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17/ENG02/003

Computer engineering

* Determine the type of filter shown below, and show that its cut-off frequency is:

$$\omega_c = 1/Rc$$

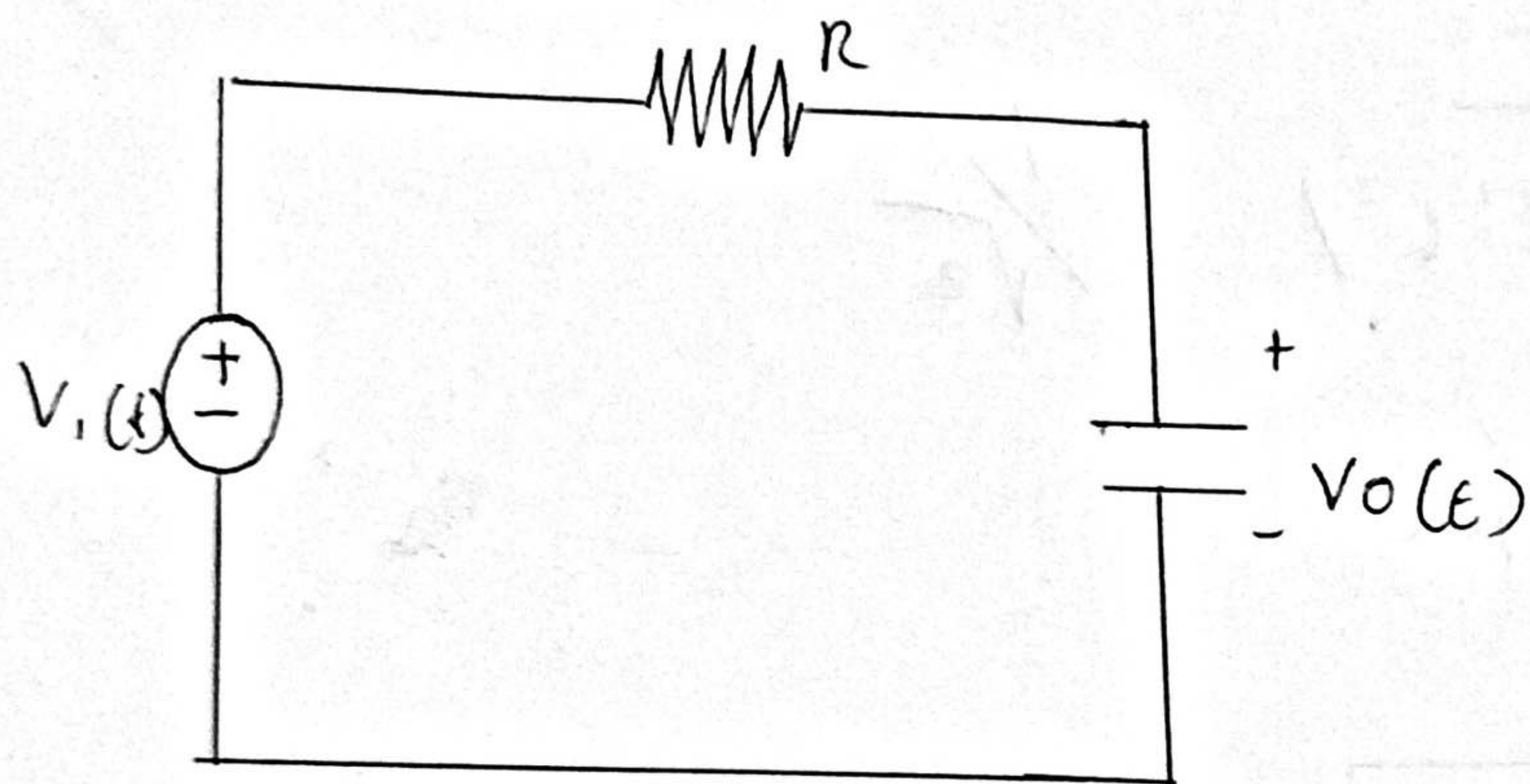


Fig Typical low pass filter

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

$$\frac{1/j\omega c}{R + 1/j\omega c} = \frac{1}{1 + Rj\omega c}$$

$$H(\omega) = 1$$

$$H(\omega) = 0$$

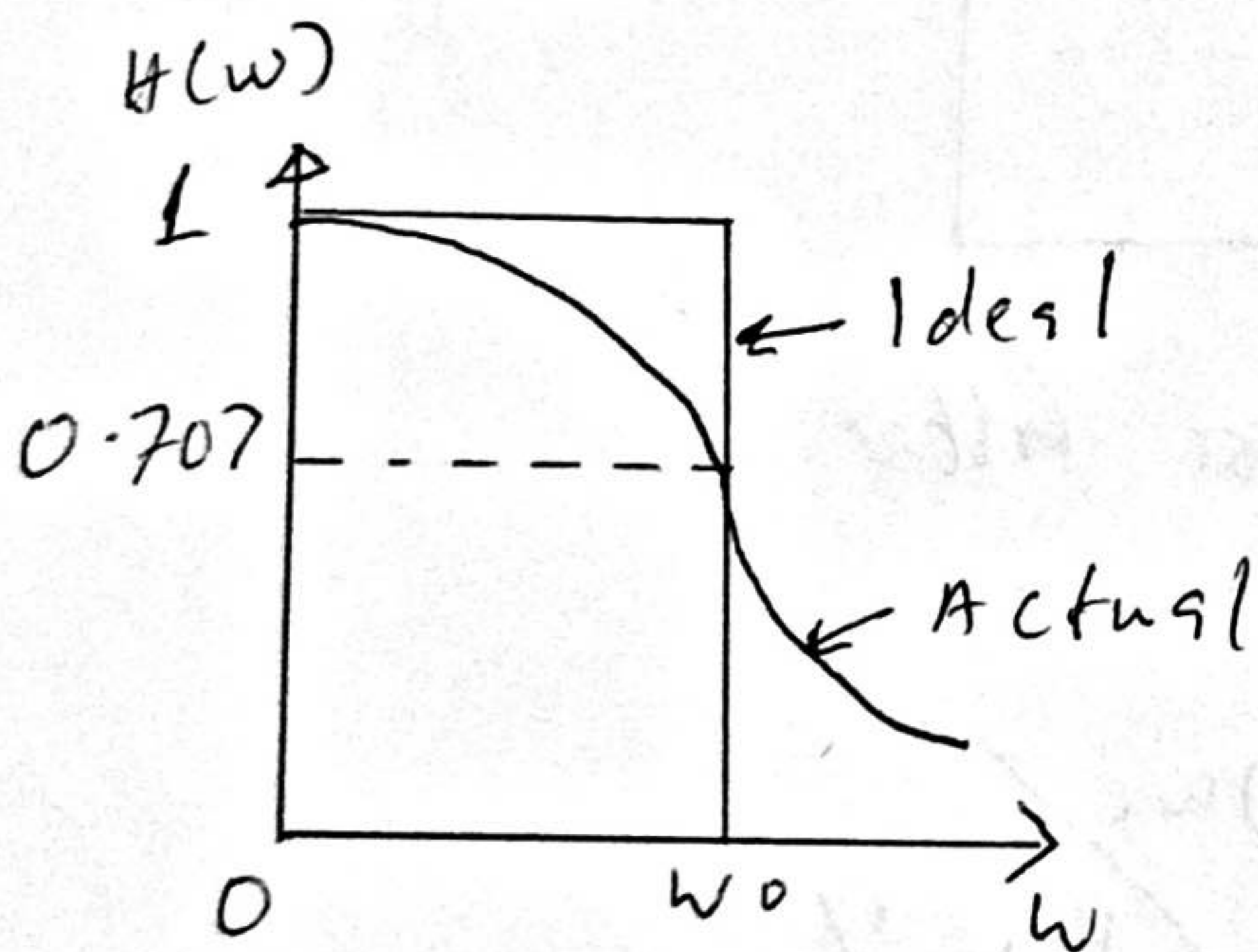
The cut off frequency ω_c is obtained by setting the magnitude of $H(\omega)$ to $1/\sqrt{2}$

$$|H(\omega)| = \left| \frac{1}{sRC + 1} \right| = \frac{1}{\sqrt{2}}$$

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

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

$$\omega C = \frac{1}{RC}$$



Ideal and actual frequency response of low pass filter.

The cut-off frequency is also called the Roll off frequency.