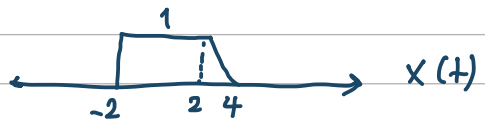
# Discussion Session 4:

(1) plot the following signals




a) $x(2t+4)$

b) $x\left(\frac{-t}{2}+1\right)$

c) $3x(-t+1)+2$

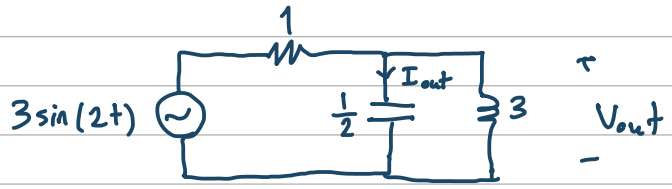
d) $-x(t)\,u(t-1)$

Answers:

② Find $x(t) * h(t)$

$x(t) = \text{rect}\left(\frac{t}{2} - 3\right)$ $\quad h(t) = \text{rect}(t+2)$

(3) Find $V_{out}$ and $I_{out}$ with phasor method




Answer

## ④ LTI checking

a) $y(t) = \int_{-\infty}^{\infty} x(\tau)\, h(2t-\tau)\, d\tau$

b) $y(t) = \begin{cases} x(t) & t \geq 0 \\ 0 & t < 0 \end{cases}$

$t - t_0)$

Transfer Function: Laplace transform of the impulse response.

$$H(s) = \int_{-\infty}^{\infty} h(\tau)\, e^{-s\tau}\, d\tau$$

$x(t) = e^{st} \longrightarrow$ [LTI] $\longrightarrow y(t) = H(s)\, e^{st}$ Eigenfunction of a LTI system

Some properties of laplace: ($x(t)$: a caus

$\mathcal{L}\{a f(t) + b g(t)\} = a F(s) + b G(s)$ Linearity

$\mathcal{L}\{f(t-T)\, u(t-T)\} = e^{-Ts} F(s)$ Time Shifting

$\mathcal{L}\{e^{at} f(t)\} = F(s-a)$ Frequency Shifting

$\mathcal{L}\{f'(t)\} = sF(s) - f(0^+)$ Differentiation in time domain

$\mathcal{L}\{f''(t)\} = s\mathcal{L}\{f'(t)\} - f'(0^+) = s^2 F(s) - sF(0^+) - f'(0^+)$

$\mathcal{L}\left\{\int_0^t f(\tau)\, d\tau\right\} = \frac{F(s)}{s}$ Integration in time domain

$\mathcal{L}\{f(t) * g(t)\} = F(s)\, G(s)$ Convolution Theorem

$\mathcal{L}\{+f(t)\} = \frac{-d}{ds} F(s)$ Differentiation is s domain

$\mathcal{L}\{t^n f(t)\} = (-1)^n \frac{d^n}{ds^n} F(s)$

$\mathcal{L}^{-1}\left\{\frac{1}{s+a}\right\} = e^{-at} u(t)$

$\mathcal{L}^{-1}\left\{\frac{1}{(s+a)^2}\right\} = te^{-at} u(t)$

Partial Fraction: $\frac{N(s)}{D(s)}$ (degree of $N(s)$ is less than degree of $D(s)$)

Example: $y(s) = \frac{3}{s(s+2)}$ (no repeated factor $(s-a)^2$, no irreducible quatratic factor $(s^2+w^2)$)

$= \frac{A}{s} + \frac{B}{s+2}$

Example #2: $y(s) = \frac{5s+7}{(s+1)^2}$ (Repeated linear factor)

$$= \frac{A}{s+1} + \frac{B}{(s+1)^2}$$

Example #3: What is $y(t)$ in example #2?