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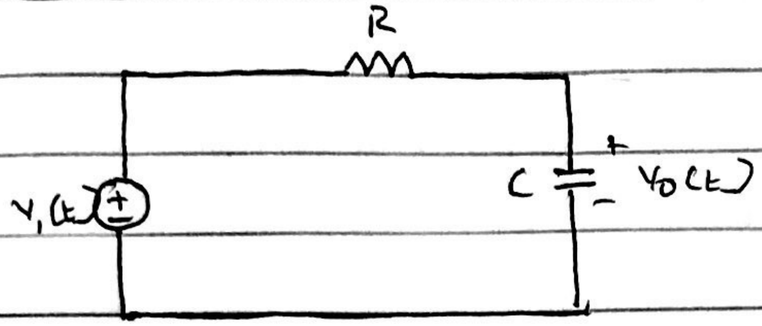
17/ENG05/038
Mechatronics
EEE 322



Solution

Converting to frequency domain

$R \rightarrow R$

$C \rightarrow \frac{1}{j\omega C}$

$H(\omega) = \frac{V_o}{V_i}$

Using KVL (series connection)

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

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

when $H(0) = 1$, $H(\infty) = 0$

The half power frequency which is equivalent to the corner frequency on the Bode plots but in the content of filters is usually known as

Cut-off frequency w_c, is obtained by setting magnitude of H(w) equal to $1/\sqrt{2}$

Substituting w_c

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

making w_c subject of formula

Taking square of both sides

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

$$2 \cdot 1^2 = 1 + w_c^2 R^2 C^2$$

$$2 = 1 + w_c^2 R^2 C^2$$

$$2 - 1 = w_c^2 R^2 C^2$$

$$1 = w_c^2 R^2 C^2$$

$$1 = w_c RC$$ (Taking square root of both sides)

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