Lab Report
IA 3203 – DIGITAL SIGNAL PROCESSING   *Department of Instrumentation and Automation Technology*   *University of Colombo*
DSP 301 – **Basic Operations on Desecrate Time Signals**

Registration No: 2021t01108

Students Name: G.G.B.S Gunawardana
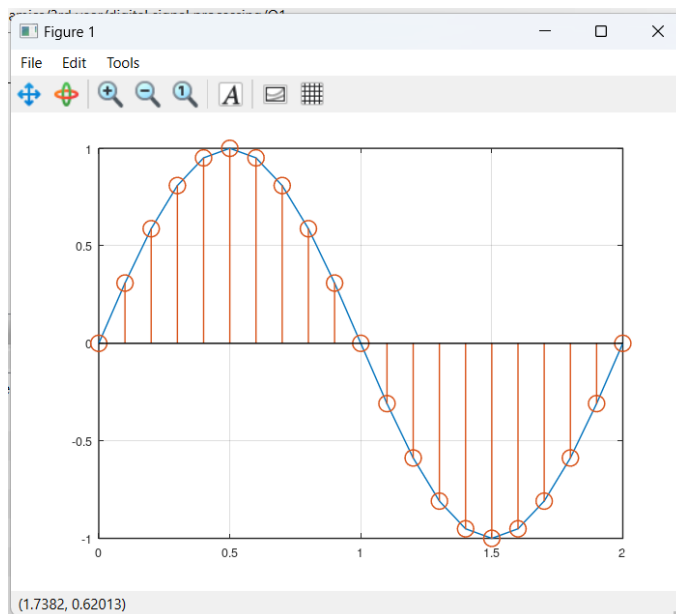
Date (dd/mm/yy): 19/07/2024

Exercise:

Question 01:

Answer:

Octave code:

```
clear all;
close all;
clc;

A = 1;
theta = 0;
f = 1/2;
omega  = (2*pi*f);

n = 0:0.1:2;

x = sin((omega * n) + theta);

plot(n , x);
hold on;

stem(n ,x);
grid on
```

Figures:

Results/Answers in Command Window:

No results in command window
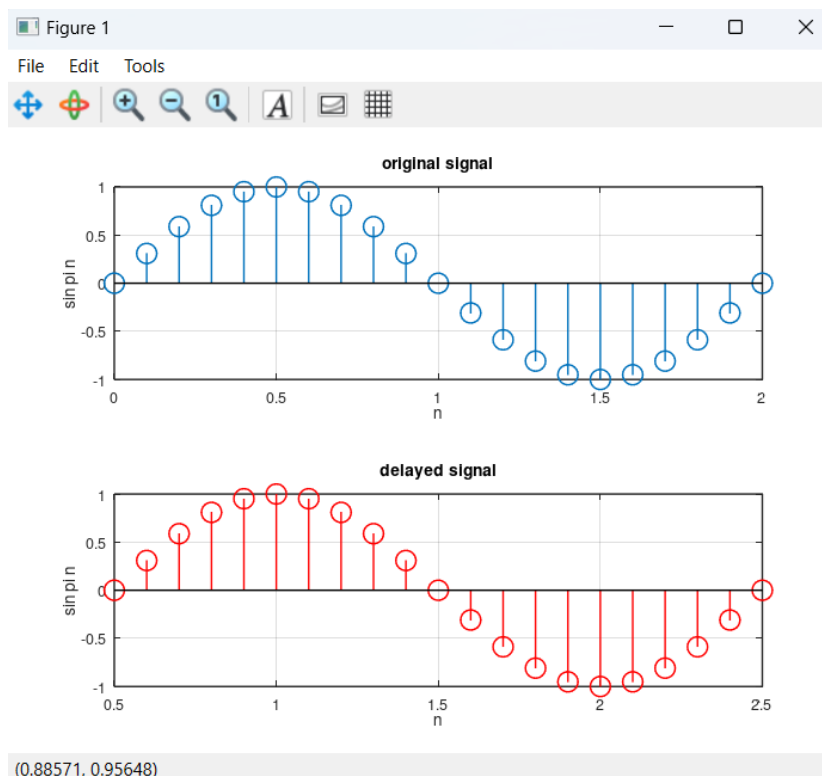
Question 02:

Answer:

i. *Octave code:*

```
Editor
File  Edit  View  Debug  Run  Help

DSP_q1.m

1
2   clear all;
3   close all;
4   clc;
5
6   A = 1;
7   theta = 0;
8   f = 1/2;
9   omega = (2*pi*f);
10
11  n = 0:0.1:2;
12
13  x = sin((omega * n) + theta);
14  delay = 0.5;
15  n_delayed = n + delay;
16
17  subplot(2,1,1);
18  stem(n,x);
19  xlabel('n');
20  ylabel('sin pi n');
21  title('original signal');
22  grid on;
23
24  subplot(2,1,2);
25  stem(n_delayed,x,'r');
26  xlabel('n');
27  ylabel('sin pi n');
28  title('delayed signal');
29  grid on;
```
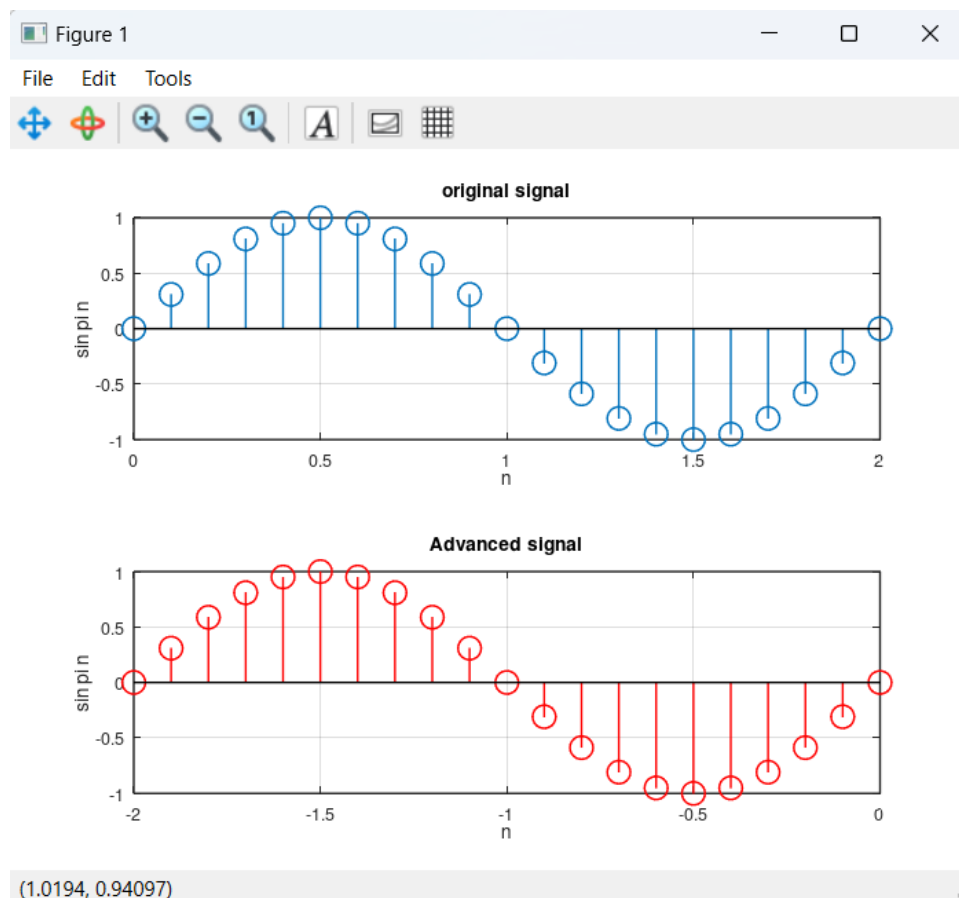
Figures:

(0.88571, 0.95648)

ii. *Octave code:*

le   Edit   View   Debug   Run   Help

)SP_301_Q2_ii.m ☒

```
1
2   clear all;
3   close all;
4   clc;
5
6   A = 1;
7   theta = 0;
8   f = 1/2;
9   omega  = (2*pi*f);
10
11  n = 0:0.1:2;
12
13  x = sin((omega * n) + theta);
14  advance = 2.0;
15  n_advance = n - advance;
16
17  subplot(2,1,1);
18  stem(n,x);
19  xlabel('n');
20  ylabel('sin pi n');
21  title('original signal');
22  grid on;
23
24  subplot(2,1,2);
25  stem(n_advance,x,'r');
26  xlabel('n');
27  ylabel('sin pi n');
28  title('Advanced signal');
29  grid on;
```
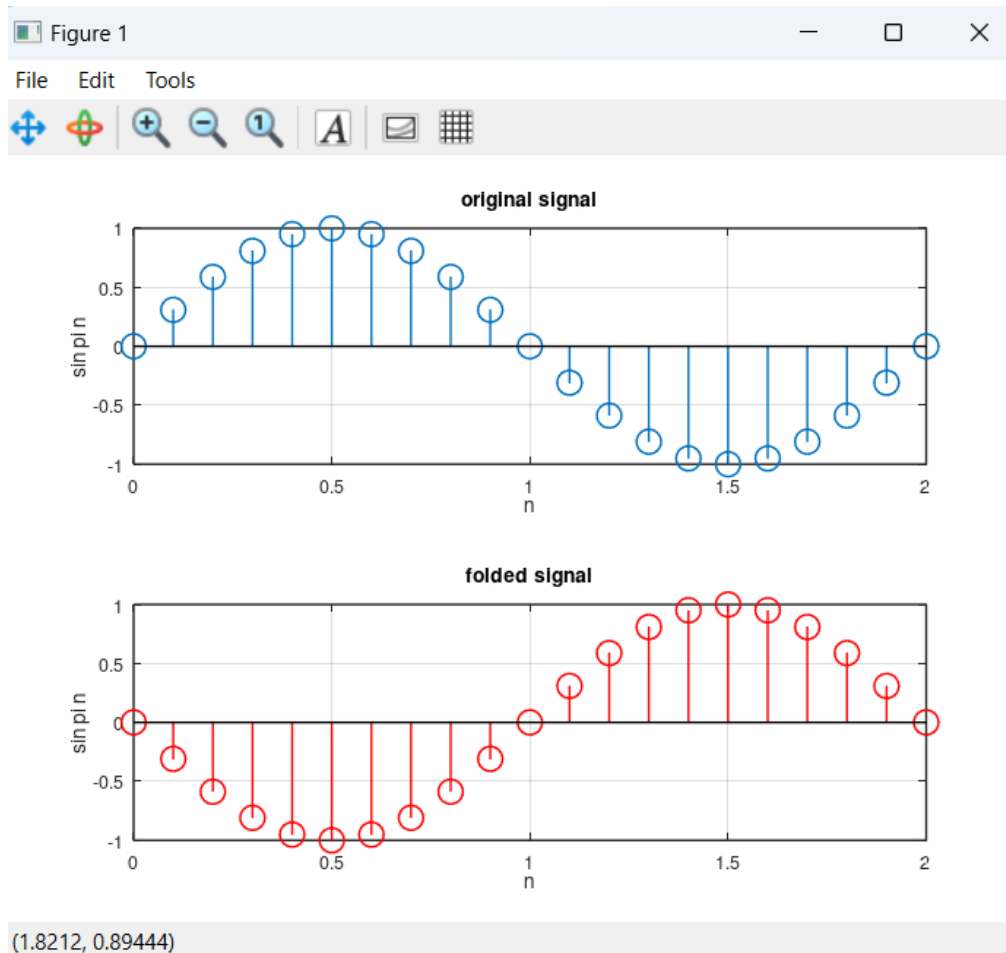
Figures:

(1.0194, 0.94097)

iii. *Octave code:*

Editor

File Edit View Debug Run Help

DSP_301_Q2_ii.m ⊠

```
1
2    clear all;
3    close all;
4    clc;
5
6    A = 1;
7    theta = 0;
8    f = 1/2;
9    omega  = (2*pi*f);
10
11   n = 0:0.1:2;
12
13   x = sin((omega * n) + theta);
14
15
16   subplot(2,1,1);
17   stem(n,x);
18   xlabel('n');
19   ylabel('sin pi n');
20   title('original signal');
21   grid on;
22
23   subplot(2,1,2);
24   stem(n,-x,'r');
25   xlabel('n');
26   ylabel('sin pi n');
27   title('folded signal');
28   grid on;
29
```
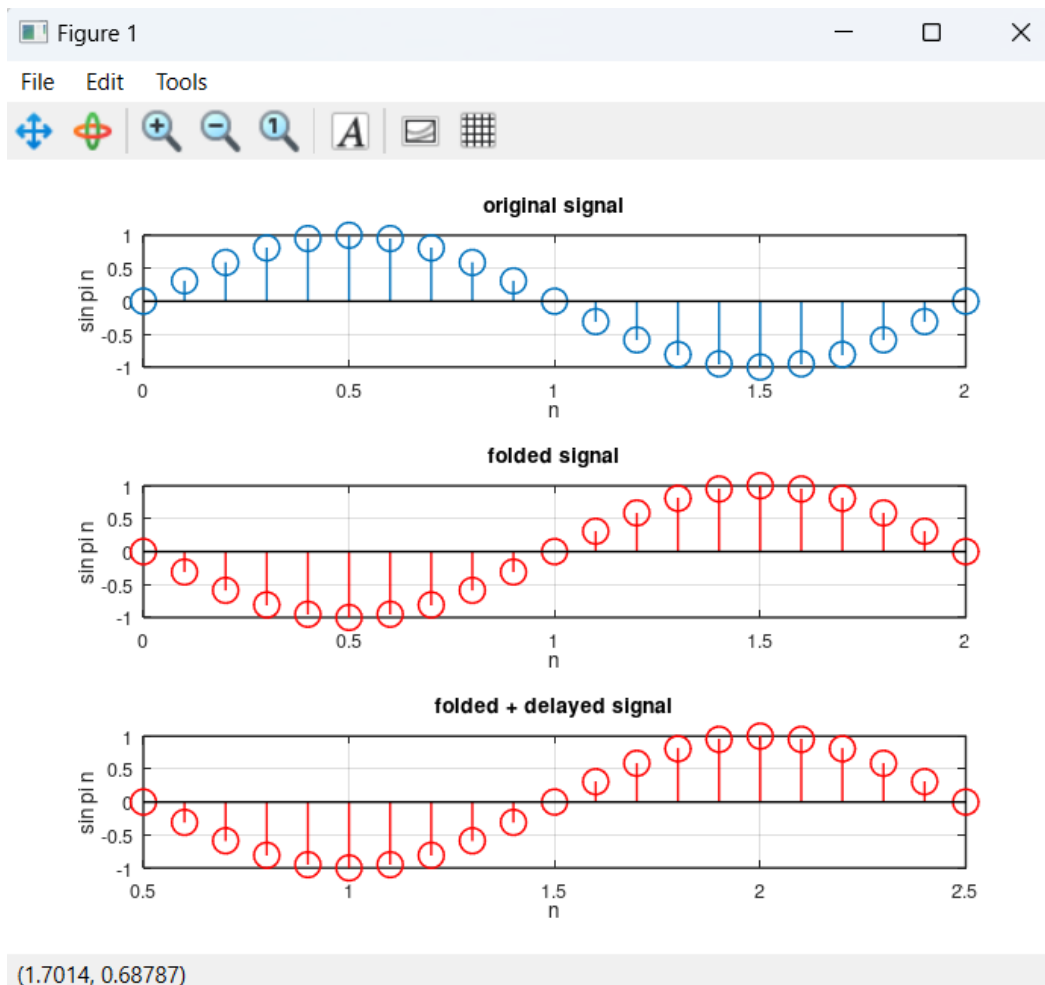
Figures:

iv. **Octave code:**

File   Edit   View   Debug   Run   Help

DSP_301_Q2_iv.m ✕

```
 1
 2   clear all;
 3   close all;
 4   clc;
 5
 6   A = 1;
 7   theta = 0;
 8   f = 1/2;
 9   omega  = (2*pi*f);
10
11   n = 0:0.1:2;
12
13   x = sin((omega * n) + theta);
14   delay = 0.5;
15   n_delayed = n + delay;
16
17
18   subplot(3,1,1);
19   stem(n,x);
20   xlabel('n');
21   ylabel('sin pi n');
22   title('original signal');
23   grid on;
24
25   subplot(3,1,2);
26   stem(n,-x,'r');
27   xlabel('n');
28   ylabel('sin pi n');
29   title('folded signal');
30   grid on;
31
32   subplot(3,1,3);
33   stem(n_delayed,-x,'r');
34   xlabel('n');
35   ylabel('sin pi n');
36   title('folded + delayed signal');
37   grid on;
```
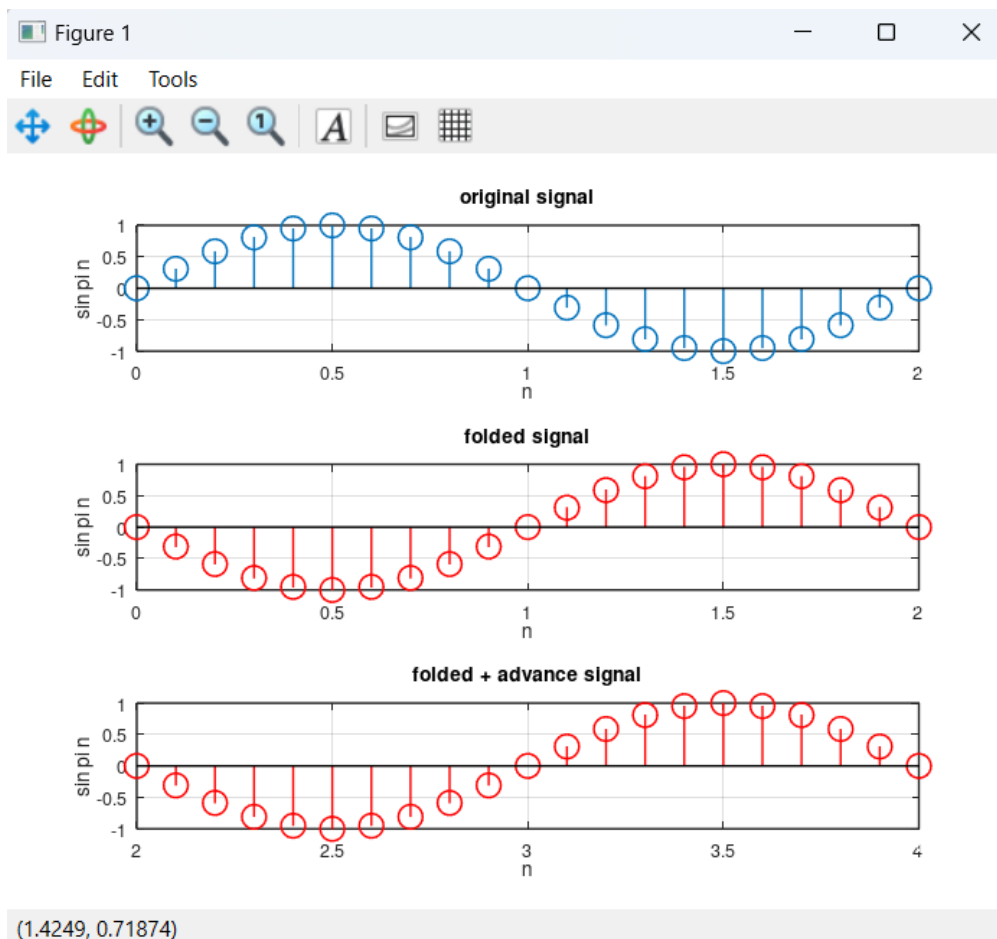
Figures:

v. **Octave code:**

File   Edit   View   Debug   Run   Help

DSP_301_Q2_v.m ⊠

```
1
2    clear all;
3    close all;
4    clc;
5
6    A = 1;
7    theta = 0;
8    f = 1/2;
9    omega  = (2*pi*f);
10
11   n = 0:0.1:2;
12
13   x = sin((omega * n) + theta);
14   advance = 2;
15   n_advance = n + advance;
16
17
18   subplot(3,1,1);
19   stem(n,x);
20   xlabel('n');
21   ylabel('sin pi n');
22   title('original signal');
23   grid on;
24
25   subplot(3,1,2);
26   stem(n,-x,'r');
27   xlabel('n');
28   ylabel('sin pi n');
29   title('folded signal');
30   grid on;
31
32   subplot(3,1,3);
33   stem(n_advance,-x,'r');
34   xlabel('n');
35   ylabel('sin pi n');
36   title('folded + advance signal');
37   grid on;
```
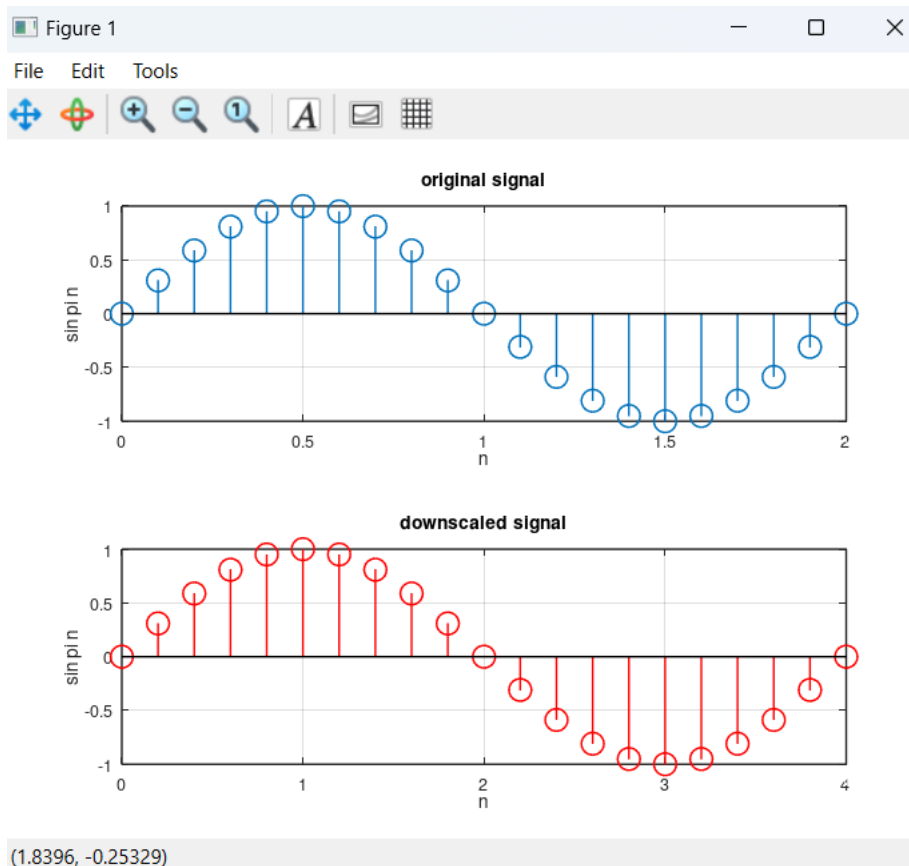
Figures:

vi. Octave code:

File   Edit   View   Debug   Run   Help

DSP_301_Q2_vi.m

```
1
2   clear all;
3   close all;
4   clc;
5
6   A = 1;
7   theta = 0;
8   f = 1/2;
9   omega  = (2*pi*f);
10
11  n = 0:0.1:2;
12
13  x = sin((omega * n) + theta);
14
15
16
17  subplot(2,1,1);
18  stem(n,x);
19  xlabel('n');
20  ylabel('sin pi n');
21  title('original signal');
22  grid on;
23
24  subplot(2,1,2);
25  stem(n*2,x,'r');
26  xlabel('n');
27  ylabel('sin pi n');
28  title('downscaled signal');
29  grid on;
30
```

Figures:

Figure 1

File   Edit   Tools

(1.8396, -0.25329)

vii. *Octave code:*
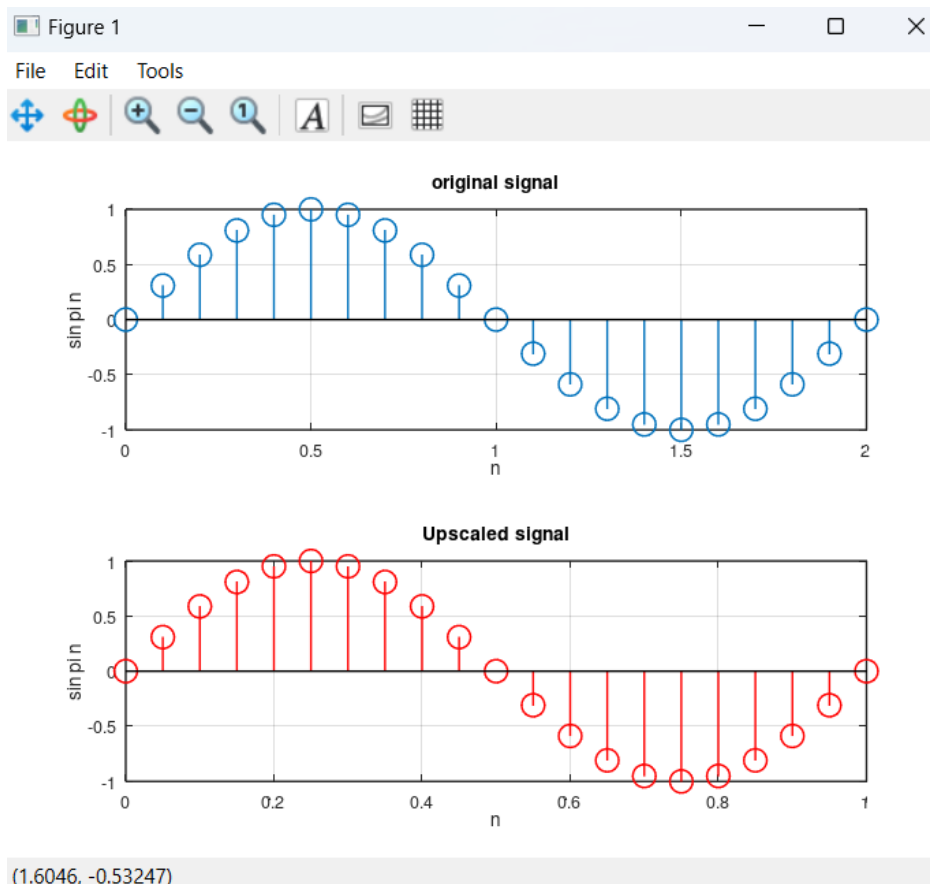
```
File   Edit   View   Debug   Run   Help
```

DSP_301_Q2_vii.m ☒

```
 1   clear all;
 2   close all;
 3   clc;
 4
 5   A = 1;
 6   theta = 0;
 7   f = 1/2;
 8   omega  = (2*pi*f);
 9
10   n = 0:0.1:2;
11
12   x = sin((omega * n) + theta);
13
14
15
16   subplot(2,1,1);
17   stem(n,x);
18   xlabel('n');
19   ylabel('sin pi n');
20   title('original signal');
21   grid on;
22
23   subplot(2,1,2);
24   stem(n/2,x,'r');
25   xlabel('n');
26   ylabel('sin pi n');
27   title('Upscaled signal');
28   grid on;
```
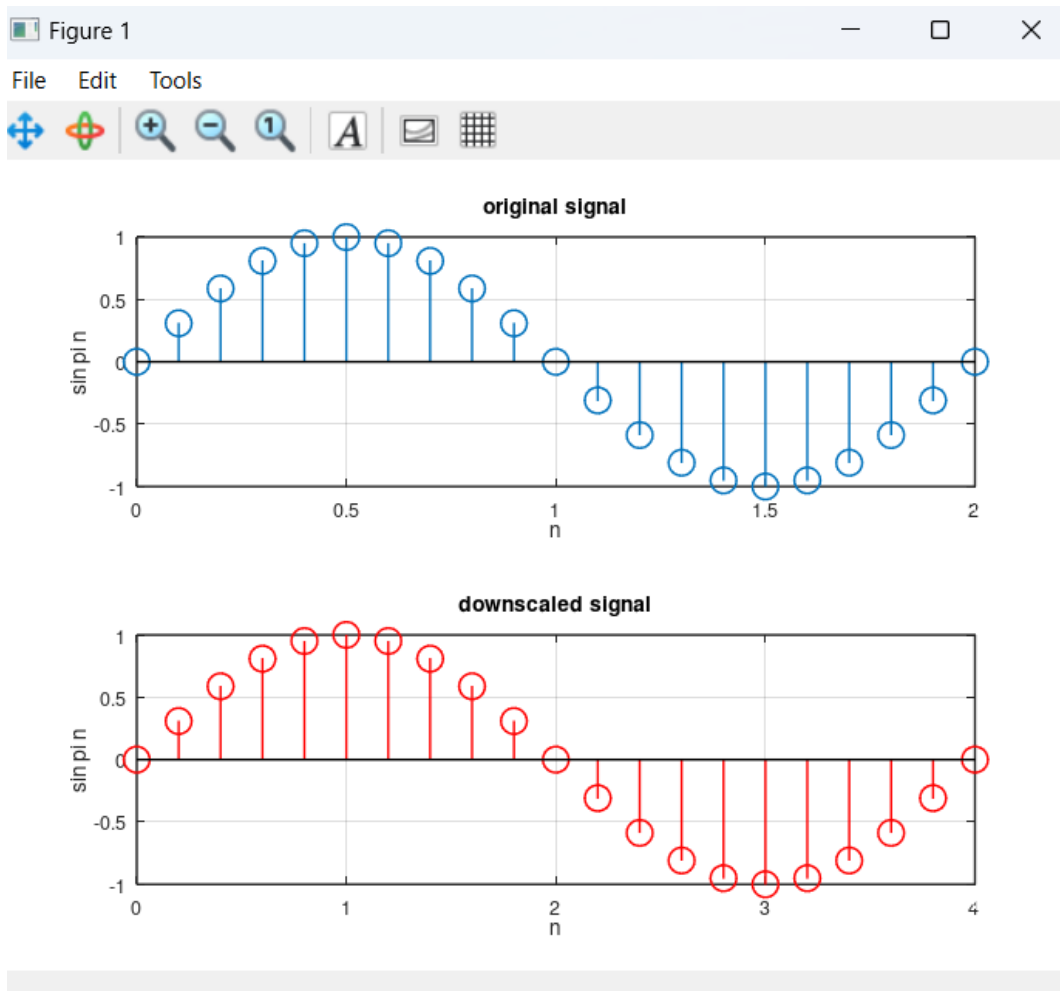
Figures:

viii. *Octave code:*

File   Edit   View   Debug   Run   Help

DSP_301_Q2_viii.m ✕

```
1
2   clear all;
3   close all;
4   clc;
5
6   A = 1;
7   theta = 0;
8   f = 1/2;
9   omega  = (2*pi*f);
10
11  n = 0:0.1:2;
12
13  x = sin((omega * n) + theta);
14
15
16  subplot(2,1,1);
17  stem(n,x);
18  xlabel('n');
19  ylabel('sin pi n');
20  title('original signal');
21  grid on;
22
23  subplot(2,1,2);
24  stem(n,x*3,'r');
25  xlabel('n');
26  ylabel('sin pi n');
27  title('upscaling (amplification) signal');
28  grid on;
29
```

Figures:

Figure 1

File   Edit   Tools

ix. Octave code:

Editor

File   Edit   View   Debug   Run   Help

DSP_301_Q2_ix.m ✖

```
1
2   clear all;
3   close all;
4   clc;
5
6   A = 1;
7   theta = 0;
8   f = 1/2;
9   omega  = (2*pi*f);
10
11  n = 0:0.1:2;
12
13  x = sin((omega * n) + theta);
14
15
16  subplot(2,1,1);
17  stem(n,x);
18  xlabel('n');
19  ylabel('sin pi n');
20  title('original signal');
21  grid on;
22
23  subplot(2,1,2);
24  stem(n,x/3,'r');
25  xlabel('n');
26  ylabel('sin pi n');
27  title('downscaling (attenuation):| signal');
28  grid on;
29
```
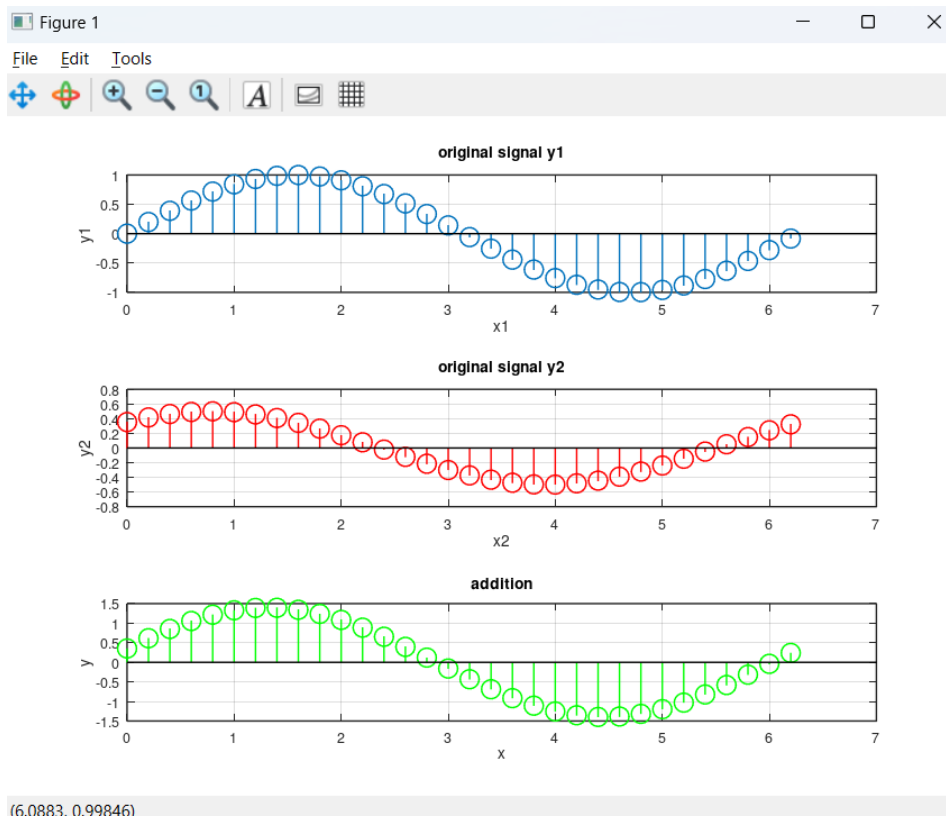
Figures:
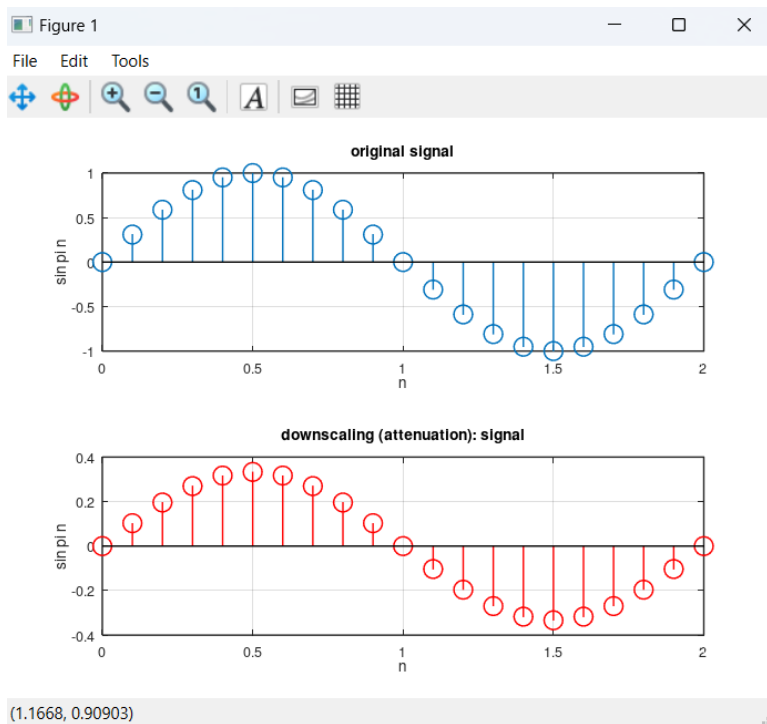
Question 03:

Answer:

Octave code:

```
Editor
File   Edit   View   Debug   Run   Help

Q3.m
 1
 2    clear all;
 3    close all;
 4    clc;
 5
 6
 7    x1 = 0:0.2:2*pi;
 8    x2 = 0:0.2:2*pi;
 9    x = 0:0.2:2*pi;
10
11    y1 = sin(x1);
12    y2 = 0.5 * cos(x2 - (pi/4));
13    y = y1+y2;
14
15    subplot(3,1,1);
16    stem(x1,y1);
17    xlabel('x1');
18    ylabel('y1');
19    title('original signal y1');
20    grid on;
21
22    subplot(3,1,2);
23    stem(x2,y2,'r');
24    xlabel('x2');
25    ylabel('y2');
26    title('original signal y2');
27    grid on;
28
29    subplot(3,1,3);
30    stem(x,y,'g');
31    xlabel('x');
32    ylabel('y');
33    title('addition');
34    grid on;
```

Figures:

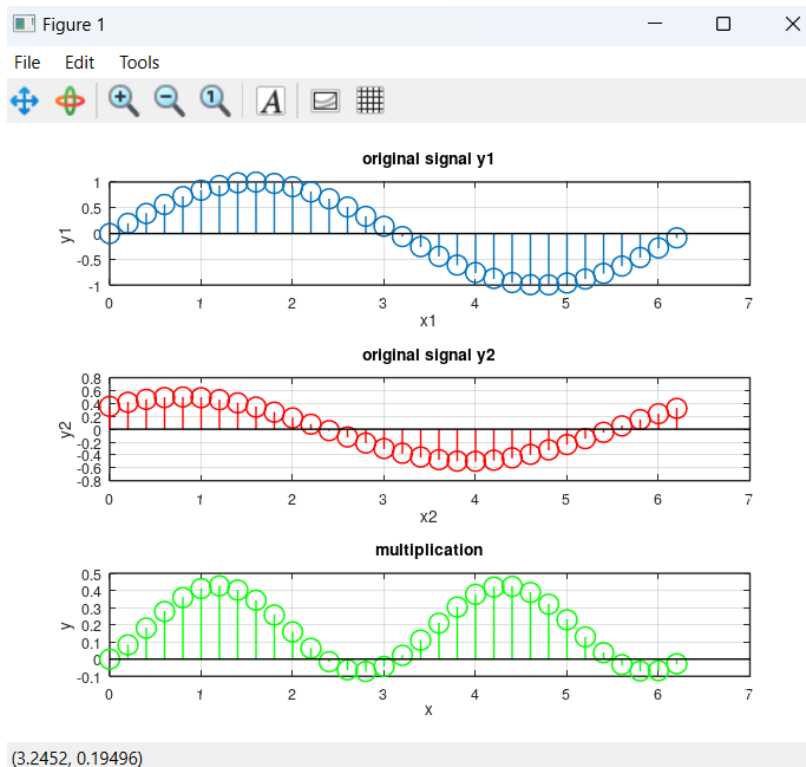## Question 04:

Answer:

Octave code:

```
Editor
File   Edit   View   Debug   Run   Help

Q4.m

 1
 2   clear all;
 3   close all;
 4   clc;
 5
 6
 7   x1 = 0:0.2:2*pi;
 8   x2 = 0:0.2:2*pi;
 9   x = 0:0.2:2*pi;
10
11   y1 = sin(x1);
12   y2 = 0.5 * cos(x2 - (pi/4));
13   y = y1.*y2;
14
15   subplot(3,1,1);
16   stem(x1,y1);
17   xlabel('x1');
18   ylabel('y1');
19   title('original signal y1');
20   grid on;
21
22   subplot(3,1,2);
23   stem(x2,y2,'r');
24   xlabel('x2');
25   ylabel('y2');
26   title('original signal y2');
27   grid on;
28
29   subplot(3,1,3);
30   stem(x,y,'g');
31   xlabel('x');
32   ylabel('y');
33   title('multiplication');
34   grid on;
```

Figures:

Question 05:

Answer:

Time delay:

- Signal reconstruction with digital filters
- Signal synchronization in communication systems
- Target direction in radar systems

Amplification

- In Audio systems
- With Sensors
- In power supply units