Myself solution 2005/6/16

Digital Signal Processing
Undergraduate Course **Student's Name:**
Mid-Term Examination **Sudent's No.**
2005.6.17 [write your answer in the blocks, each one 10%]

University of the Ryukyus
Faculty of Engineering
Dept. of Information Eng.
Prof. M.R. Asharif

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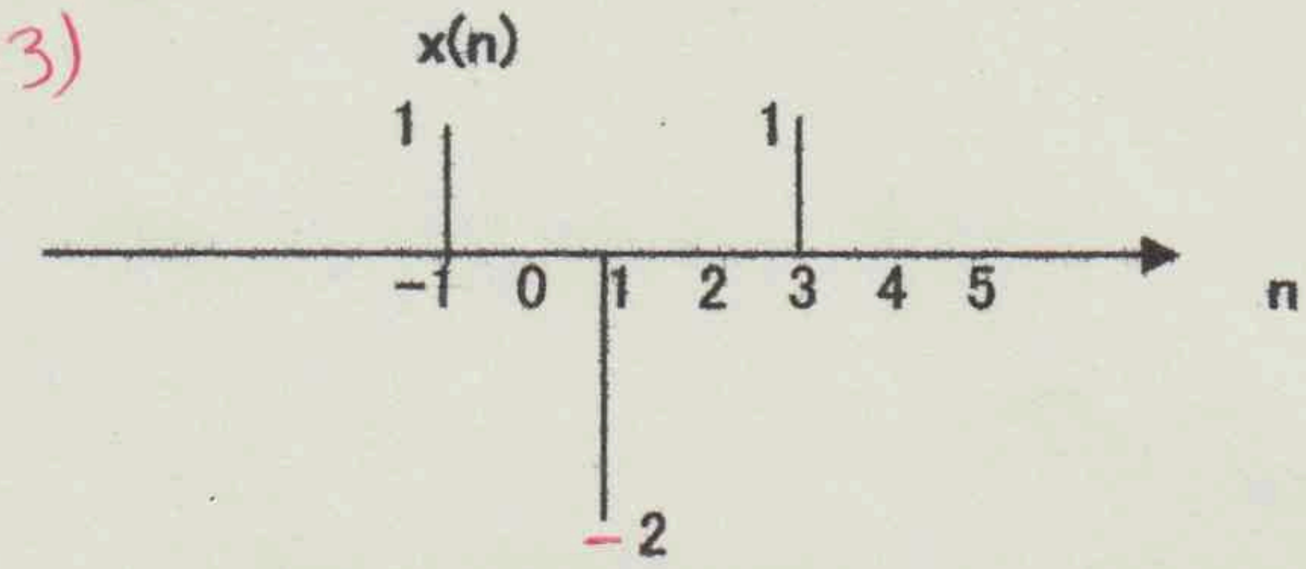
1. 図で信号、x(n)、を unit ~~step~~ impulse 関数、δ(n)、を用いて表現せよ。

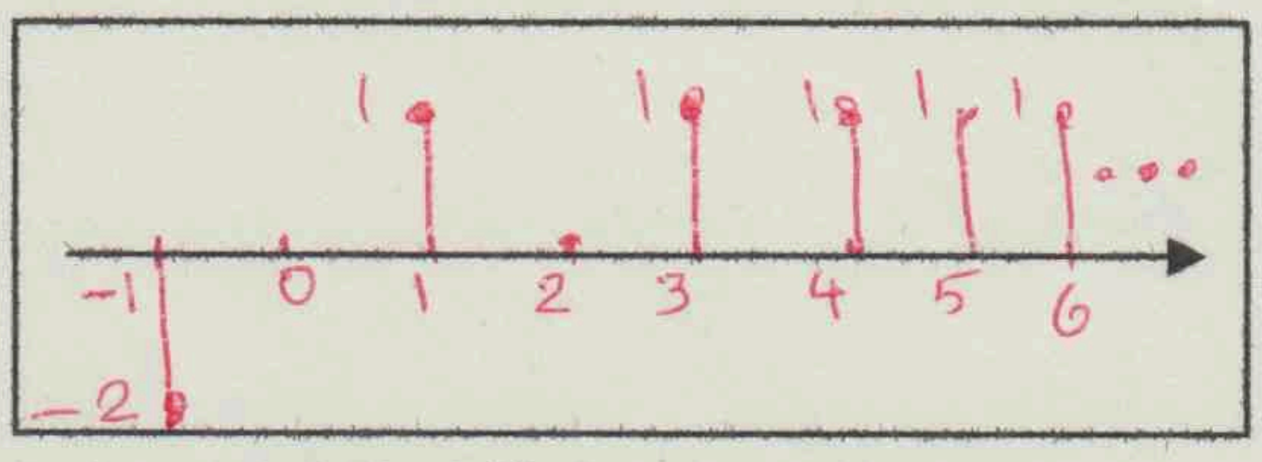
$x(n) = \delta(n+1) - 2\delta(n-1) + \delta(n-3)$



x(n)= $\delta(n+1) - 2\delta(n-1) + \delta(n-3)$

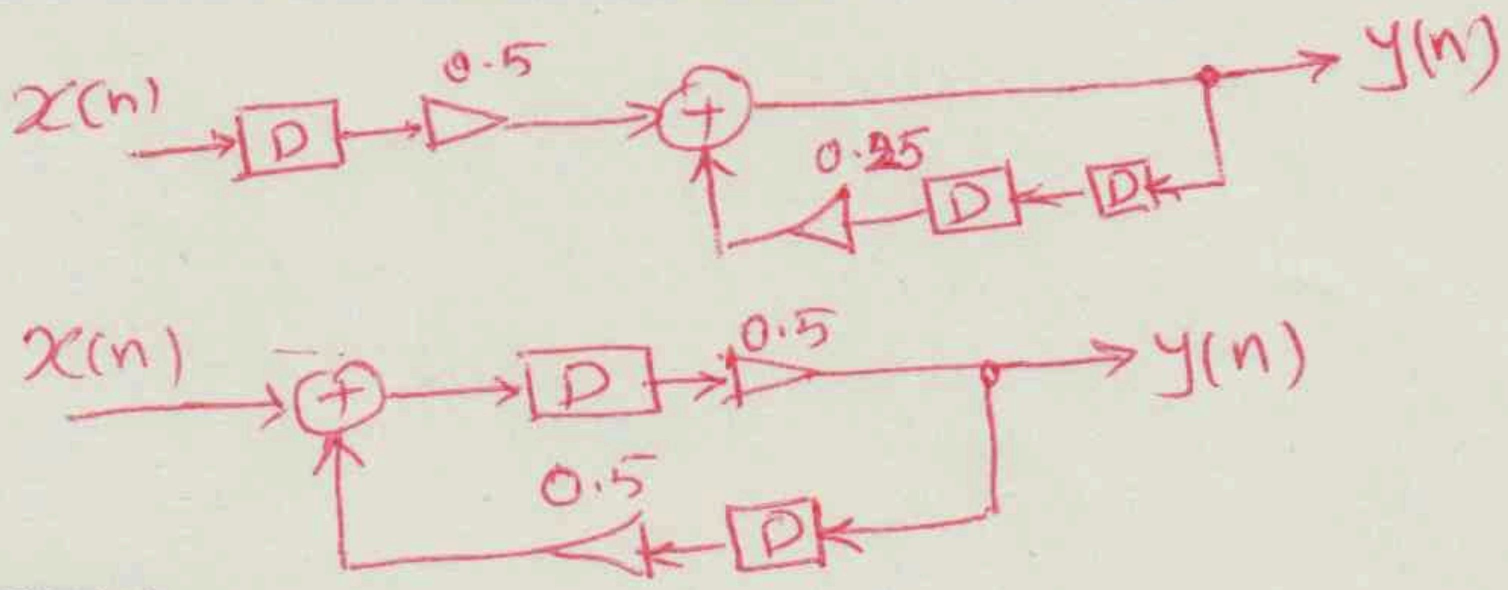
2・ 次の信号をポロットせよ。

$$x(n) = -2\delta(n+1) + u(n-1) - \delta(n-2)$$



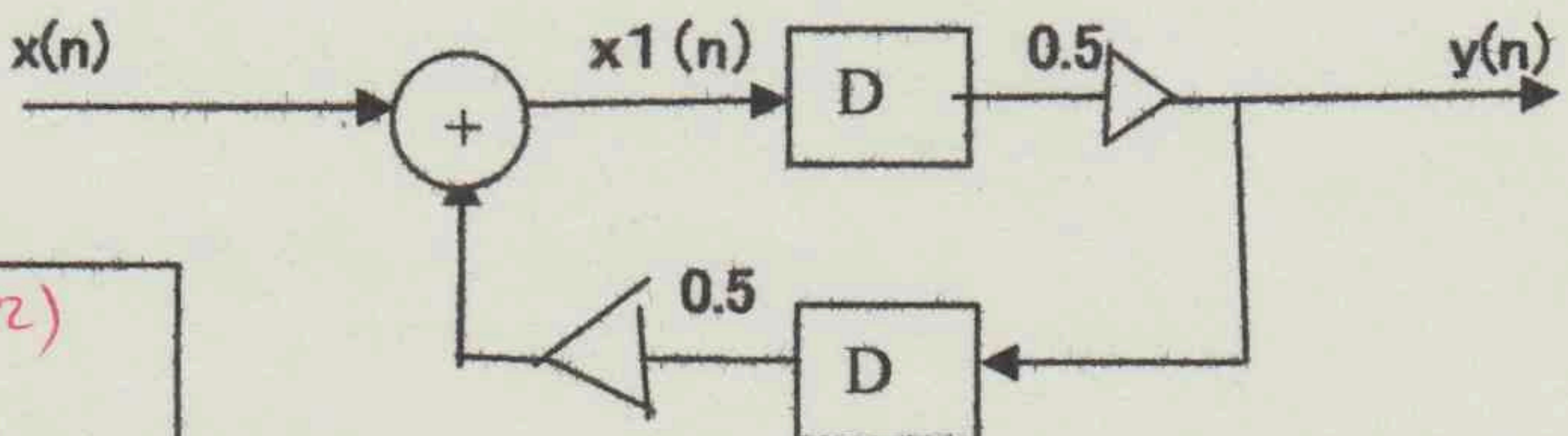
3・ 以下の差分方程式を満足する離散時間システム(x(n):入力、y(n):出力)を構成せよ。（T＝1）

$y(n) = 0.5\,x(n-1) + 0.25\,y(n-2)$



4. 図に示す離散時間システムの差分方程式を指出せよ。

$$\begin{cases} x_1(n) = x(n) + 0.5y(n-1) \\ y(n) = 0.5\,x_1(n-1) \end{cases}$$



y(n)= $0.5\,x(n-1) + 0.25\,y(n-2)$

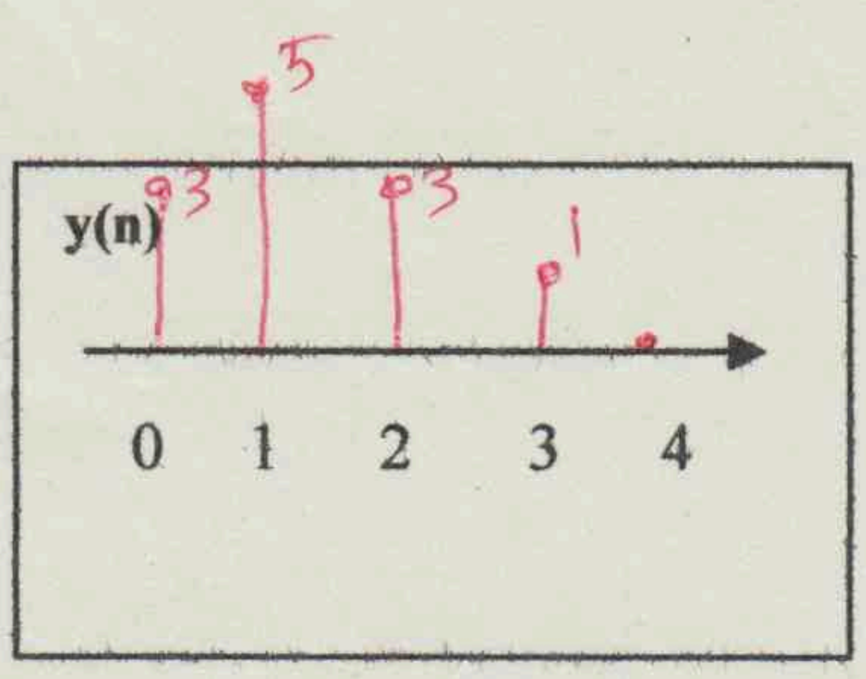
5・ 次の入出力を示すシステムの線形性、時不変性、因果性、安定性を判定せよ。

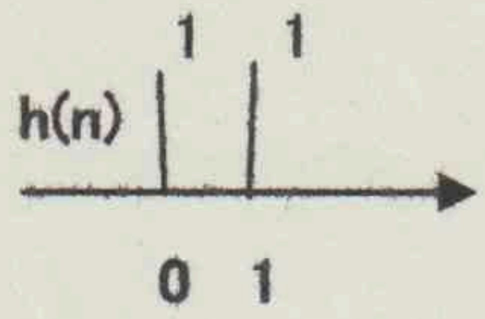
$$y(n) = (0.6)^n\, x(n-2)$$

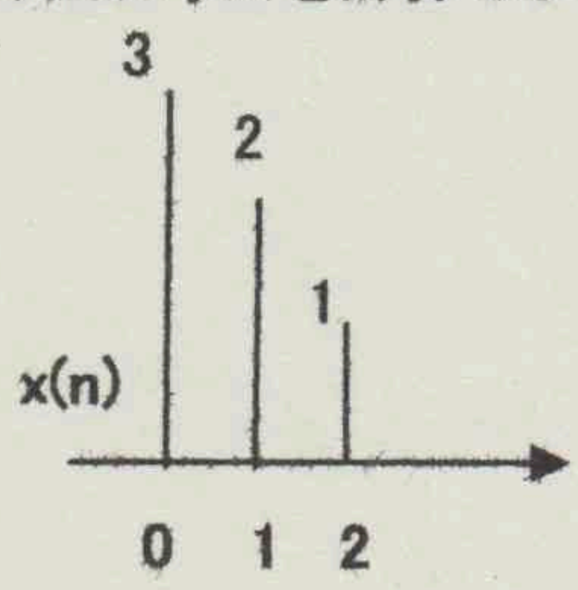
$$\begin{cases} h(2) = (0.6)^2 \\ h(n \neq 2) = 0 \end{cases} \Rightarrow \text{stable}$$

Linearity
~~**Shift Invariance**~~
Causality
Stability

6・ 次のシステムでは h(n) はインパルス応答、x(n) は入力で、出力 y(n)を計算せよ。



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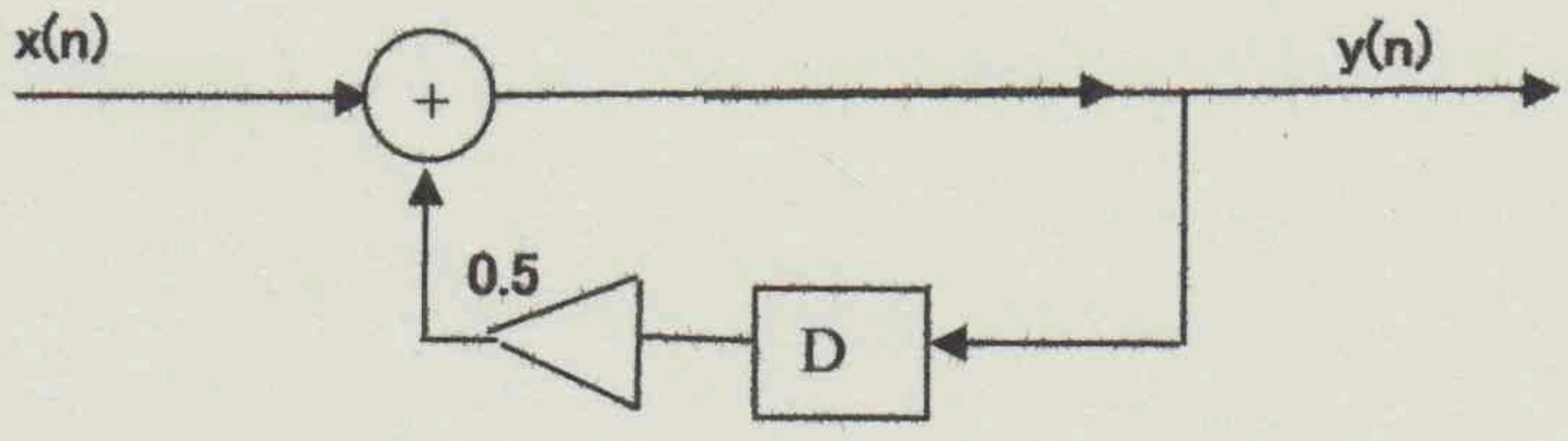
7．次の回路の差分方程式とインパルス応答を求めよ。

y(−1)=0



$y(n) = x(n) + 0.5\,y(n-1)$

$x(n) = \delta(n)$

$y(n) = h(n)$

$n=0 \quad h(0) = 1$

$n=1 \quad h(1) = 0.5$

$n=2 \quad h(2) = 0.5^2$

$n=n \quad h(n) = 0.5^n$

y(n)=	$x(n) + 0.5\,y(n-1)$
h(n)=	$0.5^n\,u(n)$

8. つぎのインパルス応答を持つシステムは、安定かどうか判断せよ。(T=1)

$h(n) = (0.9)^n\ u(n)$

安定	不安定

$$\sum |h(n)| = \sum_{n=0}^{\infty} (0.9)^n = \frac{1}{1-0.9} = \boxed{10}$$

9‒次の離散時間システムのフーリエ変換 H(w)を求めよ。

T=0.1msの時、| H(w) | をプロットせよ。

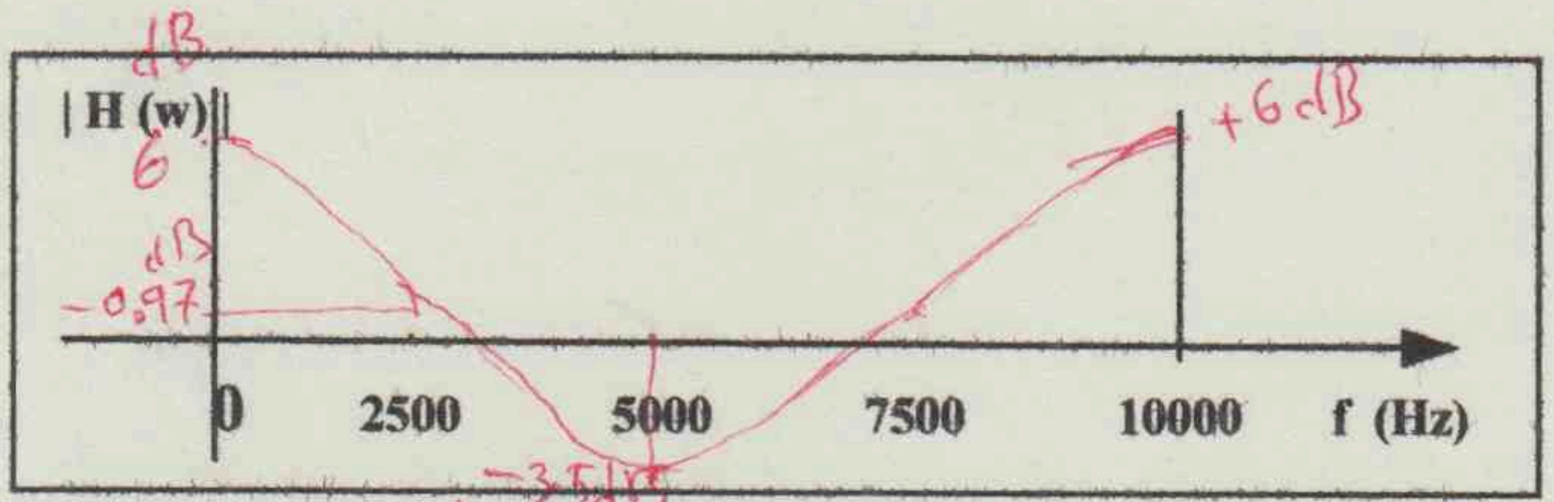
f=2500 Hz で | H(w) | (dB) と位相 (arg[H(w)]を求めよ。

$h(nT) = (0.5)^{nT}\ u(nT)$

$$H(w) = \sum_{n=0}^{\infty} 0.5^n e^{-jwnT}$$

$$H(w) = \frac{1}{1 - 0.5e^{-jwT}}$$

$$|H(w)|^2 = \frac{1}{1.25 - \cos 2wT}$$



$\lvert H(w) \rvert = \frac{1}{1.25 - \cos wT}$	$20\log_{10} \lvert H(w) \rvert = -0.97\,dB$ f=２５００
arg [H (w)] = $\arctan \frac{0.5\sin wT}{1-0.5\cos wT}$	

$w=0 \Rightarrow |H(w)|^2 = \frac{1}{0.25} = 4 \Rightarrow 10\log_{10}|H(w)|^2 = 10\log_{10}4 = 6.\ dB$

$w = 2\pi\times2500 \Rightarrow |H(w)|^2 = \frac{1}{1.25 - \cos(2\pi\times2500\times0.1\times10^{-3})} = \frac{1}{1.25 - \cancel{\cos\frac{\pi}{2}}_{0}} = 0.8 \Rightarrow 10\log_{10}0.8 = -0.97\ dB$

$w = 2\pi\times5000 \Rightarrow |H(w)|^2 = \frac{1}{1.25 - \cos(2\pi\times5000\times0.1\times10^{-3})} = \frac{1}{1.25 - \cancel{\cos\pi}_{-1}} = \frac{1}{2.25} = 0.44 \Rightarrow 10\log_{10}0.44 = -3.5\ dB$

$w = 2\pi\times7500 \Rightarrow |H(w)|^2 = \frac{1}{1.25 - \cos(2\pi\times7500\times0.1\times10^{-3})} = \frac{1}{1.25 - \cos(1.5\pi)} = 0.8 \Rightarrow 10\log_{10}0.8 = -0.97$

$w = 2\pi\times10000 \Rightarrow |H(w)|^2 = \frac{1}{1.25 - \cos(2\pi\times10000\times0.1\times10^{-3})} = \frac{1}{1.25 - \cancel{\cos 2\pi}_{1}} = \frac{1}{0.25} = 4 \Rightarrow 10\log_{10}4 = 6\ dB$