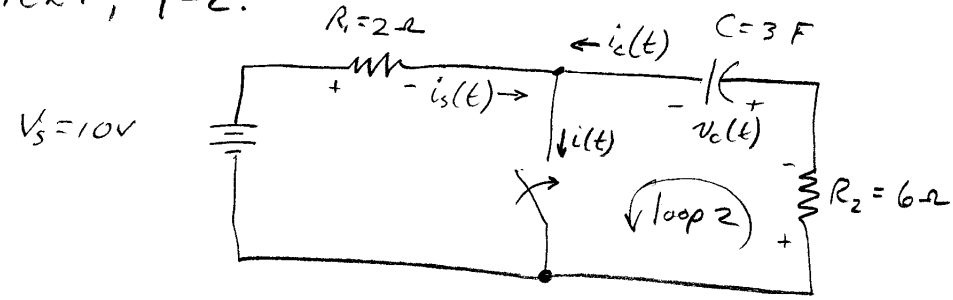
① Text, 4-2.



$$i(t) = i_s(t) + i_c(t)$$

$$i_s(t) = \frac{V_s}{R_1} \qquad i_c(t) = C\frac{d\,v_c(t)}{dt}$$

around loop 2, using KVL, after time 0

$$i_c(t)R_2 + v_c(t) = 0$$

$$6\cdot\Big(\underbrace{3\frac{dv_c(t)}{dt}}_{i_c(t)}\Big) + v_c(t) = 0 \quad \text{or} \quad \boxed{\frac{dv_c(t)}{dt} + \frac{1}{18}v_c(t) = 0}$$

Note: From Diff eqs, solution to 1st order Diff Eq is an exponent

$$\left.\begin{aligned} v_c(0) &= -10v \\ v_c(\infty) &= 0 \end{aligned}\right\} \quad v_c(t) = -10e^{-t/18}$$

$$i_c(t) = C\frac{dv_c(t)}{dt} = 3\cdot\frac{d}{dt}\left(-10e^{-t/18}\right) = -30\left(e^{-t/18}\right)\cdot\left(-\frac{1}{18}\right)$$

$$= 1.67e^{-t/18}\ A$$

$$i(t) = i_s(t) + i_c(t) = \frac{10v}{2\Omega} + 1.67e^{-t/18}\ A$$

$$\boxed{i(t) = 5 + 1.67e^{-t/18}\ A}$$

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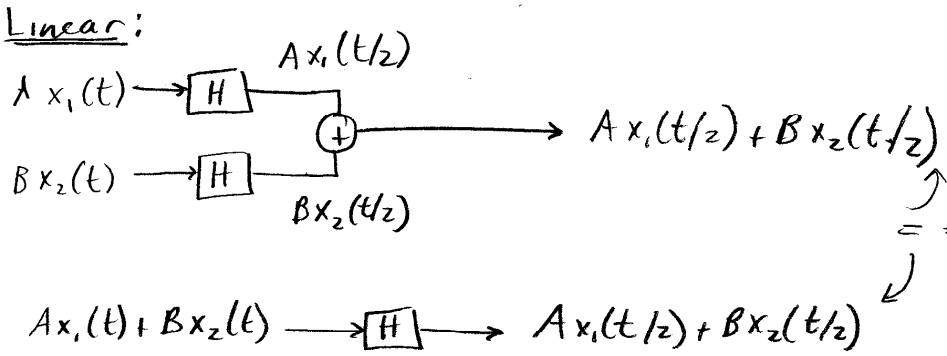
(2) Text 4-8

$$y(t) = x(t/2)$$

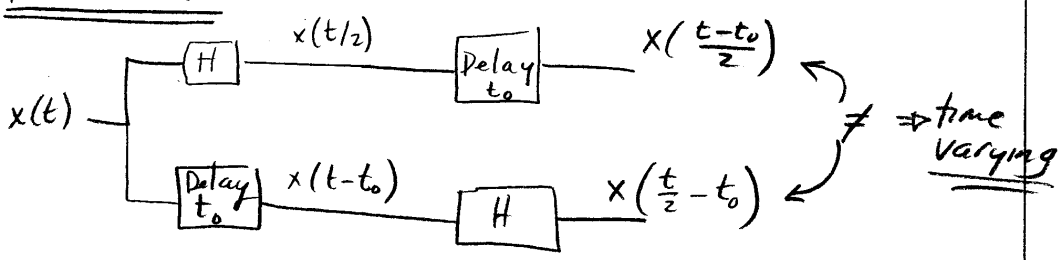
Linear:



$=$ ⇒ Linear

$$Ax_1(t) + Bx_2(t) \longrightarrow \boxed{H} \longrightarrow Ax_1(t/2) + Bx_2(t/2)$$

time variant



$\neq$ ⇒ time varying

noncausal

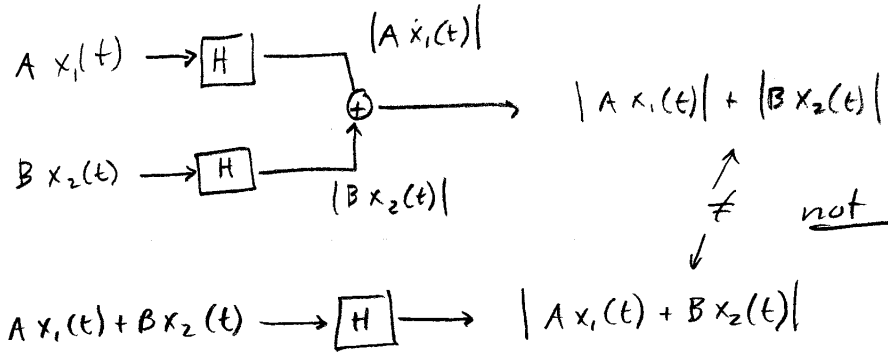
counter example: $y(-1) = x(-1/2)$ time $t=-1$ occurs before $t=-1/2$

- output for negative time values occurs before input occurs.

③ Text, 4.10

$$y(t) = |x(t)|$$

Linear?



BIBO stable?

assume $|x(t)| < M < \infty$

then $y(t) = |x(t)| < M < \infty$

if $x(t)$ is bounded, then $y(t)$ is bounded

<u>BIBO stable</u>

---

causal?

output at any time t_0 only depends on input at time t_0

$y(t_0) = |x(t_0)| \Rightarrow$ <u>causal</u>

---

invertible?

counter example:

if $y(t) = 3$, then $x(t)$ could $= +3$ or -3

so unique inputs do <u>not</u> produce unique outputs: <u>not invertible</u>