Experiment - 2

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2.1a. Write a code to find the energy/ the average power of the signal $x[n] = (0.9)^{|n|} \sin(2\pi n/4)$ and $x[n] = 4\delta_5[n] - 7\delta_7[n]$

b. Write a code to find the fundamental time period of the signal,
$x(n) = -3\sin(6\pi n/5) + 2\cos(9\pi n/4)$

2.2 Write a code to perform time shift, time reversal and time scaling and plot all graphs including for the original function in one figure for
a] Discrete time b] Continuous time

2.3 $x[n] = \begin{cases} \alpha^n, & N1 \leq n \leq N2 \\ 0, & \text{elsewhere} \end{cases}$

a] User input of α, N_1, N_2

b] $n = -10:15$

c] Calculate energy and average power of signal

d] Plot $x[an+b]$ where 'a' and 'b' are user input

e] Scale $x[n]$ to $x[cn]$ where 'c' is user input

f] Subplot all these with titles

Experiment - 2

2.1a.

Editor - C:\Users\18BIS0043\Documents\MATLAB\BIS0043_E2_1a.m

BIS0043_E2_1a.m | impND.m | BIS0043_E2_1b.m

```
% Find the energy and the average power

clc
clear all

% Calculating Energy
n = -100:100;
x = (0.9).^abs(n).*sin(2*pi*n/4);
x2 = x.^2;
E = sum(x2);
disp(['Energy = ',num2str(E)]);

% Calculating power
n = -35:34; % Since the fundamental time period is 35
x = 4*impND(5,35) - 7*impND(7,35);
x2 = x.^2;
P = (35/length(n))*(sum(x2)/35);
disp(['Power = ',num2str(P)]);
```

Command Window

```
Energy = 4.7107
Power = 0.12857
fx >>
```

Function (impND) used in the previous question:

Editor - C:\Users\18BIS0043\Documents\MATLAB\impND.m

BIS0043_E2_1a.m | impND.m | BIS0043_E2_1b.m

```
function y = impND(N,n)
if N==round(N)
    y = double((n/N)==round(n/N));
end;
```

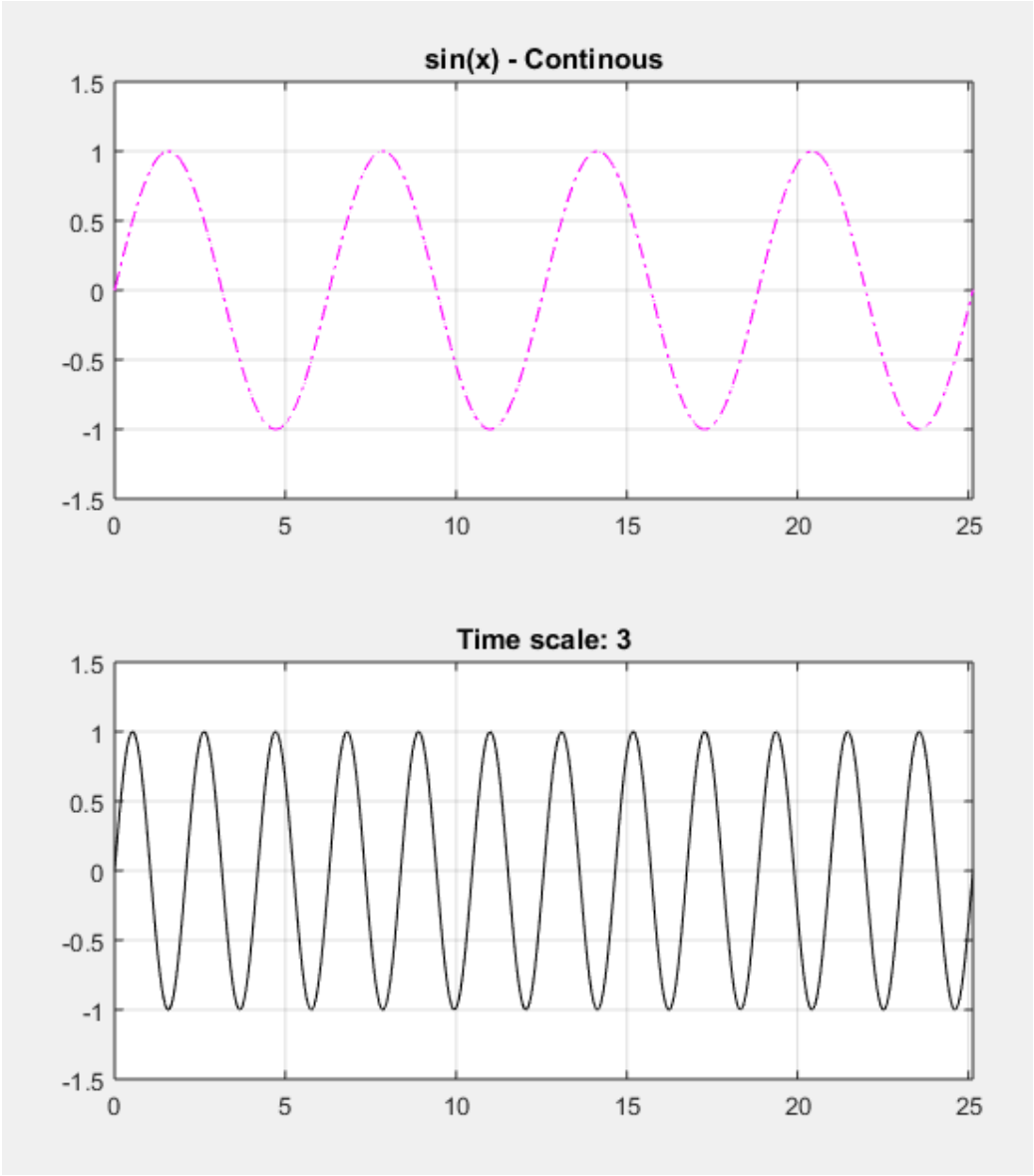
2.2a.

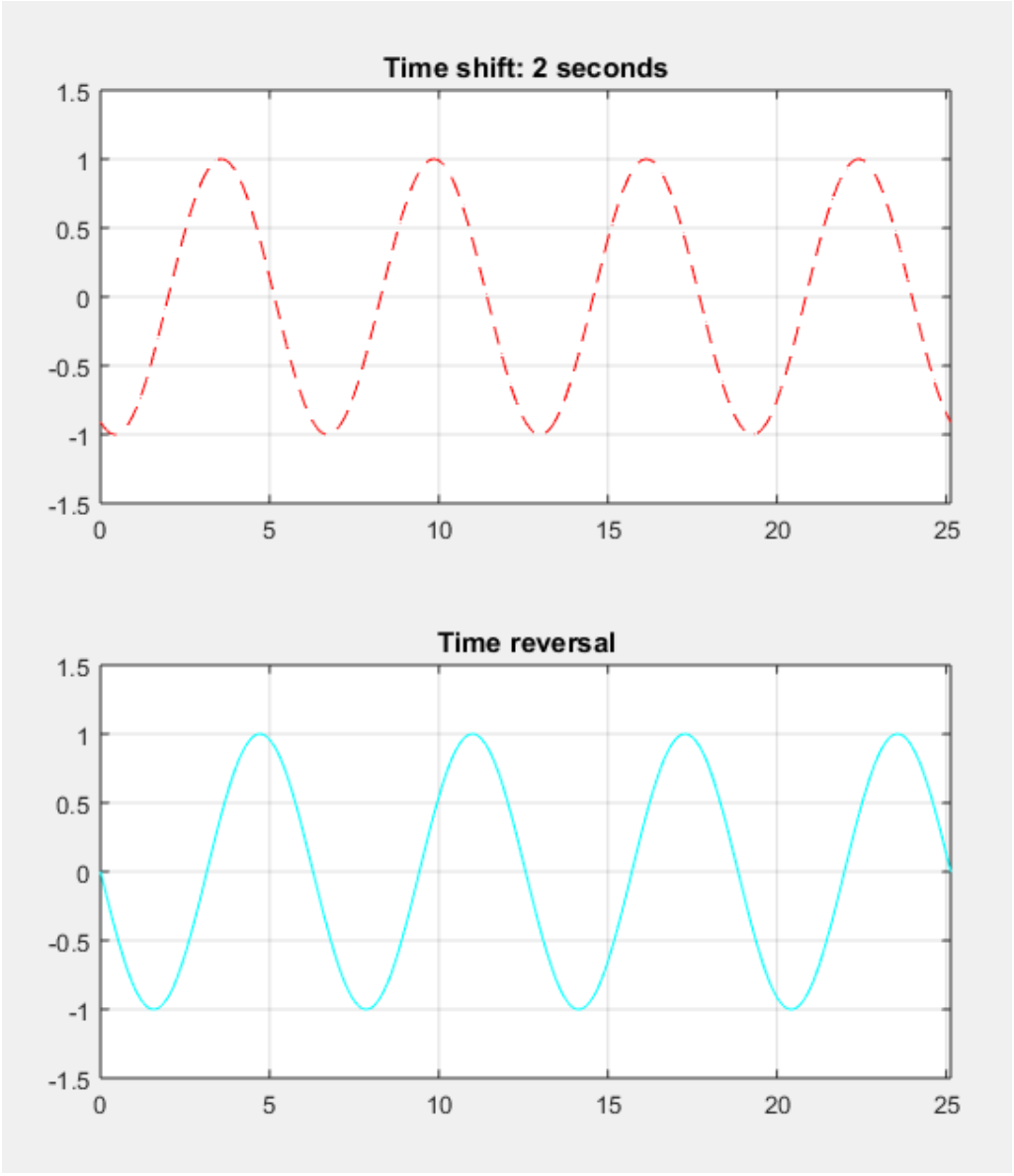
Editor - C:\Users\18BIS0043\Documents\MATLAB\BIS0043_E2_2.m

BIS0043_E2_1b.m | BIS0043_E2_2.m

```
clc
clear all

% Let's use the sine function
n = linspace(-18*pi,100*pi,10000);
x = sin(n);

subplot(2,2,1)
plot(n,x,'m-.');
title('sin(x) - Continous')
grid on;
axis([0 8*pi -1.5 1.5])

% Time shift by 2 sec
subplot(2,2,2)
plot(n+2,x,'r--');
title('Time shift: 2 seconds')
grid on;
axis([0 8*pi -1.5 1.5])
```

```
% Time scaling by +3
subplot(2,2,3)
plot(n/3,x,'black');
title('Time scale: 3')
grid on;
axis([0 8*pi -1.5 1.5])

% Time reversal
subplot(2,2,4)
x = sin(-n);
plot(n,x,'c');
title('Time reversal')
grid on;
axis([0 8*pi -1.5 1.5])
```


sin(x) - Continous
1.5
1
0.5
0
-0.5
-1
-1.5
0
5
10
15
20
25
Time scale: 3
1.5
1
0.5
0
-0.5
-1
-1.5
0
5
10
15
20
25

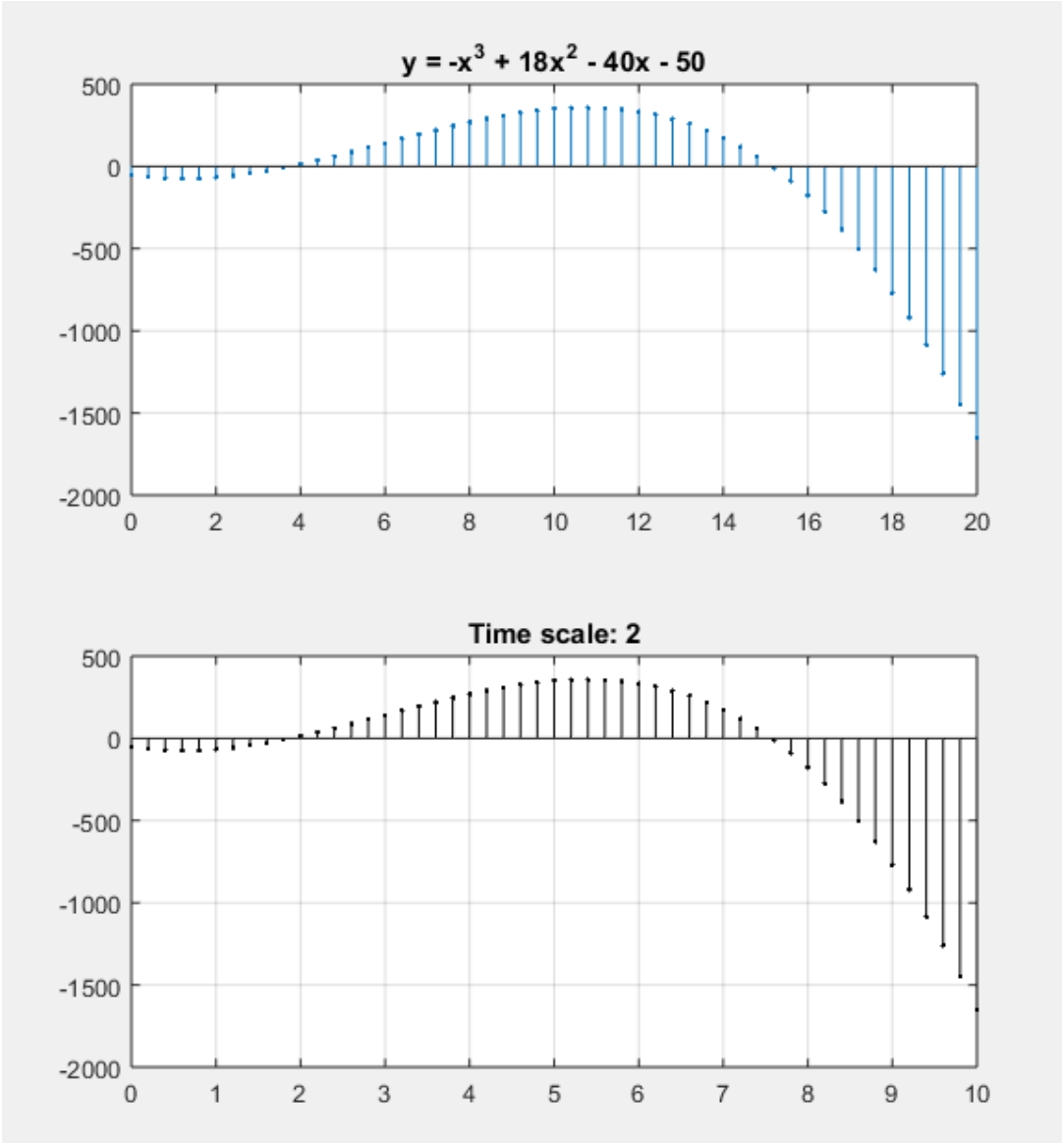

Time shift: 2 seconds
1.5
1
0.5
0
-0.5
-1
-1.5
0
5
10
15
20
25
Time reversal
1.5
1
0.5
0
-0.5
-1
-1.5
0
5
10
15
20
25

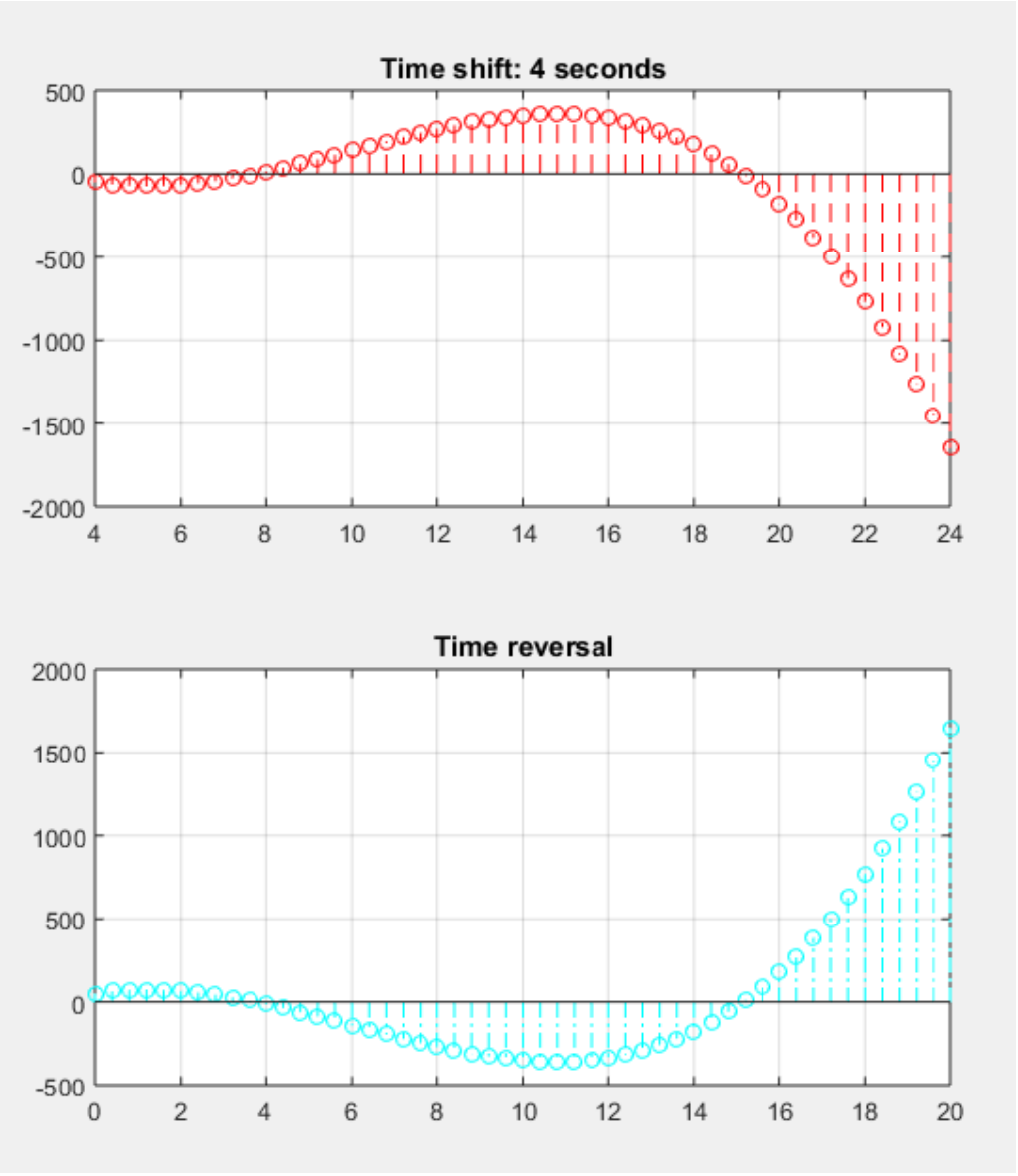
2.2b.

Editor - C:\Users\18BIS0043\Documents\MATLAB\BIS0043_E2_2b.m

BIS0043_E2_1b.m | BIS0043_E2_2.m | BIS0043_E2_2b.m

```
clc
clear all
% Let's use an example function: y = -x^3 + 18x^2 - 40x - 50
x = 0:0.4:20;
y = - x.^3 + 18*x.^2 - 40.*x - 50;
subplot(2,2,1)
stem(x,y,'.');
title('y = -x^3 + 18x^2 - 40x - 50')
grid on;
% Time shift by 4 sec
subplot(2,2,2)
stem(x+4,y,'r--');
title('Time shift: 4 seconds')
grid on;
% Time scaling by +2
subplot(2,2,3)
stem(x/2,y,'black.');
title('Time scale: 2')
grid on;
% Time reversal
subplot(2,2,4)
y = -(- x.^3 + 18*x.^2 - 40.*x - 50);
stem(x,y,'c-.');
title('Time reversal')
grid on;
```


y = -x^3 + 18x^2 - 40x - 50
500
0
-500
-1000
-1500
-2000
0
2
4
6
8
10
12
14
16
18
20
Time scale: 2
500
0
-500
-1000
-1500
-2000
0
1
2
3
4
5
6
7
8
9
10


Time shift: 4 seconds
500
0
-500
-1000
-1500
-2000
4
6
8
10
12
14
16
18
20
22
24
Time reversal
2000
1500
1000
500
0
-500
0
2
4
6
8
10
12
14
16
18
20

2.3.

Editor - C:\Users\18BIS0043\Documents\MATLAB\BIS0043_E2_3.m

BIS0043_E2_3.m | BIS0043_E2_1a.m

```
clc
clear all

% User input of all the variables
al = input('Enter Alpha: ');
N1 = input('Enter N1: ');
N2 = input('Enter N2: ');
a = input('Enter a: ');
b = input('Enter b: ');
c = input('Enter c: ');

n = linspace(-100,100,5000);
xa = al.^n;
% Function x
x1 = xa.*(n<=N2 & n>=N1);

subplot(2,2,1)
plot(n,x1,'r-.');
title('x[n]')
xlim([-10 10]);
ylim([-10 200]);
grid on;
```

Editor - C:\Users\18BIS0043\Documents\MATLAB\BIS0043_E2_3.m

BIS0043_E2_3.m | BIS0043_E2_1a.m

```
subplot(2,2,3)
x3 = xa.*(n<=N2 & n>=N1);
plot((n+b)/a,x3,'g--');
title('x[an+b]')
xlim([-10 10]);
ylim([-10 200]);
grid on;

subplot(2,2,4)
x4 = xa.*((n<=N2) & (n>=N1));
plot(n/c,x4,'black');
title('x[nc]')
xlim([-10 10]);
ylim([-10 200]);
grid on;
```

Editor - C:\Users\18BIS0043\Documents\MATLAB\BIS0043_E2_3.m

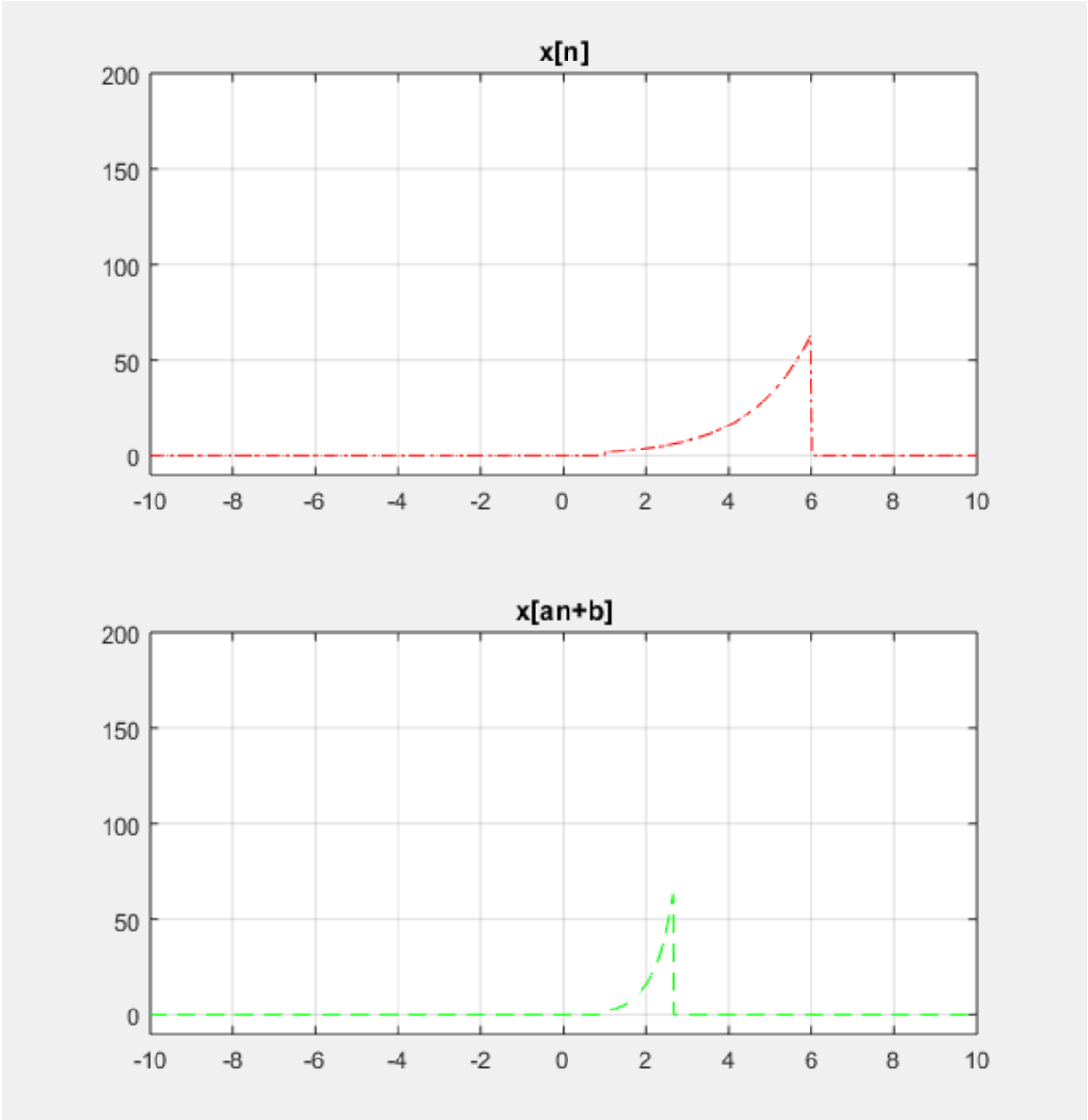
BIS0043_E2_3.m | BIS0043_E2_1a.m

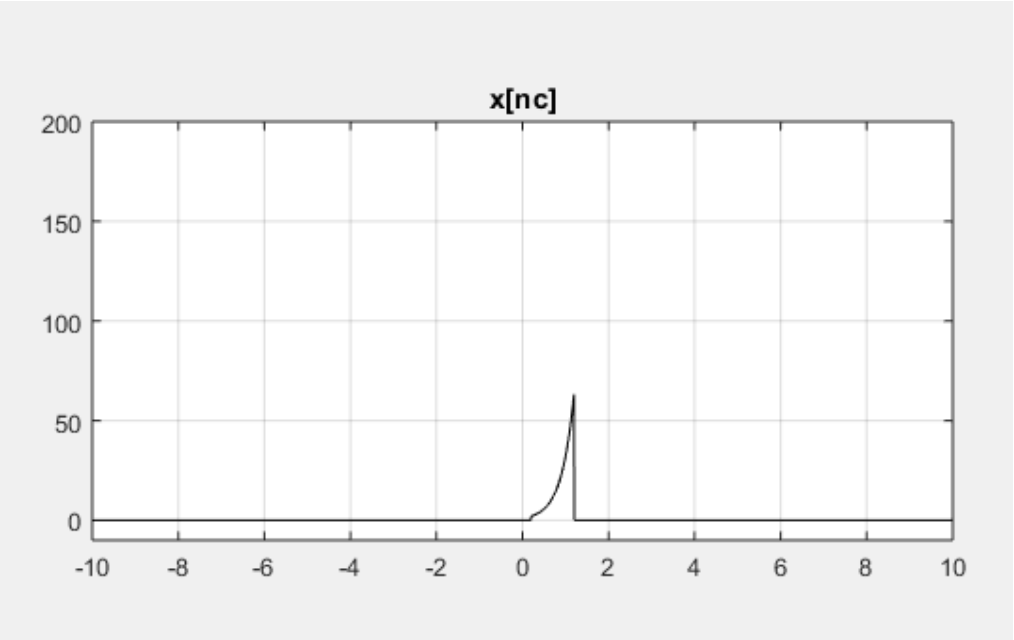
```
40      % Calculating Energy
41 -    n = -100:100;
42 -    xa = al.^n;
43 -    x = xa.*(n<=N2 & n>=N1);
44 -    x2 = x.^2;
45 -    E = sum(x2);
46 -    disp(['Energy = ',num2str(E)]);
47
48      % Calculating power
49 -    n = -35:34;
50 -    xa = al.^n;
51 -    x = xa.*(n<=N2 & n>=N1);
52 -    x2 = x.^2;
53 -    P = (35/length(n))*(sum(x2)/35);
54 -    disp(['Power = ',num2str(P)]);
55
```

Command Window

```
Enter Alpha: 2
Enter N1: 1
Enter N2: 6
Enter a: 3
Enter b: 2
Enter c: 5
Energy = 5460
Power = 78
fx >>
```

These values of A, B and C are used in the following graphs.


x[n]
200
150
100
50
0
-10
-8
-6
-4
-2
0
2
4
6
8
10
x[an+b]
200
150
100
50
0
-10
-8
-6
-4
-2
0
2
4
6
8
10


x[nc]
200
150
100
50
0
-10
-8
-6
-4
-2
0
2
4
6
8
10

Editor - C:\Users\18BIS0043\Documents\MATLAB\BIS0043_E2_1b.m

BIS0043_E2_1a.m | impND.m | BIS0043_E2_1b.m

This file can be published to a formatted document. For more information, see the publishing

```
1 -    clc
2 -    clear all
3
4 -    t = linspace(0,70,10000)
5 -    x = -3*sin(6*pi*t/5) + 2*cos(9*pi*t/4);
6
7 -    [idx,idy] = findpeaks(x);
8 -    max = 0;
9 -    for i = 1:length(idx)
10 -       if idx(i)>max;
11 -           max = idx(i);
12 -       end
13 -   end
14 -   m = round(max,2);
15
16 -   disp(['Max Peak = ' num2str(m)]);
17 -   plot(t,x);
18 -   grid on
19
```