Jan 10

Signal Transformation:

We know $x(t)$, How to draw $x(at+b)$?

1) scaling (at)

if $a>1$, the signal compress (shrinks) along the axis

if $0<a<1$, the signal stretches (expand) along the time axis.

if $a<0$, it also flips (mirrors) the signal about the vertical axis.

2) Shifting $(+b)$:

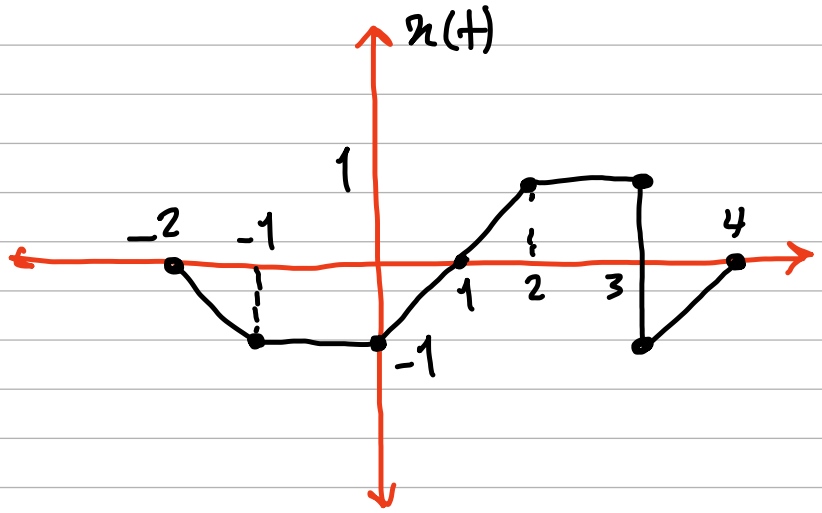
if $b>0$, the signal shift to the left (earlier in time).
if $b<0$, the signal shifts to the right (later in time).

To draw $x(at+b)$, 1) shift by b
2) Scale by a

Double cheking the critical point (peaks, zero crossing, discontinuities, etc).

$t' = ax+b \longrightarrow t = \frac{t'-b}{a}$, use this to determine where features of $x(t)$ map in $x(at+b)$

Question: what is $x(2-t)$, $x(\frac{t}{2}-1)$, and $2x(-2t+3)+1$



phasar:

$$X(t) = A\cos(\omega t + \theta) = \mathrm{Re}\{A e^{j\theta} e^{j\omega t}\}$$

A: amplitude; ω: angular freq; θ: phase angle; $A e^{j\theta}$: phasar

$$\sin(\omega t + \theta) = \cos(\omega t + \theta - \frac{\pi}{2})$$

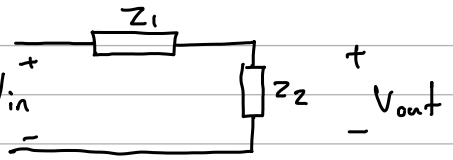
example: $x(t) = 5\cos(100\pi t + \frac{\pi}{4}) \longrightarrow X = 5e^{j\pi/4}$

$$x(t) = 3\sin(200\pi t + \frac{\pi}{6}) = 3\cos(200\pi t + \frac{\pi}{6} - \frac{\pi}{2}) = 3\cos(200\pi t - \frac{\pi}{3}) \Rightarrow X = 3e^{-j\pi/3}$$

Capacitor: $i_C = C\frac{dv}{dt} \longrightarrow I_C = j\omega C V_C \Rightarrow Z_C = \frac{1}{j\omega C}$

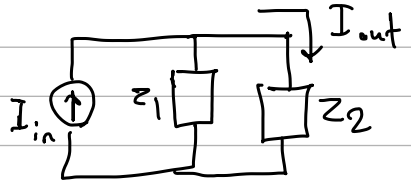
Inductor: $V = L\frac{di}{dt} \longrightarrow V = j\omega L I \Rightarrow Z_L = j\omega L$

Voltage divider:



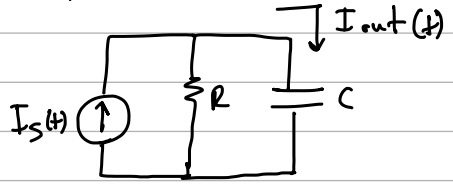
$$\frac{V_{out}}{V_{in}} = \frac{Z_2}{Z_1 + Z_2}$$

Current divider



$$\frac{I_{out}}{I_{in}} = \frac{Z_1}{Z_1 + Z_2}$$

Example:



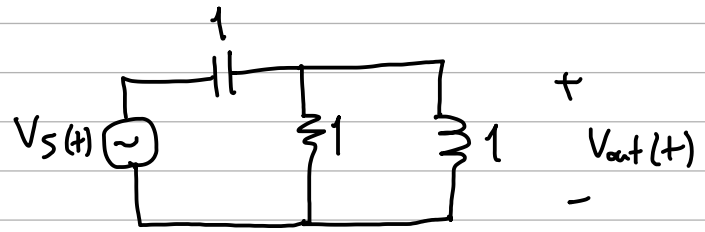
$I_S(t) = A\cos(\omega t)$

a) What is phasor of $I_S(t)$?

b) Find how I_{out} will relate to I_S in frequency domain?

c) compute $I_{out}(t)$

Example:



$$V_S(t) = 5\cos\left(2t + \frac{\pi}{6}\right)$$

a) What is phasor of $V_S(t)$?

b) How V_{out} will relate to V_S in frequency domain?

c) Compute $V_{out}(t)$