ComputationalHW1

Contents

Question 1 **2**

Part A, Plotting $x[n]$ **2**

Part B, Plotting $x[n-2]$ **2**

Part C, Plotting $x[-2n-2]$ **2**

Part D, Plotting $x\left[\frac{n}{3}-2\right]$ **5**

Question 2 **5**

Question 3 **8**

Part A, a=0, T_o=10, \phi=0 **8**

Part B, a=0, T_o=10, \phi=-\frac{\pi}{4} **8**

Part C, a=-.05, T_o=10, \phi=0 **10**

Question 4 **10**

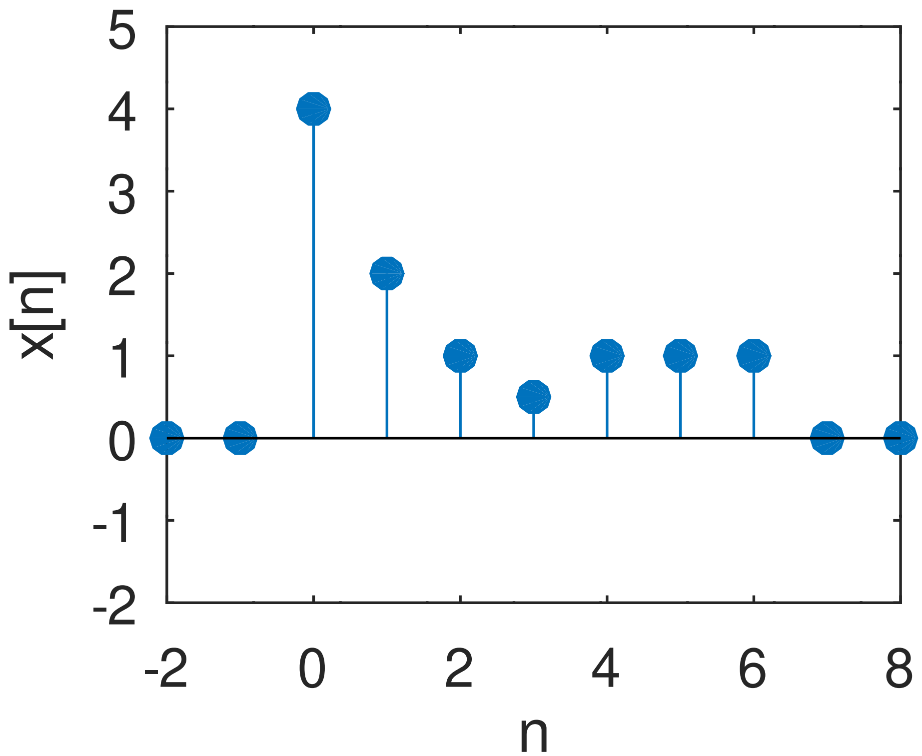
```
clear; % Clear workspace
```

Question 1

```
delta = @(n) (n == 0); % Define the unit impulse function
    , $\delta[n]$
u = @(n) ((n >= 0) & (rem(n,1) == 0)); % Define the unit
    step function, $u[n]$
a = .5; % Define exponential value
halfExp = @(n) (a).^(n-2) .* u(n) - (a).^(n-2) .* u(n-4);
     % Define the exponential function

n=-20:25; % Range of times to evaluate
x = @(n) halfExp(n) + delta(n-4) + delta(n-5) + delta(n
    -6); % Define $x[n]$ per the problem specifications
```

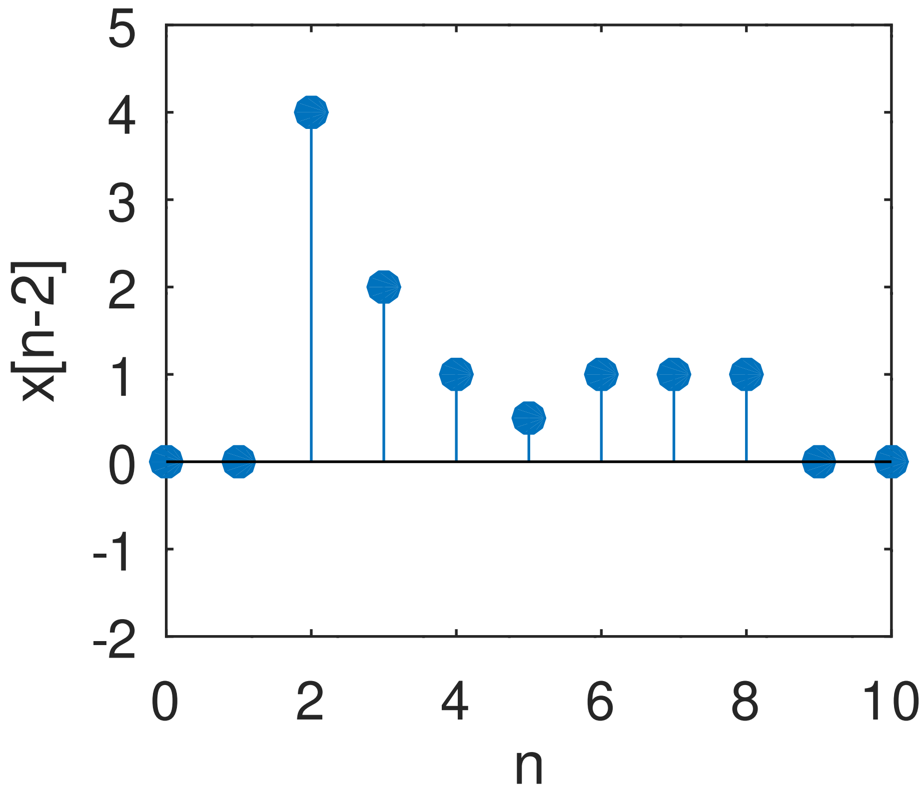
Part A, Plotting $x[n]$

```
subplot(2,2,1); % Create subplots
stem(n,x(n),'fill'); % Plot figure
xlabel('n'); % Define $x$-axis title
ylabel('x[n]'); % Define $y$-axis title
ylim([-2 5]); % Establish $y$ limits
xlim([-2 8]); % Establish $x$ limits
```



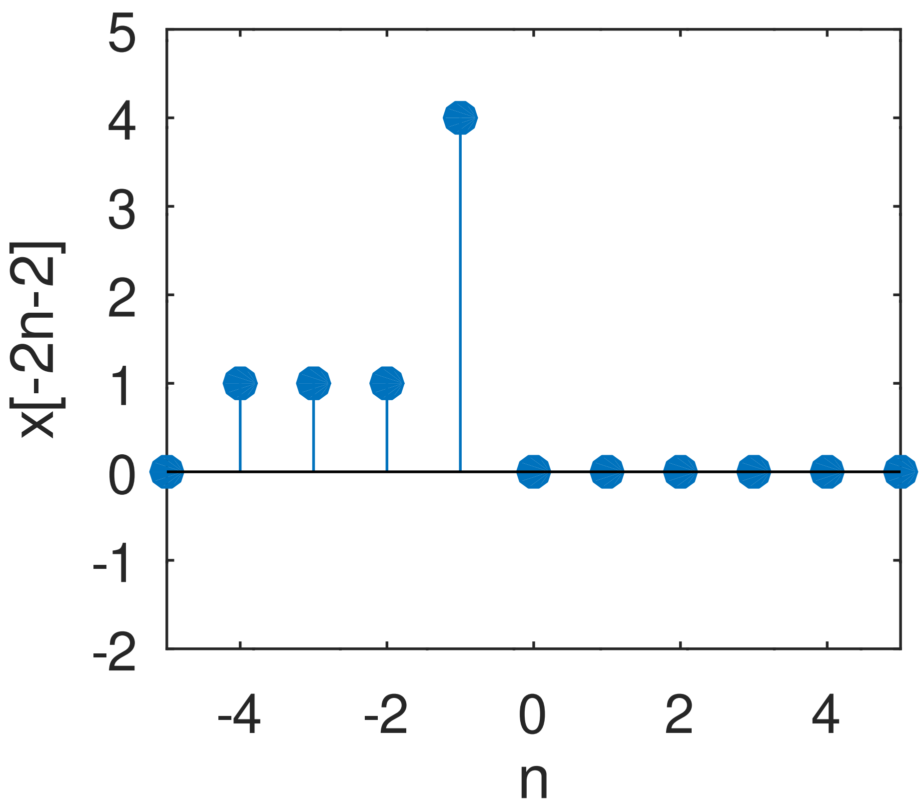
Part B, Plotting $x[n-2]$

```
subplot(2,2,2);
stem(n,x(n-2),'fill');
xlabel('n');
ylabel('x[n-2]');
ylim([-2 5]);
xlim([0 10]);
```



Part C, Plotting $x[-2n-2]$

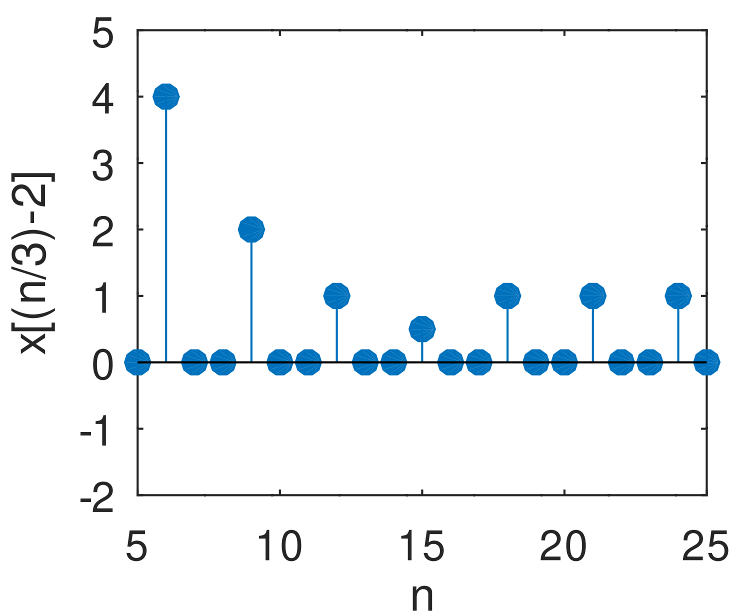
```
subplot(2,2,3);
stem(n,x(-2*n-2),'fill');
xlabel('n');
ylabel('x[-2n-2]');
ylim([-2 5]);
xlim([-5 5]);
```



Part D, Plotting $x\left[\frac{n}{3}-2\right]$

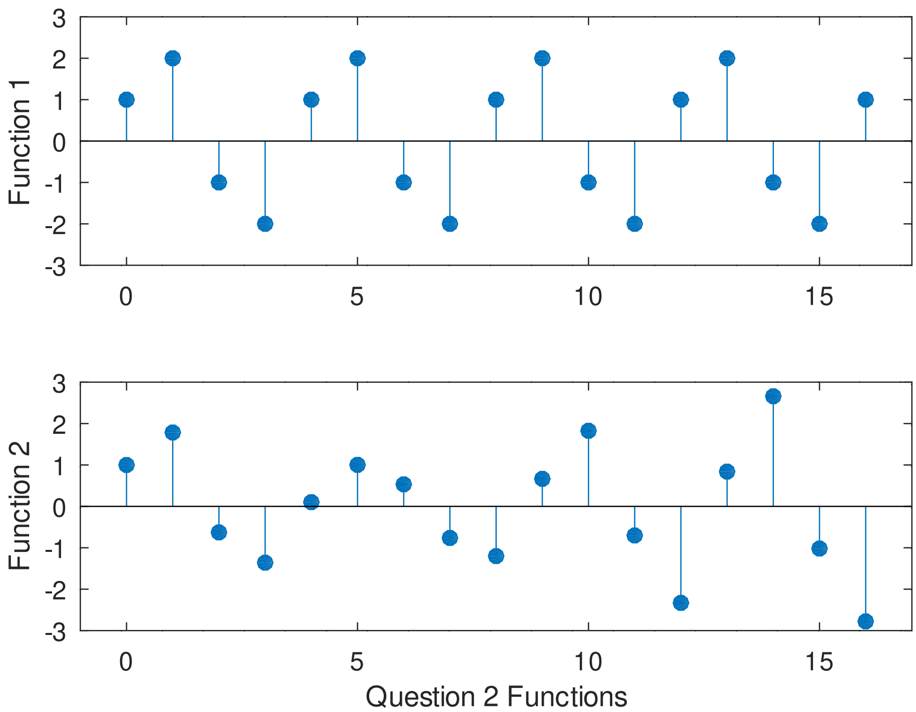
```
subplot(2,2,4);
stem(n,x(n/3−2),'fill');
xlabel('n');
ylabel('x[(n/3)−2]');
ylim([−2 5]);
xlim([5 25]);
axes('visible', 'off', 'title', 'x[n] and variations' );

pause; % Wait for input before continuing to next
    question

clear all; % Clear the workspace
```

x[n] and variations



Question 2

```
N = 4; % Define $N$ value
range = 0:4*N; % Define plotting range
x1 = @(m) 2*sin( (2*pi*m) / N) + cos( (6*pi*m) / N); %
    Define function 1
x2 = @(l) 2*sin( (6*l) / N) + cos( (18*l) / N); % Define
    function 2

% We can see from the functions that $x_1$ is periodic,
    since the fundamental period of the first function is
    $N=4$ and $$(N/3)m=4$$ for the second one, thus the
    least common multiple of the frequencies is 4
% We can see from the second function that $x_2$ is not
    periodic, since neither sinusoid contains $\pi$ in its
     period

subplot(2,1,1);
stem(range, x1(range), 'fill'); % Use stem to plot figure
ylim([-3 3]); % Set $y$-axis bounds
xlim([-1 4*N+1]); % Set $x$-axis bounds
ylabel('Function 1'); % Label $y$-axis

subplot(2,1,2);
stem(range, x2(range), 'fill');
ylim([-3 3]); % Set $y$-axis bounds
xlim([-1 4*N+1]); % Set $x$-axis bounds
xlabel('Question 2 Functions'); % Label $x$-axis
ylabel('Function 2');

% We can see that, indeed, no value in function 2 repeats
     (at least within this range); on the other hand $x_1$
     repeats every 4 samples

pause; % Wait for input before continuing to next
    question

clear all; % Clear the workspace
```

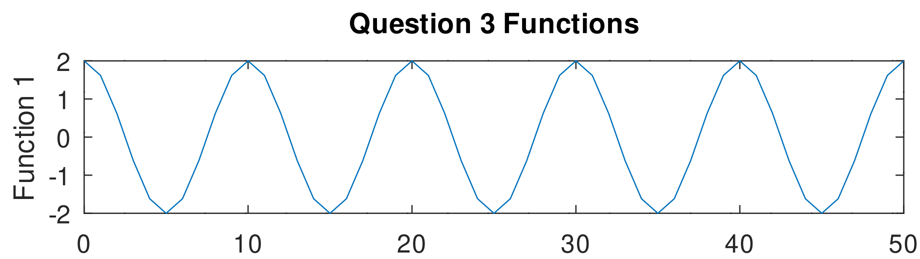


Question 3

```
q3Func = @(a,T,phi,t) (2 .* e.^(a * t) .* cos( (2 * pi *
    t) / T + phi));
```

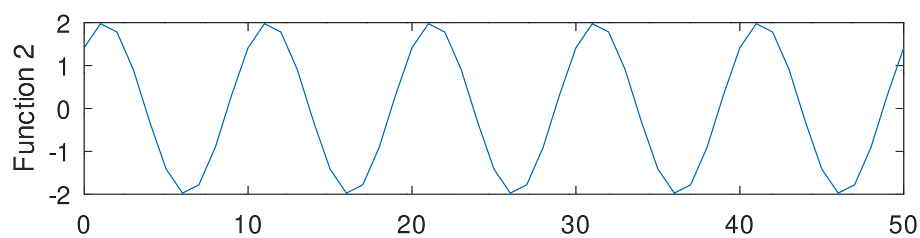
Part A, a=0, T_o=10, \phi=0

```
subplot(3,1,1); % Create subplots for each plot
a = 0;
T = 10;
phi = 0;
t = 0:(5*T); % Define parameter variables for the
    function ($a, T_o, \phi, t$)
plot(t, q3Func(a,T,phi,t)); % Plot the function
title('Question 3 Functions'); % Title Graphs
ylabel('Function 1'); % Label y axis
```



Part B, a=0, T_o=10, \phi=-\frac{\pi}{4}

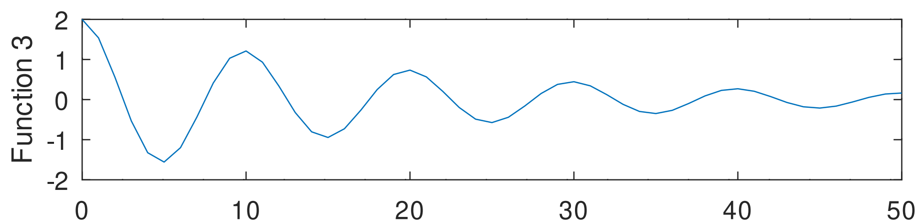
```
subplot(3,1,2); % Create subplots for each plot
a = 0;
T = 10;
phi = -(pi/4);
t = 0:(5*T); % Define parameter variables for the
    function ($a, T_o, \phi, t$)
plot(t, q3Func(a,T,phi,t)); % Plot the function
ylabel('Function 2'); % Label y axis

% We see that $\phi$ causes a phase shift of the signal.
    Because, in this case, it is negative, the signal
    shifts to the right by $\pi/4$
```



Part C, a=-.05, T_o=10, \phi=0

```
subplot(3,1,3); % Create subplots for each plot
a = -.05;
T = 10;
phi = 0;
t = 0:(5*T); % Define parameter variables for the
    function ($a, T_o, \phi, t$)
plot(t, q3Func(a,T,phi,t)); % Plot the function
ylabel('Function 3'); % Label y axis
```

```
% We see that $a$ is the attentuation factor. Since it is
    negative in this case, the signal attenuates as it
    goes on (gets weaker)

pause; % Wait for input before continuing to next
    question

clear all; % Clear the workspace
```



Question 4

```
No = 3; % Define fundamental period
q4Func = @(n) 5 .* sin((2 * pi / No) * n + (pi / 4)); %
    Define function without $k$
q4FuncK = @(n,k) 5 .* sin((2 * pi * k / No) * n + (pi /
    4)); % Define function with $k$
xlimits = 0:2*No; % Set $x$ limits

% Plotting the graphs
subplot(3,2,1);
stem(xlimits, q4Func(xlimits), 'fill');
ylabel('Function 1');
subplot(3,2,2);
stem(xlimits, q4FuncK(xlimits,1), 'fill');
ylabel('Function 2 (k=1)');
subplot(3,2,3);
stem(xlimits, q4FuncK(xlimits,2), 'fill');
ylabel('Function 3 (k=2)');
subplot(3,2,4);
stem(xlimits, q4FuncK(xlimits,3), 'fill');
ylabel('Function 4 (k=3)');
subplot(3,2,5);
stem(xlimits, q4FuncK(xlimits,4), 'fill');
ylabel('Function 5 (k=4)');
subplot(3,2,6);
```

```
stem(xlimits, q4FuncK(xlimits,5), 'fill');
ylabel('Function 6 (k=5)');

% We see that, for all values of $k$ that are not an
    integer multiple of $N_o$, the same plot is generated

% When $k$ is an integer multiple of $N_o$, the
    fundamental frequency becomes 1
```