ICE503 DSP-Homework#1

1. Consider a discrete-time system which can develop the output sequence

$$y[n] = 3x[n] + 5x[n-1] + 4x[n-2] + 8x[n-4] + x[n-5]$$

   (a) Plot the block diagram for this system.

   (b) The input sequence $x[n]$ is shown in Figure 1, sketch and label $y[n]$.

   (c) Following (b), sketch and label the down sampling sequence $y[3n]$.

   (d) Following (b), sketch and label the up sampling sequence $y[\frac{1}{2}n]$.

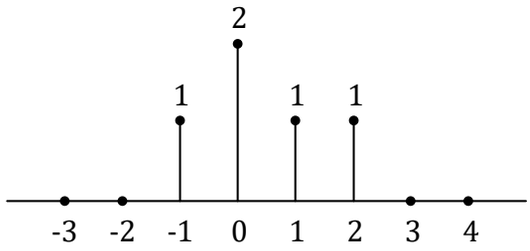


Figure 1: The input sequence $x[n]$

2. Determine whether each of the following signals is periodic. If the signal is periodic, state its fundamental period.

   (a) $x[n] = 2\cos\left(\frac{\pi}{2}n\right)$

   (b) $x[n] = n\sin\left(\frac{\pi}{4}n\right)$

   (c) $x[n] = e^{j\frac{3}{5}\pi n}$

3. MATLAB simulation:

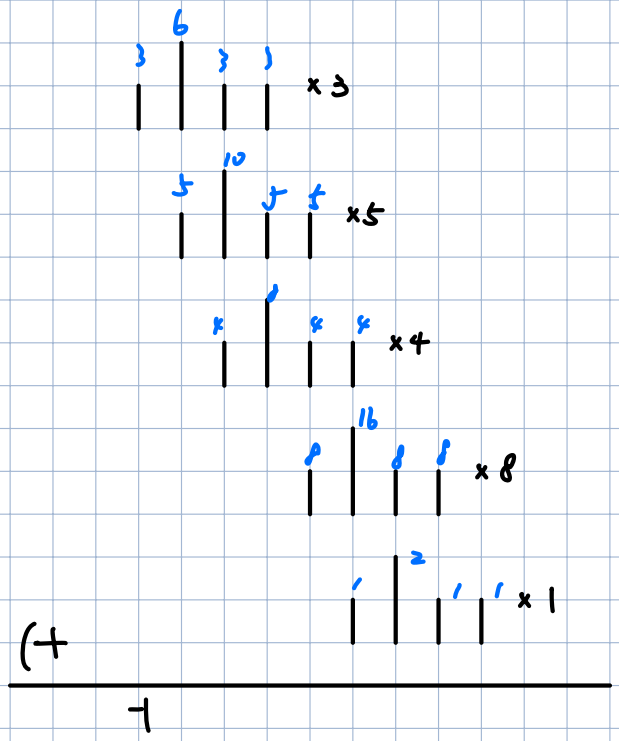
   (a) Generate the complex-valued signal.

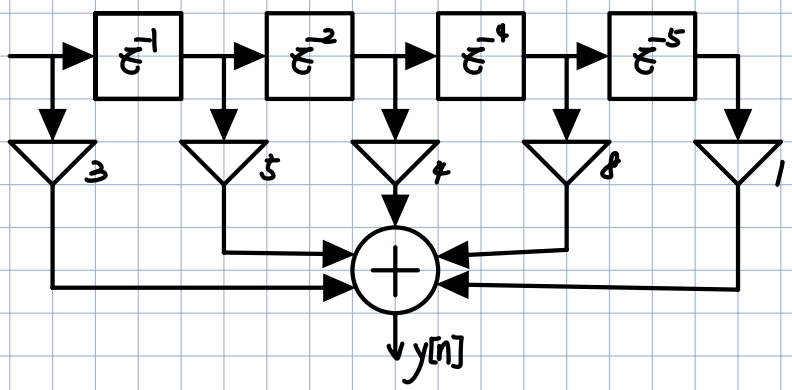
$$x[n] = e^{j\frac{1}{10}\pi n}, \qquad n = -10, \dots, -1, 0, 1, \dots 10$$

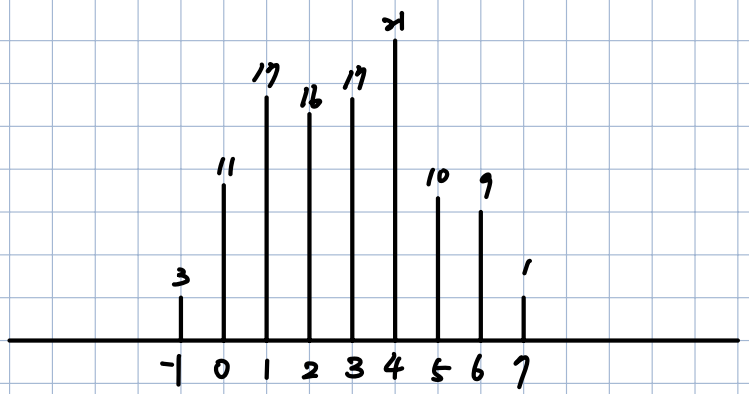
   (b) Use `stem` function to plot the real part and the imaginary part of $x[n]$.

   (c) Determine whether $x[n]$ is a conjugate symmetric sequence or a conjugate antisymmetric sequence, and explain the reason.

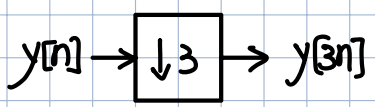
1. (a) (b)

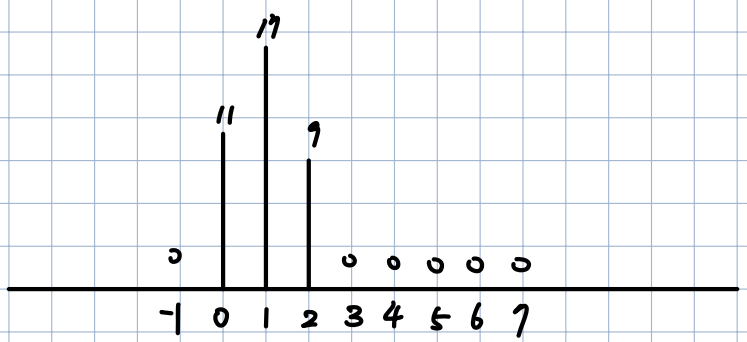

3 6 3 1 ×3
5 10 5 5 ×5
4 8 4 4 ×4
8 16 8 8 ×8
1 2 1 1 ×1
(+
-1


z^{-1}
z^{-2}
z^{-3}
z^{-4}
z^{-5}
3
5
4
8
1
y[n]

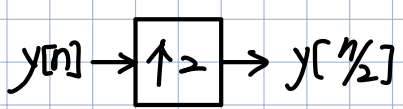

3 11 17 16 17 21 10 9 1
-1 0 1 2 3 4 5 6 7

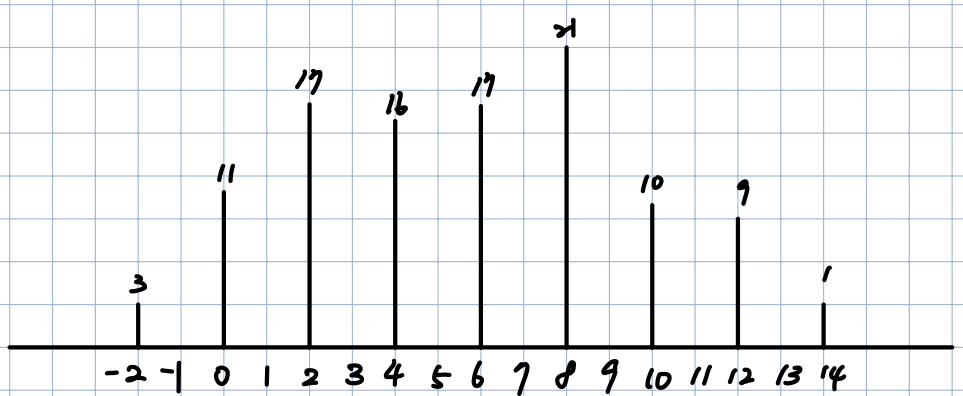
(c)


y[n]
↓3
y[3n]


0 11 17 9 0 0 0 0 0
-1 0 1 2 3 4 5 6 7

(d)


y[n]
↑2
y[n/2]


3 11 17 16 17 21 10 9 1
-2 -1 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14

2. (a) $x[n] = 2\cos\left(\frac{\pi}{2}n\right)$

$\frac{\pi}{2}n = 2\pi r \Rightarrow n = 4r$, when $n=4$, $r=1$, the equation satisfies

$\Rightarrow$ periodic

(b) $x[n] = n\sin\left(\frac{\pi}{4}n\right)$

$\frac{\pi}{4}n = 2\pi r \Rightarrow n = 8r \Rightarrow$ Let $n=8$, $r=1$

But $x[1] = 1\sin\left(\frac{\pi}{4}\right) \neq 9\cdot\sin\left(\frac{9\pi}{4}\right) = x[9]$, not periodic

(c) $e^{j\frac{3}{5}\pi n}$

$\frac{3}{5}\pi n = 2\pi r \Rightarrow 3n = 10r \Rightarrow$ Let $n=10$, $r=3$ periodic