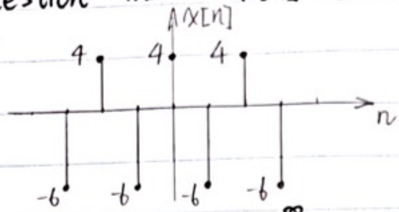
EEE 5502 HW #01 Hudanyun Sheng

Question #1

I spent 2 hours.

Question #2 $x[n] = 5(-1)^{n+2} - 1 = 5(-1)^n - 1$

(a)



(b) $E_x = \sum_{n=-\infty}^{\infty} |x[n]|^2 = \sum_{n=-\infty}^{\infty} |5(-1)^n - 1|^2 = \sum_{n=-\infty}^{\infty} (25(-1)^{2n} + 1 - 10(-1)^n)$

$= \sum_{n=-\infty}^{\infty} (26 - 10(-1)^n) = \infty$

(c) $\cancel{x[-n] = 5(-1)^{-n} - 1 = 5(-1)^n - 1 = x[n]}$

$\because x[n] = 5(-1)^{n+2} - 1 = 5(-1)^n - 1 = x[n-2]$

$\therefore$ This is a periodic signal with period 2

$P_x = \frac{1}{2} \sum_{n=0}^{1} |x[n]|^2 = \frac{1}{2}[|x[0]|^2 + |x[1]|^2] = \frac{1}{2}|16+36| = 26$

(d) ~~x~~ Based on (b),(c), $x[n]$ is a power signal.

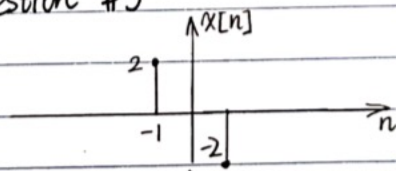
(e) $x[-n] = 5(-1)^{-n+2} - 1 = 5(-1)^{-n} - 1 = 5(-1)^n - 1 = 5(-1)^{n+2} - 1 = x[n]$

$\therefore x[n]$ is an even signal.

(f) $x[n]$ is acausal.

Question #3

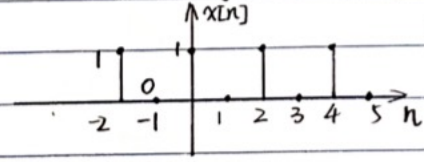
(a)



$E_x = \sum_{n=-\infty}^{\infty} |x[n]|^2 = 2^2 + 2^2 = 8$

$P_x = \lim_{N \to \infty} \frac{1}{2N+1} \sum_{n=-N}^{N} |x[n]|^2 = 0$

(b)



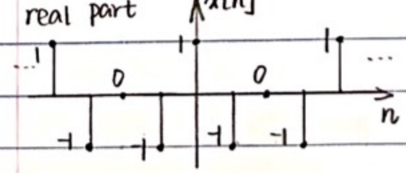
$x_2[n] = u(n+2) - u(n+1) + u(n) - u(n-1) + u(n-2) - u(n-3) + u(n-4) - u(n-5)$

$E_x = 4(1)^2 = 4$

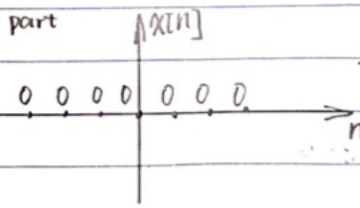
$P_x = \lim_{N \to \infty} \frac{1}{2N+1}(4) = 0$

(c) $x_3[n] = \cos(\pi n) - j\sin(\pi n)$

real part



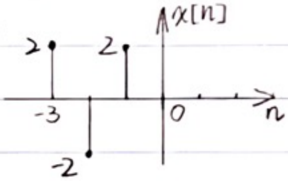
imaginary part



$$E_x=\sum_{n=-\infty}^{\infty}[\cos(\pi n)-j\sin(\pi n)]^2=\sum_{n=-\infty}^{\infty}[\cos^2(\pi n)-\sin^2(\pi n)-2j\cos(\pi n)\sin(\pi n)]=\infty$$

$$P_x=\lim_{N\to\infty}\frac{1}{2N+1}\sum_{n=-N}^{N}|x(n)|^2=\lim_{N\to\infty}\frac{1}{2N+1}(2N+1)=1$$

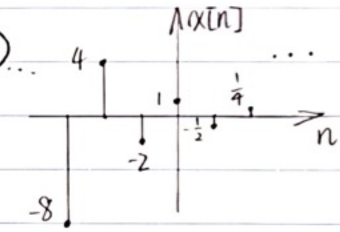
(d)



$$E_x=\sum_{n=-\infty}^{\infty}|x[n]|^2=12$$

$$P_x=\lim_{N\to\infty}\frac{1}{2N+1}\sum_{n=-N}^{N}|x[n]|^2=\lim_{N\to\infty}\frac{12}{2N+1}=0$$

(e)



$$E_x=\sum_{n=-\infty}^{\infty}|x[n]|^2=\sum_{n=-\infty}^{\infty}\left(\frac{1}{4}\right)^n=\sum_{n=-\infty}^{\infty}4^{-n}=\sum_{n=1}^{\infty}4^{-n}+\sum_{n=1}^{\infty}4^{n}+1=\infty$$

$$P_x=\lim_{N\to\infty}\frac{1}{2N+1}\sum_{n=-N}^{N}|x[n]|^2$$

$$=\lim_{N\to\infty}\frac{1}{2N+1}\frac{4^{N+1}-4^{-N}}{3}=\infty$$

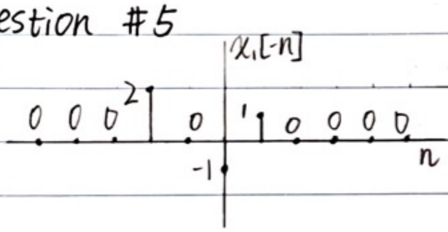
Question #4

(a) $r[n]=u[n+3]+u[n+2]-3u[n-1]+u[n-3]$.

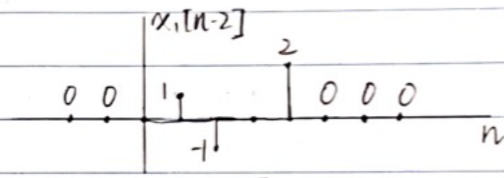
(b) $r[n]=\delta[n+3]+2\delta[n+2]+2\delta[n+1]+2\delta[n]-\delta[n-1]-\delta[n-2]$

Question #5

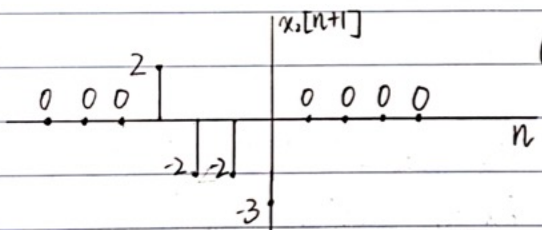
(a)



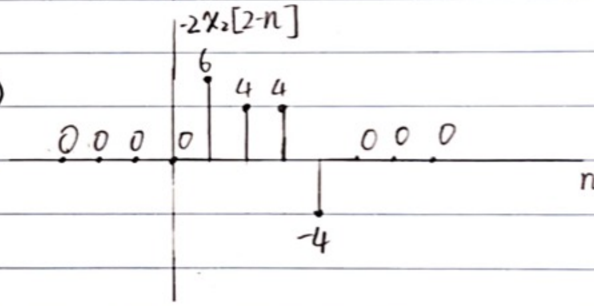
(b)



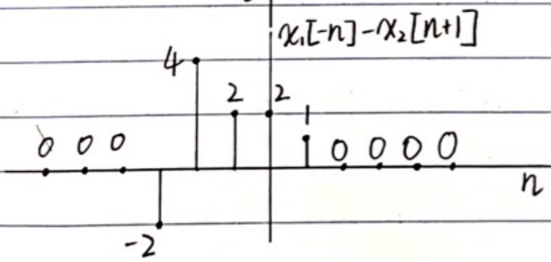
(c)



(d)



(e)



Question #6

(a) ~~Ape~~periodic. T=2

(b) Aperiodic

(c) Periodic. $T=6$

(d) Aperiodic

(e) Periodic. $T=10$

(f) Periodic. $T=4$

Question #7

(a) The system is causal, because $y[n]$ only depend on past and present value of $x[n]$

(b) The system is not memoryless, because $y[n]$ not only depend on $x[n]$ at current time, but also past $x[n]$

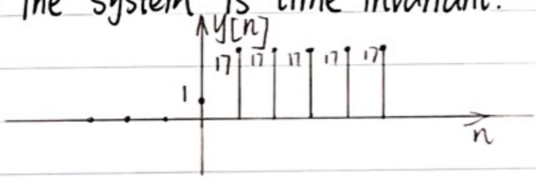
(C) The system is not BIBO stable. For the bounded input $x[n] = 5(-1)^n - 1$, the out put $y[n]$ is unbounded.

(d) $H(ax_1[n] + bx_2[n]) = \sum_{m=-\infty}^{n} |ax_1[m] + bx_2[m]|^2 \neq a \cdot H\{x_1[n]\} + b\{x_2[n]\}$

~~$H(ax_1[n])+$~~ $\therefore$ The system is nonlinear.

(e) The system is time invariant. $y[n+N] = \sum_{m=-\infty}^{n+N} |x[m]|^2 = \sum_{m=-\infty}^{n} |x[m+N]|^2$

(f)



(g) The system calculates the sum of squared values. It can be used to calculate the energy for the input signal.

Question #8

(a) $y_1[n] = 2x[n]$, $y_2[n] = y_1[n-2] = 2x[n-2]$, $y_3[n] = 3y_1[n] + 1 = 6x[n] + 1$

$\therefore y[n] = y_2[n] + y_3[n] = 2x[n-2] + 6x[n] + 1$

(b) $y[n] = 2\delta[n-2] + 6\delta[n] + 1$

(c) $y[n] = 2(u[n-2] - u[n-3]) + 6(u[n] - u[n-1]) + 1$

$= 6u[n] - 6u[n-1] + 2u[n-2] - 2u[n-3] + 1$