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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.

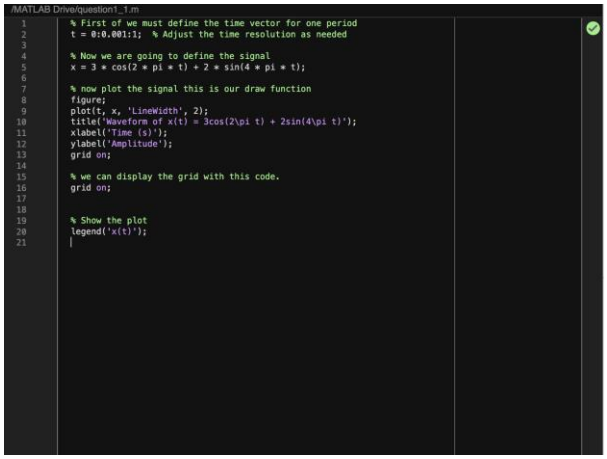
My Answers using with MATLAB (text and screenshots from MATLAB online version):

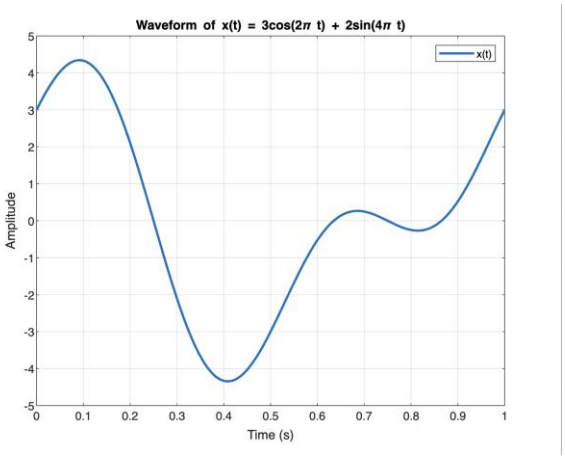
Q1-1:

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:



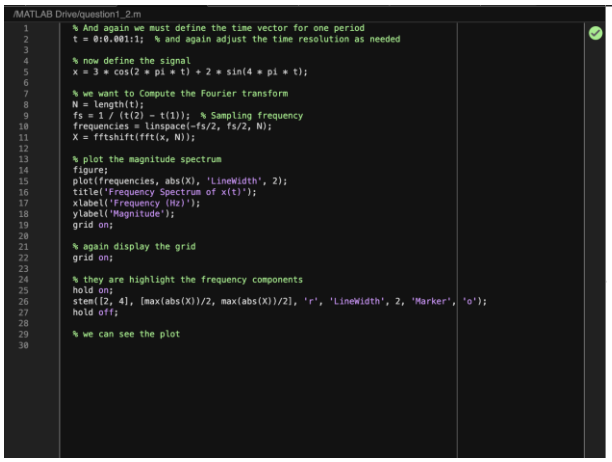


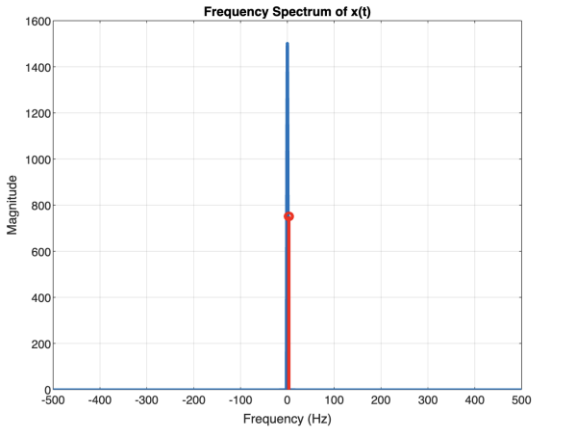
Q1-2:

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:



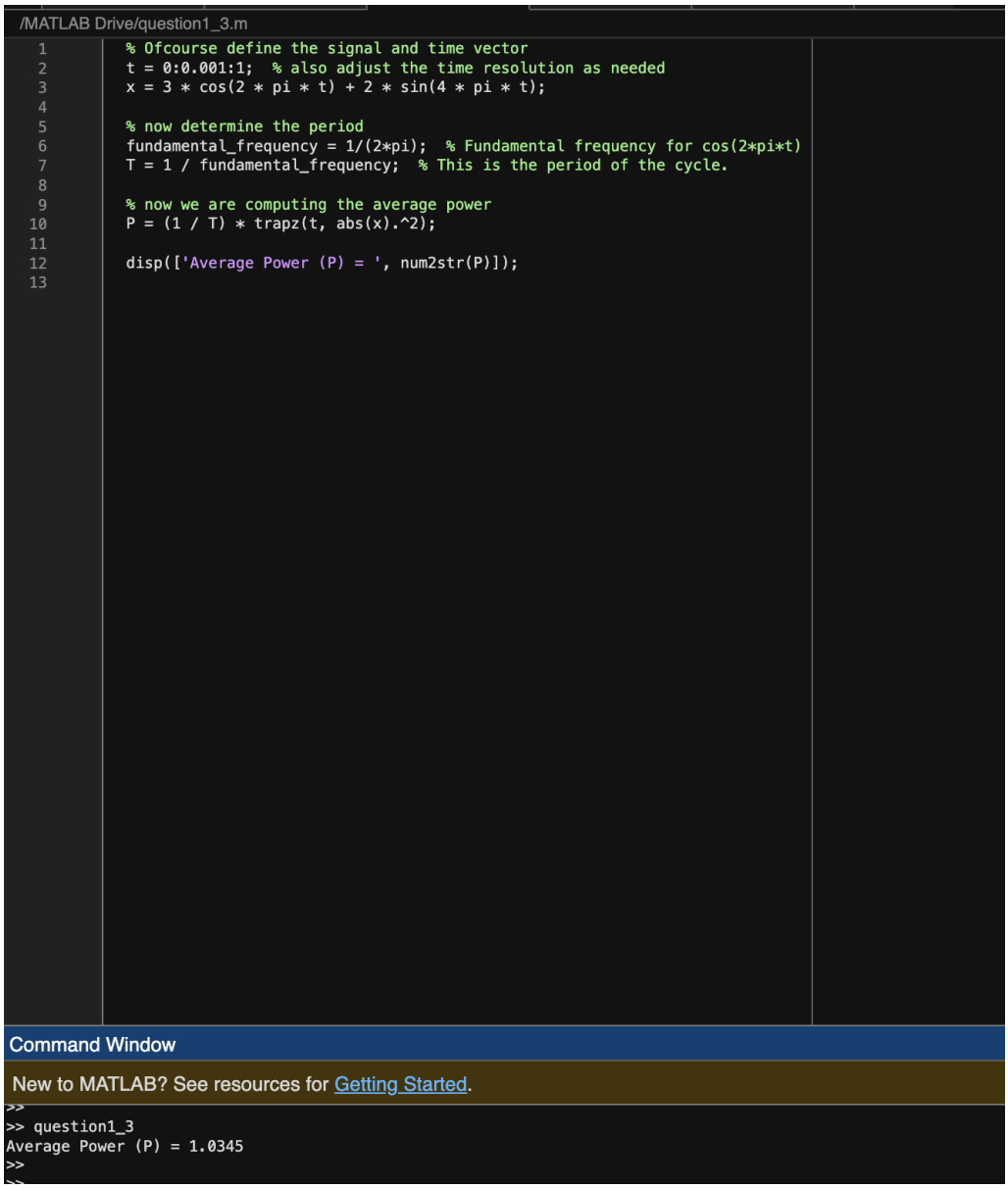


Q1-3:

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:

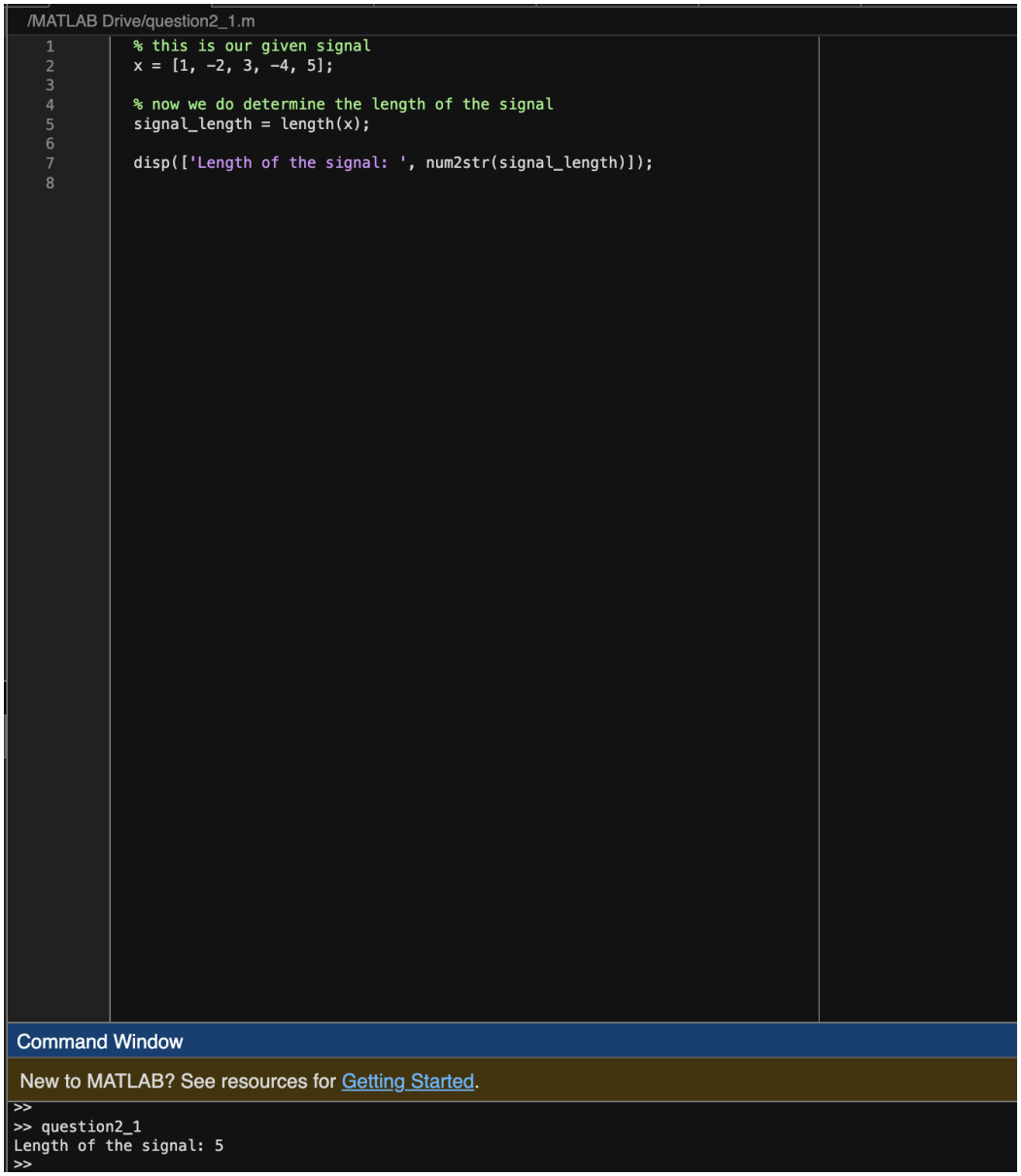


Q2-1:

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:

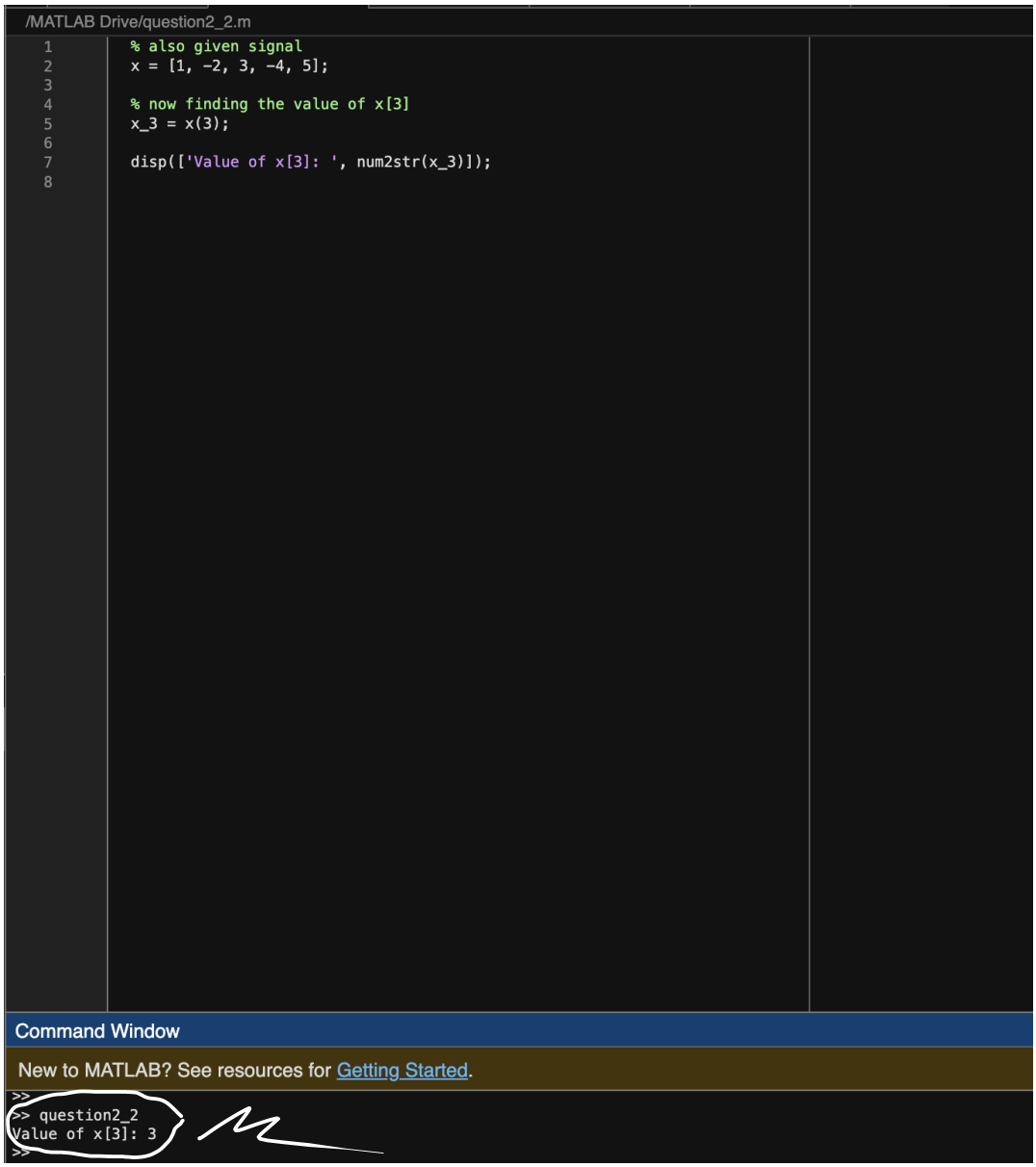


Q2-2:

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:



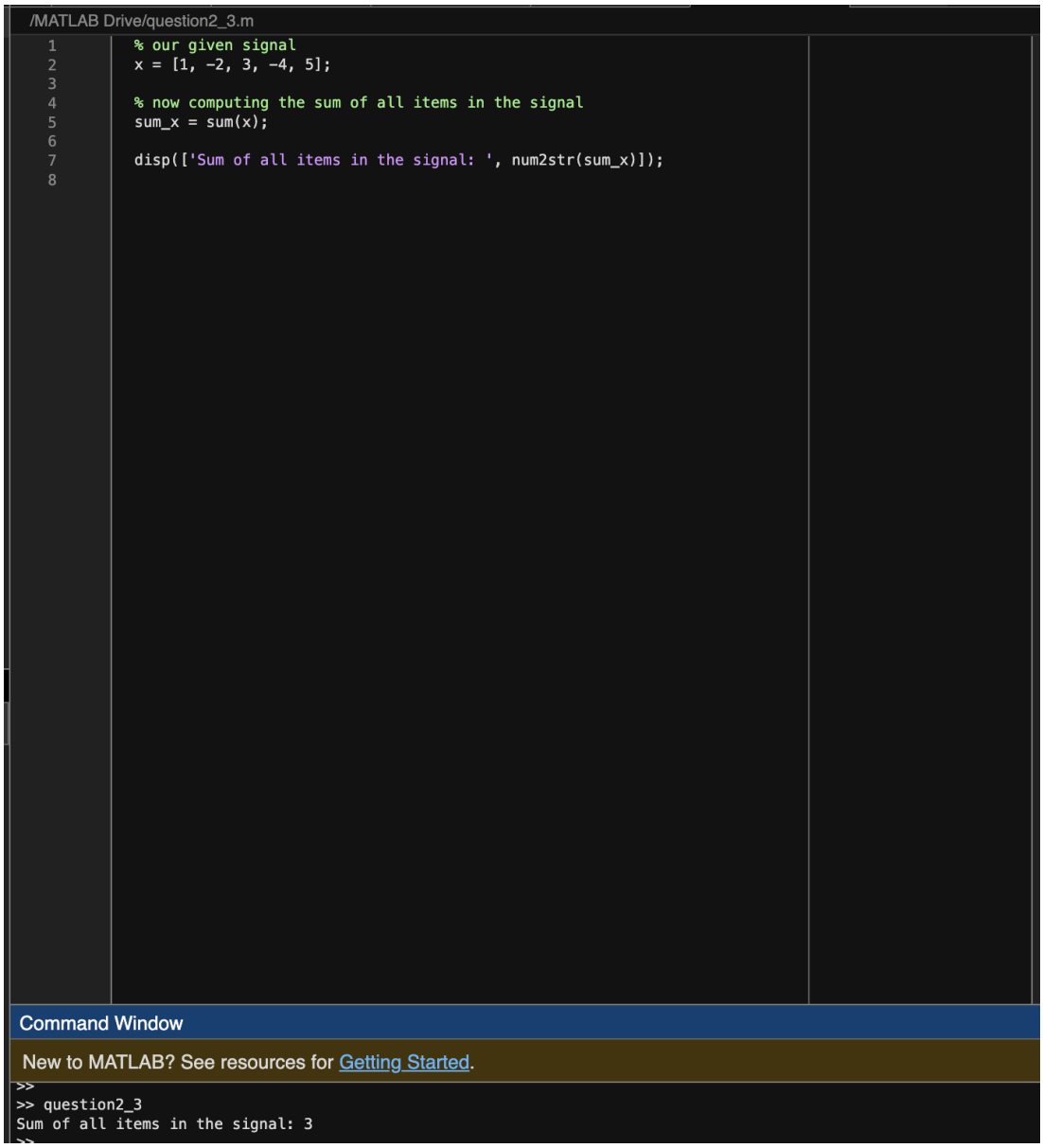
Q2-3:

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:



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: