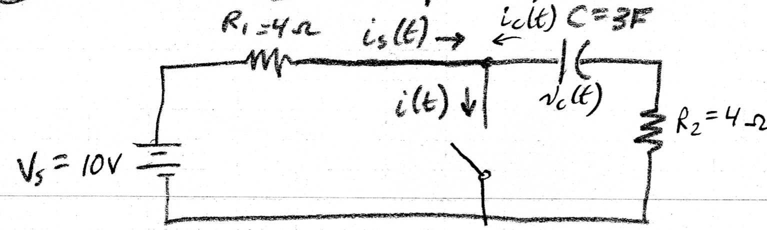
(1) Text 4-2 except $R_1 = R_2 = 4\Omega$



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

$$= \frac{V_s}{R_1} + C\frac{dv_c(t)}{dt}$$

KVL: $v_c(t) + i_c(t)R_2 = 0 = v_c(t) + R_2 C\frac{dv_c(t)}{dt}$

since $v_c(t) + R_2 C\frac{dv_c(t)}{dt} = 0$, $\frac{dv_c(t)}{dt} + \frac{1}{R_2 C} v_c(t) = 0$

This has a solution of form $v_c(t) = k e^{-\frac{t}{R_2 C}}$
(from Diff Eqs)

at $t=0$, $v_c(0) = -10V = K e^{-0/R_2 C}$ so $k = -10$

$v_c(t) = -10 e^{-t/12}$ volts

$i_c(t) = C\frac{dv_c(t)}{dt} = 3(-10)(-\frac{1}{12})e^{-t/12} = \frac{5}{2}e^{-t/12}$

$$\boxed{i(t) = \frac{V_s}{R_1} + i_c(t) = 2.5 + 2.5e^{-t/12} \text{ Amps}}$$

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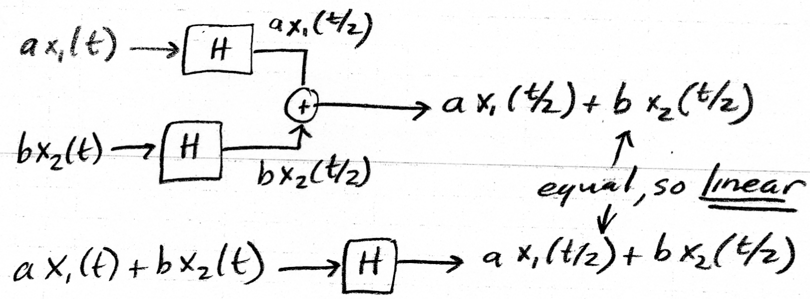
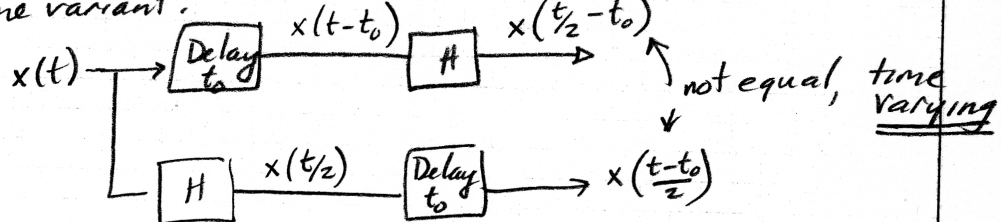
② Text, 4-8

$y(t) = x\left(\frac{t}{2}\right)$

Linear?



time variant?



non causal ?

causal means that the output does <u>not</u> precede the input. For any negative value of time, this is not true for this system.

e.g. The output at time -2 is computed from the input at time -1. Here, the output occurs <u>before</u> the input!

<u>Not causal</u> $y(-2) = x(-1)$

(3) $y(t) = \mathrm{tri}(x(t))$

a. Causal? Yes – the output at any time t_0 depends only on the input at t_0 (no future input values)

$$y(t_0) = \mathrm{tri}(x(t_0))$$

b. Memoryless? Yes – the output at any time t_0 only depends on the input at time t_0

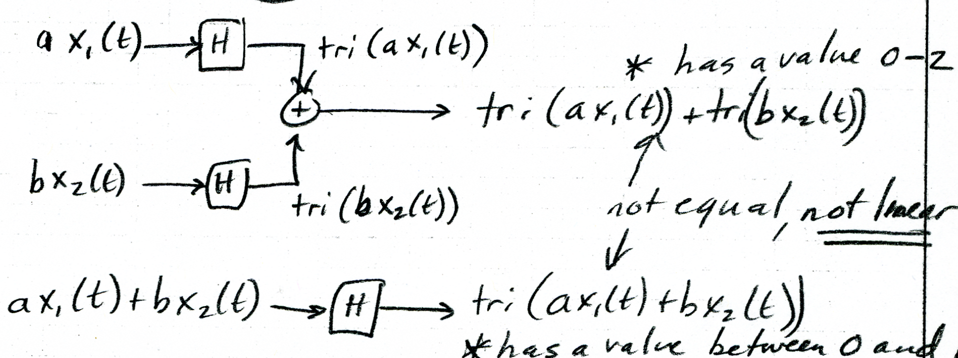
$$y(t_0) = \mathrm{tri}(x(t_0))$$

c. BIBO stable? Yes

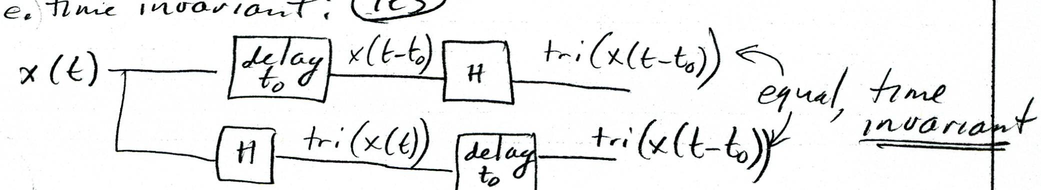
assume input is bounded: $|x(t)| < M < \infty$

Then since the output is the triangle function, it is also bounded (the value of the tri function always has values between 0 and 1.

d. Linear? NO



e. time invariant? Yes



(4) $y(t) = x(3-t)$

a) memoryless? No current output depends on inputs at other than current time.

e.g. $y(0) = x(3)$

b) BIBO stable? Yes

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

Then $|y(t)| = |x(3-t)| < M < \infty$

* if $x(t)$ is bounded, doing a time shift/scale does not matter - it is still bounded.

c) Time invariant? Yes