Inbyggd elektronik 2018-05-15 #14

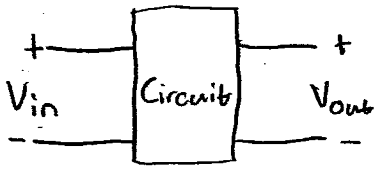
$V_s = V_m \cos(\omega t + \Phi)$ Phasor representation $\hat{V} = V_m \angle \Phi^\circ$

$\hat{V} = Z\hat{I}$ Z is impedance $[\Omega]$

Element	$Z[\Omega]$
Resistor	R
Inductor	$j\omega L$
Capacitor	$\frac{1}{j\omega C}$

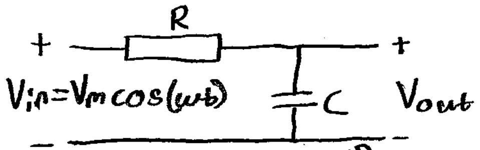
All linear techniqes applies: Node-Voltage
Mesh-Current
Thevenin-equivalents
Superposition

Filter circuits (Chapter 14 in book $s = j\omega$)

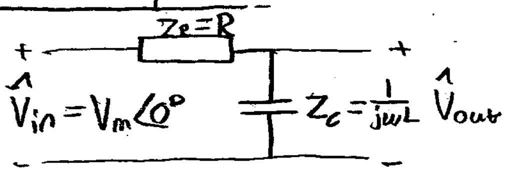


- The circuit will change the amplitude and phase angle of V_{out} with respect to V_{in}.
- The amplitude and phase angle of V_{out} will depend on ω of V_{in}.

Ex:



Complex representation



$$\hat{V}_{out} = \hat{V}_{in} \cdot \frac{Z_c}{Z_R + Z_c} = \hat{V}_{in} \frac{\frac{1}{j\omega C}}{R + \frac{1}{j\omega C}} =$$

$$= \hat{V}_{in} \frac{1}{1 + j\omega RC} = \frac{1 - j\omega RC}{(1 + j\omega RC)(1 - j\omega RC)} =$$

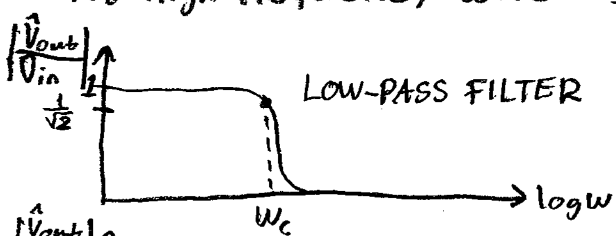
$$= \hat{V}_{in} \frac{1 - j\omega RC}{1 + (\omega RC)^2}$$

Amplitude ($V_{in} = 1$)

$$\left|\frac{\hat{V}_{out}}{\hat{V}_{in}}\right| = \left|\frac{1 - j\omega RC}{1 + (\omega RC)^2}\right| = \sqrt{\frac{1}{(1+(\omega RC)^2)^2} + \frac{(\omega RC)^2}{(1+(\omega RC)^2)^2}} = \sqrt{\frac{1 + (\omega RC)^2}{(1 + (\omega RC)^2)^2}} = \frac{1}{\sqrt{1 + (\omega RC)^2}}$$

At low frequency $\omega RC \ll 1 \Rightarrow |V_{out}| = |V_{in}|$

At high frequency $\omega RC \gg 1 \Rightarrow |V_{out}| = \frac{|V_{in}|}{\omega RC} \to 0$ when $\omega \to \infty$



ω_c is the cut-off frequency. $\omega_c = \frac{1}{RC} = \frac{1}{\tau}$