Signals and Systems Homework_1

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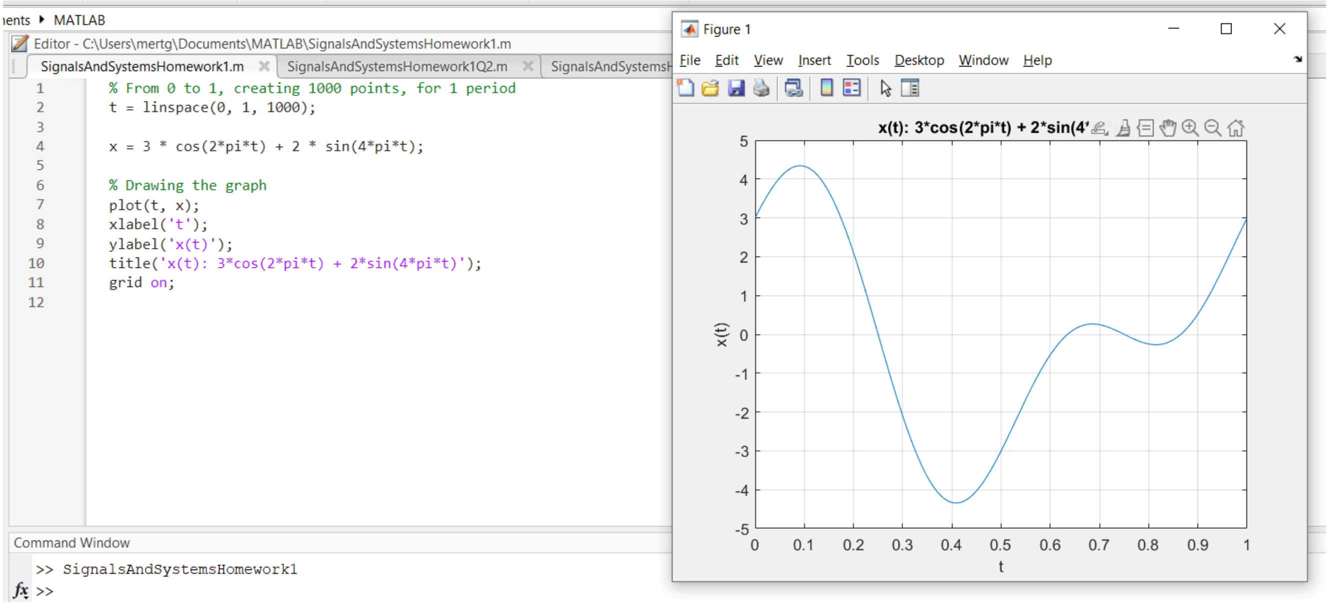
(Source Codes are on the last page)

Q1)

a) Sketch the waveform of x(t) over one period:



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Editor - C:\Users\mertg\Documents\MATLAB\SignalsAndSystemsHomework1.m
SignalsAndSystemsHomework1.m
SignalsAndSystemsHomework1Q2.m
SignalsAndSystemsH
Command Window
Figure 1
File Edit View Insert Tools Desktop Window Help
x(t): 3*cos(2*pi*t) + 2*sin(4'
5
4
3
2
1
0
-1
-2
-3
-4
-5
x(t)
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
t

```
% From 0 to 1, creating 1000 points, for 1 period
t = linspace(0, 1, 1000);

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

% Drawing the graph
plot(t, x);
xlabel('t');
ylabel('x(t)');
title('x(t): 3*cos(2*pi*t) + 2*sin(4*pi*t)');
grid on;
```

```
>> SignalsAndSystemsHomework1
fx >>
```

b) Determine frequency components present in x(t):

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

This function has two different frequency components;

- 1st Frequency Component for 3 * cos(2 * pi * t):

Frequency = 2 * pi

Amplitude = 3

Cosine Type

- 2nd Frequency Component for 2 * sin(4 * pi * t):

Frequency = 4 * pi

Amplitude = 2

Sine Type

As a result:

The function x(t) is a signal that has two frequency components 1st Frequency Component = (2 * pi) and 2nd Frequency Component = (4 * pi).

c) Compute the average power of x(t) over one period:

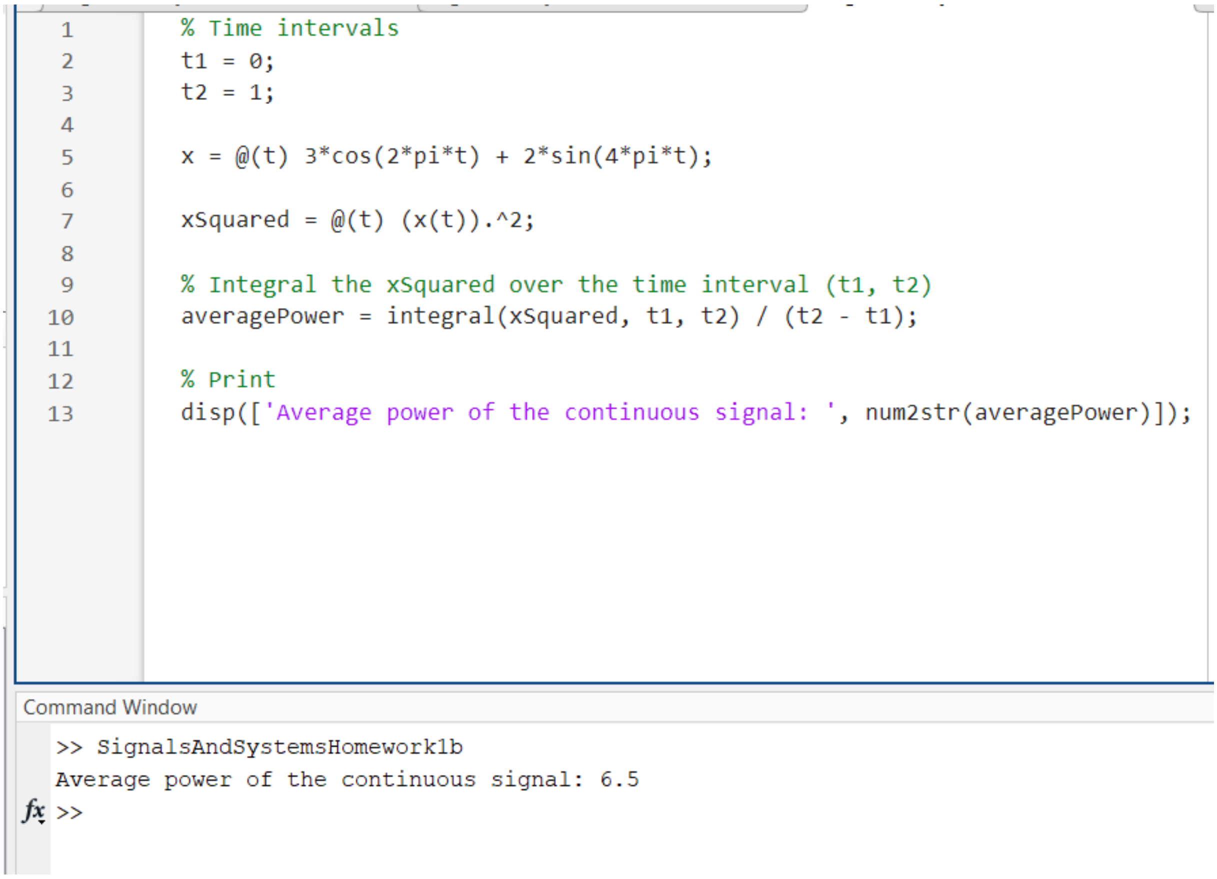
To find Pavg, I need to know:

- The time average of total energy is $\frac{1}{(t_2-t_1)}\int_{t_1}^{t_2}|x(t)|^2\,dt$ and referred to as average power of $x(t)$ over $t_1 \le t \le t_2$

And if I define my Pavg like that:

$$Pavg = \frac{1}{2-1}\int_0^1 \left|(3\cdot\cos(2\cdot\pi\cdot t)) + (2\cdot\sin(4\cdot\pi\cdot t))\right|^2 dt$$

Then I can calculate it in Matlab like that, and I found **Pavg = 6.5**



```
% Time intervals
t1 = 0;
t2 = 1;

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

xSquared = @(t) (x(t)).^2;

% Integral the xSquared over the time interval (t1, t2)
averagePower = integral(xSquared, t1, t2) / (t2 - t1);

% Print
disp(['Average power of the continuous signal: ', num2str(averagePower)]);
```

```
>> SignalsAndSystemsHomework1b
Average power of the continuous signal: 6.5
fx >>
```

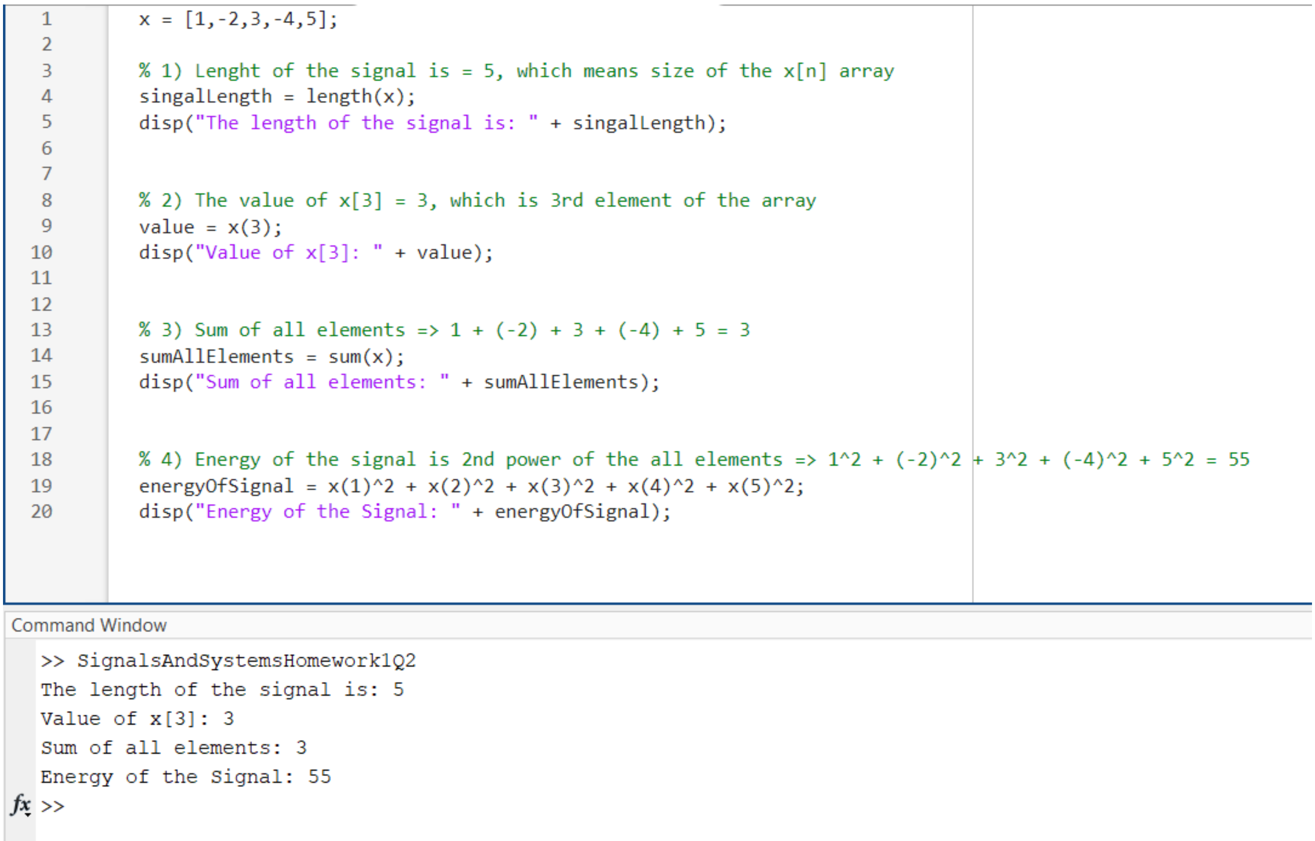
Q2)

1) The length of the signal is: **5**

2) Value of x[3]: **3**

3) Sum of all elements: **3**

4) Energy of the Signal: **55**



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

% 1) Lenght of the signal is = 5, which means size of the x[n] array
singalLength = length(x);
disp("The length of the signal is: " + singalLength);


% 2) The value of x[3] = 3, which is 3rd element of the array
value = x(3);
disp("Value of x[3]: " + value);


% 3) Sum of all elements => 1 + (-2) + 3 + (-4) + 5 = 3
sumAllElements = sum(x);
disp("Sum of all elements: " + sumAllElements);


% 4) Energy of the signal is 2nd power of the all elements => 1^2 + (-2)^2 + 3^2 + (-4)^2 + 5^2 = 55
energyOfSignal = x(1)^2 + x(2)^2 + x(3)^2 + x(4)^2 + x(5)^2;
disp("Energy of the Signal: " + energyOfSignal);
```

```
>> SignalsAndSystemsHomework1Q2
The length of the signal is: 5
Value of x[3]: 3
Sum of all elements: 3
Energy of the Signal: 55
>>
```

Source Code Q1/A:

```
% From 0 to 1, creating 1000 points, for 1 period

t = linspace(0, 1, 1000);

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

% Drawing the graph
plot(t, x);
xlabel('t');
ylabel('x(t)');
title('x(t): 3*cos(2*pi*t) + 2*sin(4*pi*t)');
grid on;
```

Source code Q1/C:

```
% Time intervals
t1 = 0;
t2 = 1;

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

xSquared = @(t) (x(t)).^2;

% Integral the xSquared over the time interval (t1, t2)
averagePower = integral(xSquared, t1, t2) / (t2 - t1);

% Print
disp(['Average power of the continuous signal: ', num2str(averagePower)]);
```

Source Code Q2:

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

% 1) Lenght of the signal is = 5, which means size of the x[n] array
singalLength = length(x);
disp("The length of the signal is: " + singalLength);


% 2) The value of x[3] = 3, which is 3rd element of the array
value = x(3);
disp("Value of x[3]: " + value);


% 3) Sum of all elements => 1 + (-2) + 3 + (-4) + 5 = 3
sumAllElements = sum(x);
disp("Sum of all elements: " + sumAllElements);


% 4) Energy of the signal is 2nd power of the all elements => 1^2 + (-2)^2 +
3^2 + (-4)^2 + 5^2 = 55
energyOfSignal = x(1)^2 + x(2)^2 + x(3)^2 + x(4)^2 + x(5)^2;
disp("Energy of the Signal: " + energyOfSignal);
```