINEERING

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



The transfer function, $H(\omega) = \frac{V_o}{V_i} = \frac{\frac{1}{j\omega C}}{R + \frac{1}{j\omega C}} = \frac{1}{1 + j\omega RC}$

To determine the type of filter,

$$H(0) = \frac{\frac{1}{j(0)C}}{R + \frac{1}{j(0)C}} = \frac{1}{1 + j(0)RC} = \frac{1}{1} = 1$$

$\therefore H(0) = 1$

$$H(\infty) = \frac{1}{1 + j(\infty)RC} = 0$$

Since $H(0) = 1$ and $H(\infty) = 0$, the filter is a Low Pass Filter.

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

Therefore, $|H(\omega_c)| = \left|\frac{1}{1 + j\omega RC}\right| = \frac{1}{\sqrt{1 + \omega_c^2 R^2 C^2}}$

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

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

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

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

$$\omega_c^2 = \frac{1}{R^2 C^2} \quad \therefore \omega_c = \frac{1}{RC}$$

The cut-off frequency, $\omega_c = \frac{1}{RC}$