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Bilgisayar Mühendisliği (İngilizce) 3.Sınıf

Signals and Systems

Homework

Questions are:

Problem 1: Continuous-Time Signals and Systems

Consider a continuous-time signal $x(t) = 3 \cos(2\pi t) + 2 \sin(4\pi t)$.

1. Sketch the waveform of $x(t)$ over one period.
2. Determine the frequency components present in $x(t)$.
3. Compute the average power of $x(t)$ over one period.

Problem 2: Discrete-Time Signals and Systems

Given the discrete-time signal $x[n] = \{1, -2, 3, -4, 5\}$:

1. Determine the length of the signal.
2. Find the value of $x[3]$.
3. Compute the sum of all elements in the signal.
4. Calculate the energy of the signal.

My Answers using with MATLAB (text and screenshots from MATLAB online version):

Q1-1:

My code:

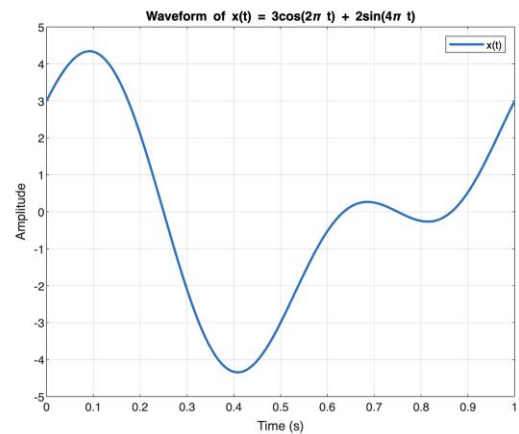
```
% this is our given signal
x = [1, -2, 3, -4, 5];

% now we do determine the length of the signal
signal_length = length(x);

disp(['Length of the signal: ', num2str(signal_length)]);
```

And the result screenshot:

```
MATLAB Development 1.m
1 % First of we must define the time vector for one period
2 t = 0:0.001:1; % Adjust the time resolution as needed
3
4 % Now we are going to define the signal
5 x = 3 * cos(2 * pi * t) + 2 * sin(4 * pi * t);
6
7 % now plot the signal this is our draw function
8 figure;
9 plot(t, x, 'LineWidth', 2);
10 title('Waveform of x(t) = 3cos(2pi t) + 2sin(4pi t)');
11 xlabel('Time (s)');
12 ylabel('Amplitude');
13 grid on;
14
15 % we can display the grid with this code.
16 grid on;
17
18 % Show the plot
19 legend('x(t)');
20
21
```



Q1-2:

My code:

% And again we must define the time vector for one period

t = 0:0.001:1; % and again adjust the time resolution as needed

% now define the signal

x = 3 * cos(2 * pi * t) + 2 * sin(4 * pi * t);

% we want to Compute the Fourier transform

N = length(t);

fs = 1 / (t(2) - t(1)); % Sampling frequency

frequencies = linspace(-fs/2, fs/2, N);

X = fftshift(fft(x, N));

% plot the magnitude spectrum

figure;

plot(frequencies, abs(X), 'LineWidth', 2);

title('Frequency Spectrum of x(t)');

xlabel('Frequency (Hz)');

ylabel('Magnitude');

grid on;

% again display the grid

grid on;

% they are highlight the frequency components

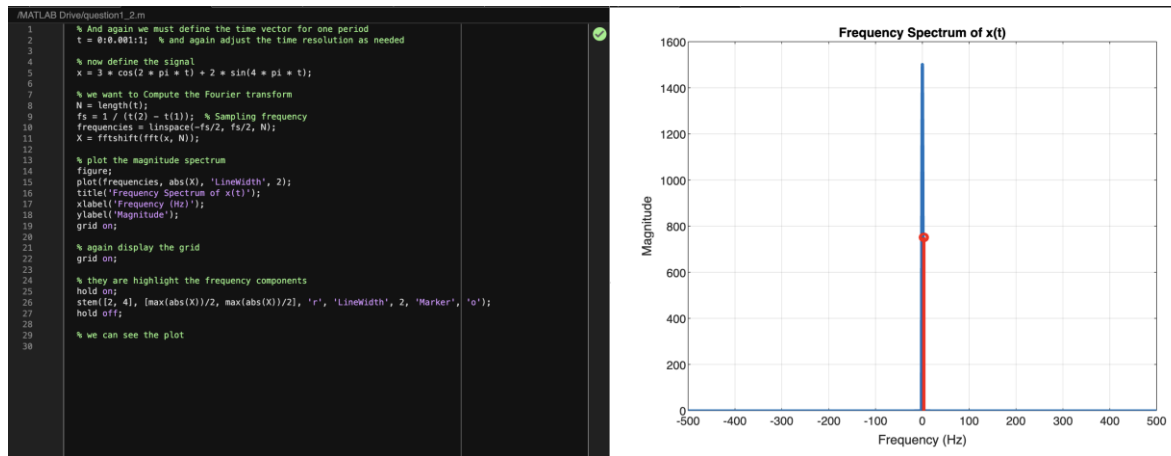
hold on;

stem([2, 4], [max(abs(X))/2, max(abs(X))/2], 'r', 'LineWidth', 2, 'Marker', 'o');

hold off;

% we can see the plot

And the result screenshot:



Q1-3:

My code:

% Ofcourse define the signal and time vector

t = 0:0.001:1; % also adjust the time resolution as needed

x = 3 * cos(2 * pi * t) + 2 * sin(4 * pi * t);

% now determine the period

fundamental_frequency = 1/(2*pi); % Fundamental frequency for cos(2*pi*t)

T = 1 / fundamental_frequency; % This is the period of the cycle.

% now we are computing the average power

P = (1 / T) * trapz(t, abs(x).^2);

disp(['Average Power (P) = ', num2str(P)]);

And the result screenshot:

```
/MATLAB Drive/question1_3.m
1      % Ofcourse define the signal and time vector
2      t = 0:0.001:1; % also adjust the time resolution as needed
3      x = 3 * cos(2 * pi * t) + 2 * sin(4 * pi * t);
4
5      % now determine the period
6      fundamental_frequency = 1/(2*pi); % Fundamental frequency for cos(2*pi*t)
7      T = 1 / fundamental_frequency; % This is the period of the cycle.
8
9      % now we are computing the average power
10     P = (1 / T) * trapz(t, abs(x).^2);
11
12     disp(['Average Power (P) = ', num2str(P)]);
13
```

Command Window

New to MATLAB? See resources for [Getting Started](#).

```
>>
>> question1_3
Average Power (P) = 1.0345
>>
>>
```

Q2-1:

My code:

```
% this is our given signal
x = [1, -2, 3, -4, 5];

% now we do determine the length of the signal
signal_length = length(x);

disp(['Length of the signal: ', num2str(signal_length)]);
```

And the result screenshot:

```
/MATLAB Drive/question2_1.m
1  % this is our given signal
2  x = [1, -2, 3, -4, 5];
3
4  % now we do determine the length of the signal
5  signal_length = length(x);
6
7  disp(['Length of the signal: ', num2str(signal_length)]);
8
```

Command Window

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```
>> question2_1
Length of the signal: 5
>>
```

Q2-2:

My Code:

```
% also given signal
x = [1, -2, 3, -4, 5];
% now finding the value of x[3]
x_3 = x(3);
disp(['Value of x[3]: ', num2str(x_3)]);
```

And the result screenshot:

```
/MATLAB Drive/question2_2.m
1 % also given signal
2 x = [1, -2, 3, -4, 5];
3
4 % now finding the value of x[3]
5 x_3 = x(3);
6
7 disp(['Value of x[3]: ', num2str(x_3)]);
8
```

Command Window

New to MATLAB? See resources for [Getting Started](#).

```
>> question2_2
Value of x[3]: 3
>>
```

Q2-3:

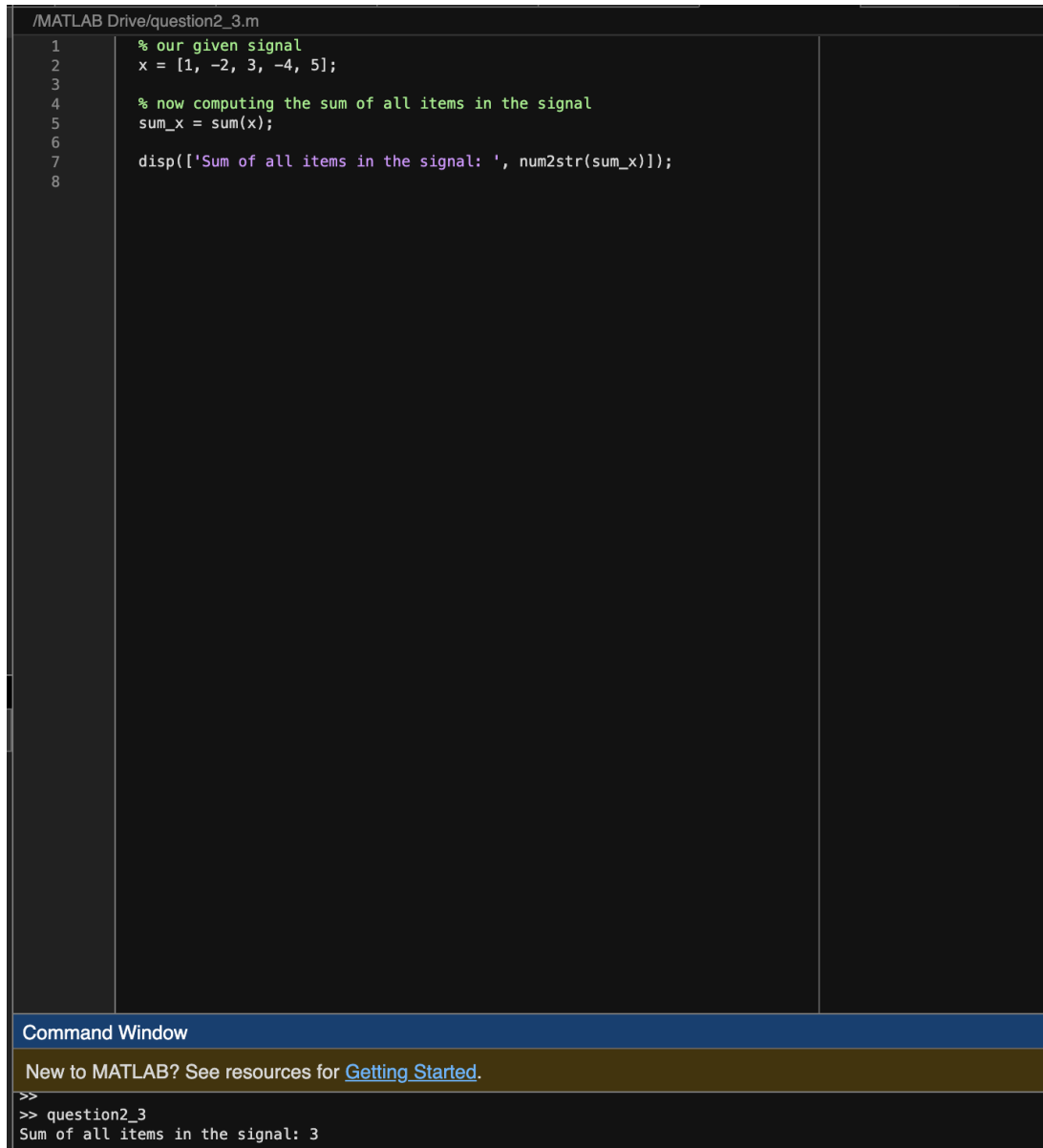
My Code:

```
% our given signal
x = [1, -2, 3, -4, 5];

% now computing the sum of all items in the signal
sum_x = sum(x);
```

```
disp(['Sum of all items in the signal: ', num2str(sum_x)]);
```

And the result screenshot:



The screenshot shows a MATLAB script editor with the following code:

```
1 % our given signal
2 x = [1, -2, 3, -4, 5];
3
4 % now computing the sum of all items in the signal
5 sum_x = sum(x);
6
7 disp(['Sum of all items in the signal: ', num2str(sum_x)]);
8
```

Below the script editor is the Command Window, which displays the output of the script:

```
>> question2_3
Sum of all items in the signal: 3
```

Q2-4:

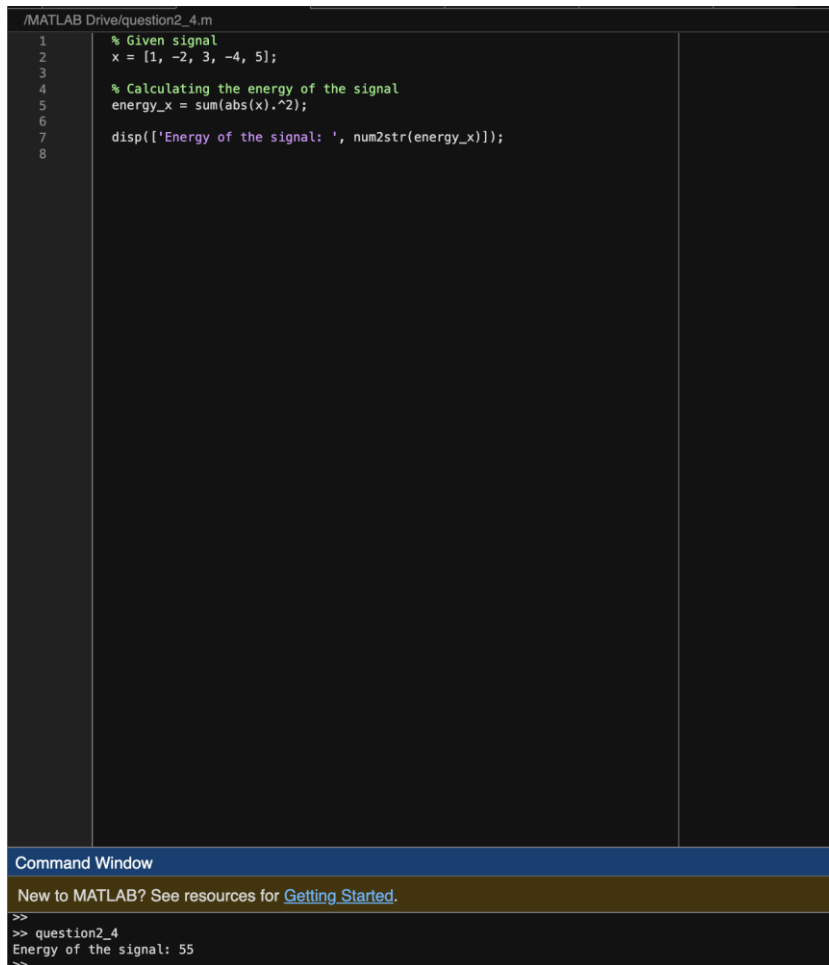
My code:

```
% Given signal
x = [1, -2, 3, -4, 5];

% Calculating the energy of the signal
energy_x = sum(abs(x).^2);

disp(['Energy of the signal: ', num2str(energy_x)]);
```

And the result screenshot:



The image shows a MATLAB script editor window with a dark background. The script is titled `/MATLAB Drive/question2_4.m` and contains the following code:

```
1 % Given signal
2 x = [1, -2, 3, -4, 5];
3
4 % Calculating the energy of the signal
5 energy_x = sum(abs(x).^2);
6
7 disp(['Energy of the signal: ', num2str(energy_x)]);
8
```

Below the script editor is a **Command Window** with a blue header. It contains the following text:

New to MATLAB? See resources for [Getting Started](#).

```
>>
>> question2_4
Energy of the signal: 55
>>
```