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Assingment 2

1) a) $x_1(n) = \cos(0.5\pi n)$

$x_1(n) = \cos[2\pi(0.25)n]$

$x_1(n+N) = \cos[2\pi(0.25)(N+n)]$

$= \cos(0.5\pi n + 2\pi N)$

Since $\cos(0.5\pi n) = \cos(0.5\pi n + 2\pi N)$

$x(n) = x(n+N)$

$\therefore$ $x_1(n)$ is periodic

$E = \sum_{n=-\infty}^{\infty} |\cos(0.5\pi n)|^2$

$= \infty$

$\therefore$ $x_1(n)$ is a power signal

b) $x_2(n) = (0.5)^n u(n)$.

$x_2(n+N) = (0.5)^{n+N} u(n+N)$

$\therefore$ $x_2(n)$ is aperiodic

$E = \sum_{n=-\infty}^{\infty} [0.5^n u(n)]^2$

$= \sum_{n=0}^{\infty} 0.5^{2n}$

$= \frac{1}{1-0.25} = \frac{4}{3}$

$\therefore$ $x_2(n)$ is an energy signal

c). $x_3(n) = 1$

this is periodic.

$E = \sum_{n=-\infty}^{\infty} 1^2$

$= \infty$

$P = \lim_{N\to\infty} \frac{1}{2N+1} \sum_{n=-N}^{N} 1^2$

$= \lim_{N\to\infty} \frac{N+N+1}{2N+1} = \frac{2}{2} = 1$

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2). $y(n) - 0.5y(n-1) = x(n)$.

a). impulse response of $y(n)$

let $h(n) - 0.5\,h(n-1) = \delta(n)$.

$n=0$ $h(0) - 0.5\,h(-1) = 1$ Since $h(-1) = 0$ due to causa

$h(0) = 1$

$n=1$ $h(1) - 0.5\,h(0) = 0$

$h(1) = 0.5$

$n=2$ $h(2) - 0.5\,h(1) = 0$

$h(2) = 0.5^2$

$n=3$ $h(3) - 0.5\,h(2) = 0$

$h(3) = 0.5^3$

$\therefore$ $h(n) = 0.5^n u(n)$

b). Step response.

let $s(n) - 0.5s(n-1) = u(n)$.

at $n=0$. $s(0) - 0.5\,s(-1) = 1$ Since $s(-1) = 0$

$s(0) = 1$

at $n=1$ $s(1) - 0.5\,s(0) = 1$

$s(1) = 1 + 0.5$

$= 1.5$.

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at $n=2$ $\quad S(2) - 0.5\,S(1) = 1$

$S(2) = 1 + 0.75$

$= 1.75$

at $n=3$ $\quad S(3) - 0.5\,S(2) = 1$

$S(3) = 1 + 0.875$

$= 1.875$

$$\underline{\underline{S(n) = (2 - 0.5^n)\,u(n)}}$$

c) $h(n)$ is decaying exponentialy while $S(n)$ is starting from 1 and converge to 2 when $n \to \infty$.