Digital Signal Processing

Fast Fourier Transform

I-1. a. Determine the convolution of the two discrete signals:

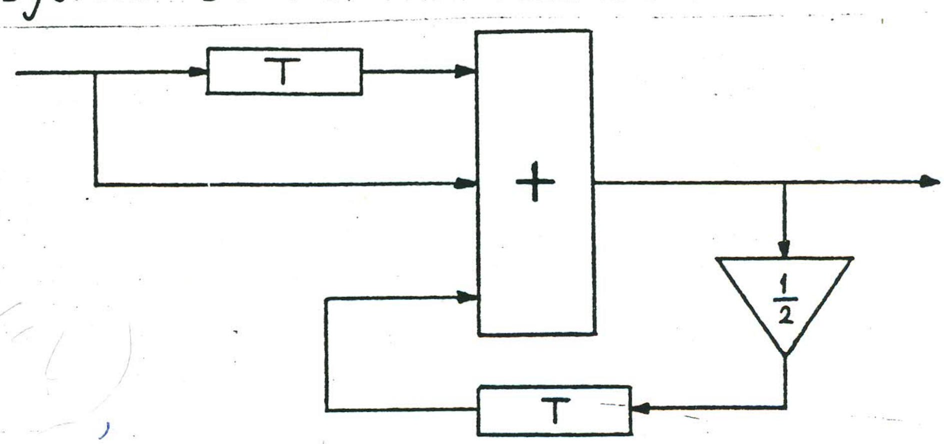
$$x(n) = \begin{cases} 0 & n < 0 \\ 1 & 0 \leq n \leq 3 \\ 0 & n > 3 \end{cases}$$

$$h(n) = \begin{cases} 0 & n < 0 \\ 1 & 0 \leq n \leq 4 \\ 0 & n > 4 \end{cases}$$

b As a , except with

$$h(n) = \begin{cases} 0 & n < 0 \\ 1 & n \geq 0 \end{cases}$$

I-2. a Determine the impulse response h(n) of the system below:



b Show that $h(n)$ can be taken as the convolution of $h_1(n)$ and $h_2(n)$ where

$$h_1(n) = \begin{cases} 0 & n < 0 \\ 1 & 0 \leq n \leq 1 \\ 0 & n > 1 \end{cases}$$

$$h_2(n) = \begin{cases} 0 & n < 0 \\ (1/2)^n & n \geq 0 \end{cases}$$

I-3 The system h consists of a cascade of two linear time invariant systems h_1 and h_2

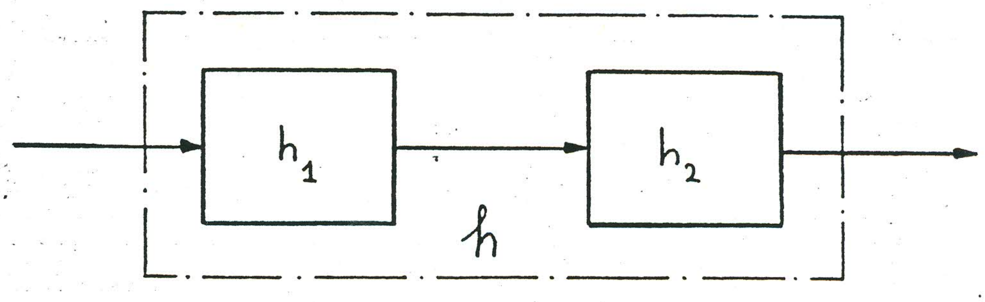
a Proof that h is stable when h_1 and h_2 both are stable

b Proof that h is causal when h_1 and h_2 both are causal

c Show with an example that the inverse does not hold in general, i.e.

h stable $\rightarrow$ h_1 and h_2 stable

h causal $\rightarrow$ h_1 and h_2 causal.



I-4. a Determine for each of the three systems below the impulse response.

b Will it be possible to choose the coefficients (a_0, a_1, a_2), (b_0, b_1, b_2) and (c_1, c_2, c_3) in such a way that the impulse responses will be identical?