Signal Project

- **قواعد اخلاقية:**

1-المجموعات مكونة من فردين.

2-غير مسموح بأي حال من الحوال نقل ال code من أي مجموعة أخرى، و لكن من الممكن المناقشة حول الأفكار

3- التعاون بين أفراد الفريق واجب، و يجب على كل فرد من افراد المجموعة أن يعلم باقي الأفراد ما يعرفه

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- **Submit your code to mfathyae1@gmail.com**
- **Deadline for code submission : Wed. 11 May.**

- **Project discussion will be on last week.**

- **The Matlab file name should be as follows: Ass_k_ID1_ID2, where, k is the assignment number, ID1 and ID2 are the bench numbers of the 1st, 2nd students, respectively.**

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Assignment 1

a) x(t) is a CT periodic signal with period T_0. Starting from the following FS synthesis equation:

$$x(t) = \sum_{k=-\infty}^{\infty} a_k e^{jk\omega_o n}, \quad where \quad \omega_0 = \frac{2\pi}{T_0}$$

if x(t) is real, Prove that x(t) can be expressed as follows:

$$x(t) = a_0 + \sum_{k=1}^{\infty} |a_k| \cos\left(k\omega_o t + \theta_k\right)$$

where $|a_k|$ and θ_k are the magnitude and phase of a_k, respectively.

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b) For an arbitry (neither even nor odd) signal x(t), estimate

$$a_0, |a_k| \; and \; \theta_k .$$

c) Write a Matlab program to:

i) Sketch 3 periods of an arbitrary periodic signal.

ii) Synthesize the signal from its FS coefficients starting from DC term, then adding 1st harmonic, 2nd Harmonic,… Sketch the signal added and resultant signal at each step showing how the signal is modified with different harmonics added.

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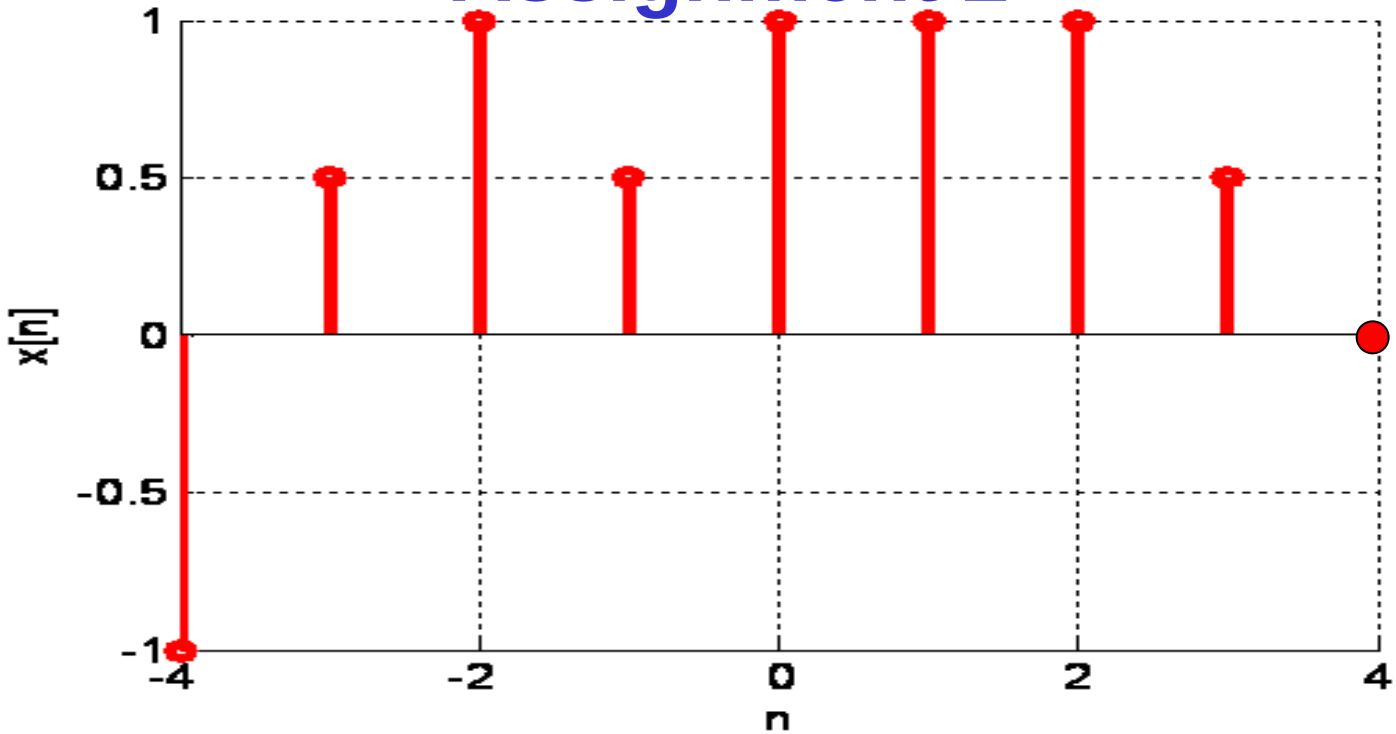
Assignment 2



For the shown discrete time signal (DTS), write a Matlab program to

a) Defines x[n], x[n-2], & x[n+3].

b) Sketch the three signals in one page.

Your page should appear as follows:

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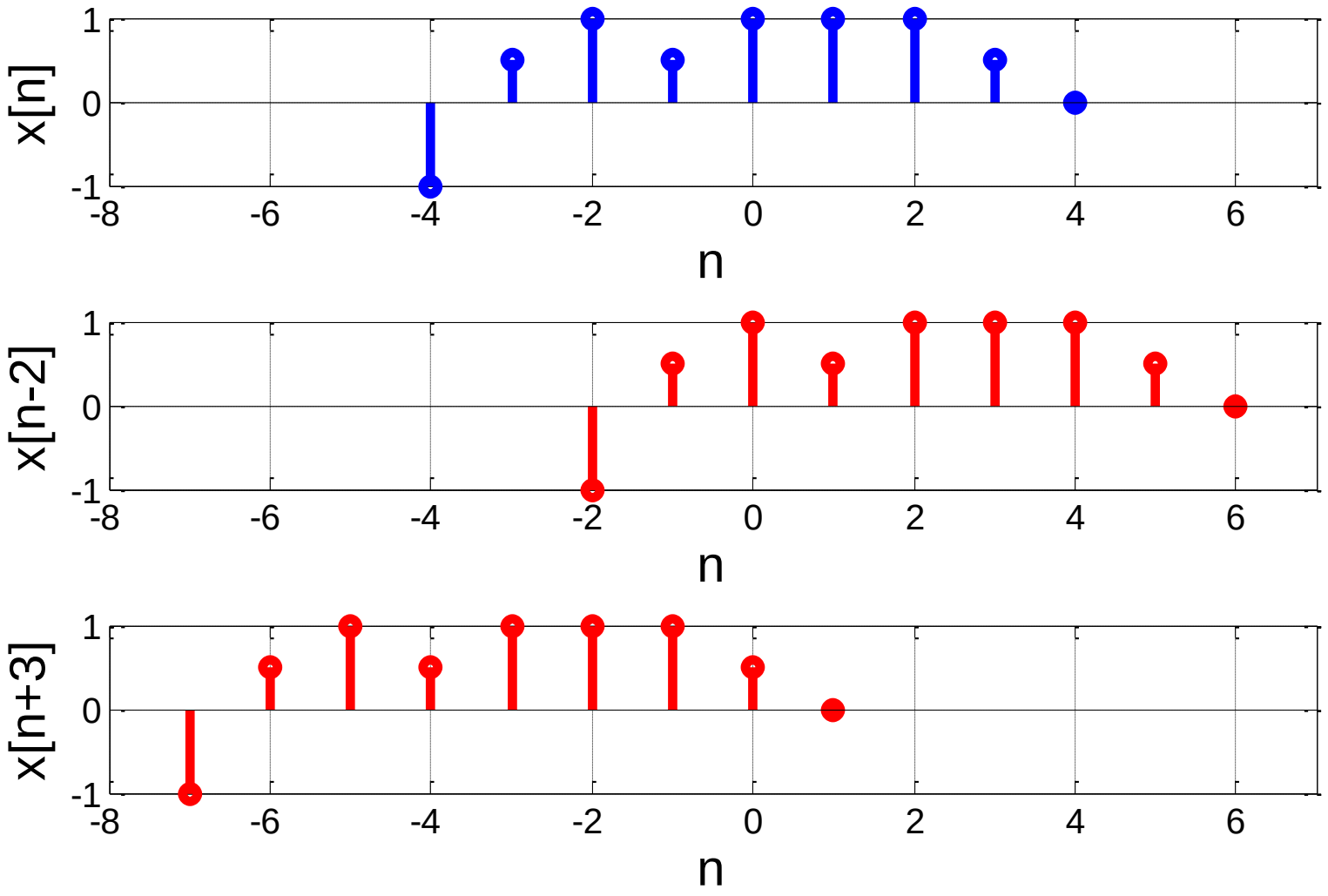

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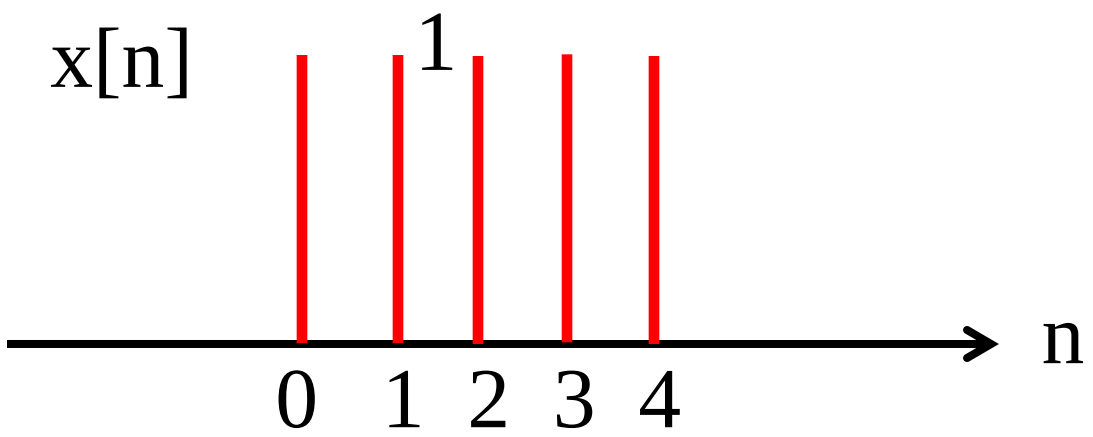
Assignment 3



For the shown discrete time signal (DTS), write a Matlab program to Defines and sketch x[n] & x[-n], even part of x[n] & odd part of x[n] in one page.

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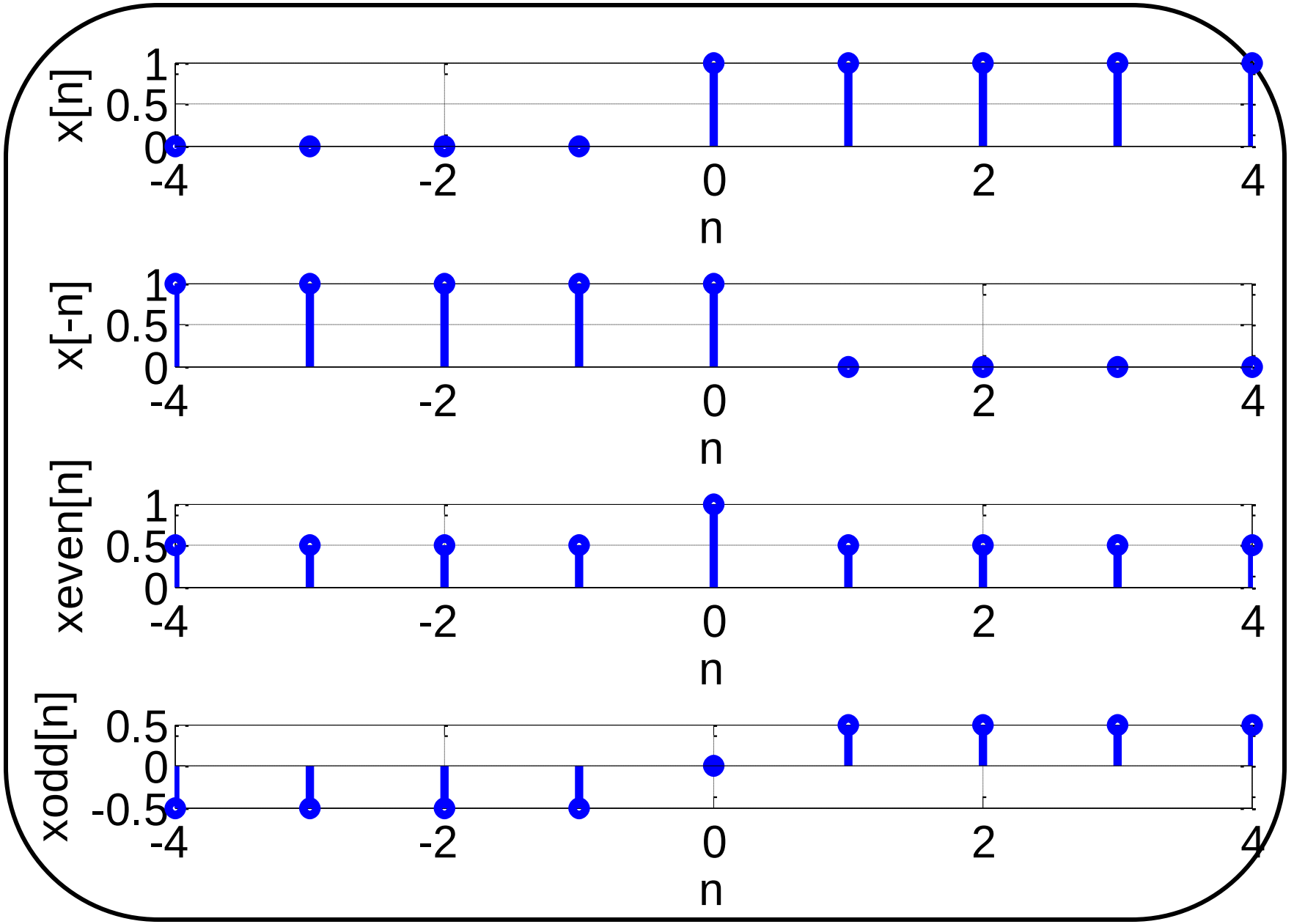

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Assignment 4

- Signal processing can be used to hide messages in files.
- The message can be hidden in a sound file or in an image file,
- In this assignment, A message is hidden in a sound file **(hidden_ message.wav)**.
- You will listen to the file without observing anything wrong.
- After some signal processing, you will be able to extract the hidden message.

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- Write a Matlab program to:
- Read the wave file.
- Find the sampling frequency in which sound is recorded.
- Play the signal x stored on the file.
- Extract the hidden message. **The hidden message is the first half of the odd part of this signal.**

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- Play the hidden message.
- **Note:** The origin of the time is the middle of the signal, not the beginning of it.

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Assignment 5

- Write a Matlab program to:

- Read the image file “hidden_img.png”.
- View the image.
- Extract the hidden message. **The hidden message is the first half of the odd part of this image.**
- View the hidden image.

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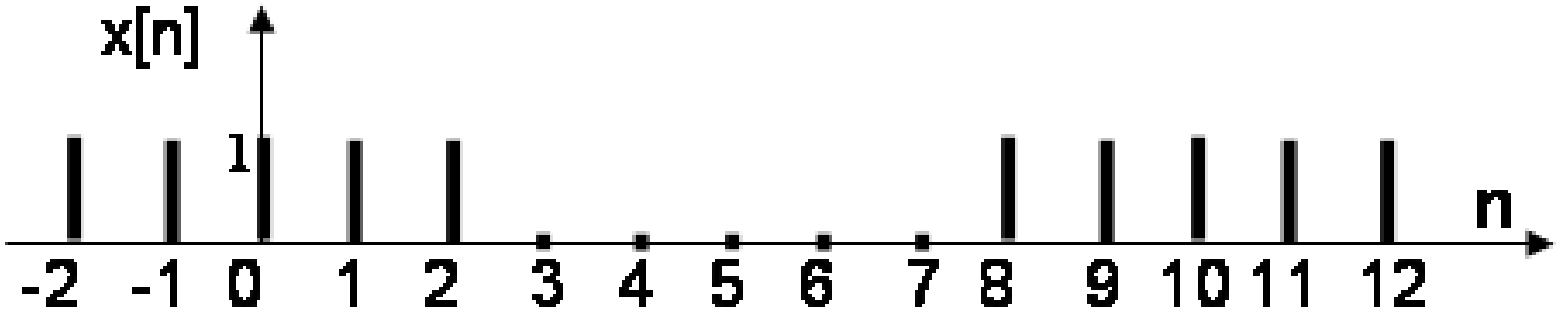
Assignment 6

Consider the DT square wave

$$x[n]=\begin{cases}1 & -2 \le n \le 2 \\ 0 & \text{otherwise}\end{cases}$$

that is period with period N.



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Write a Matlab program to:

- Define one period of x with index nx for different values of N (10, 20,100 & 1000)
- Find and sketch the FSC of x using FFT command.
- Comment on results for large values of N.

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Assignment 7 (Noise removal)

- Write a Matlab program to:

1) Read x from the file noisy.wav
2) Plot x
3) Play x as an audio signal
4) Find the FSC of x
5) Find the noise frequency components

6) Remove noisy components

7) Sketch FSC before and after de-noising in one page.

8) Estimate the de-noised audio signal

9) Play the de-noise audio signal.

10) Sketch the noisy & de-noised audio signal in one page.