

## Appendices:

### Appendix A: Figure of Impulse Response Part

```
1   range = -10:50;  
2   impulse_1 = (7/8).^(range).*(range >= 4);  
3  
4   % Plot the impulse response  
5   figure;  
6   stem(range, impulse_1, 'filled');  
7   xlabel('n');  
8   ylabel('h[n]');  
9   title('Impulse Response h[n] = (7/8)^n u[n-4]');  
10  grid on;  
11
```

Figure 1: MatLab Code of Impulse Response

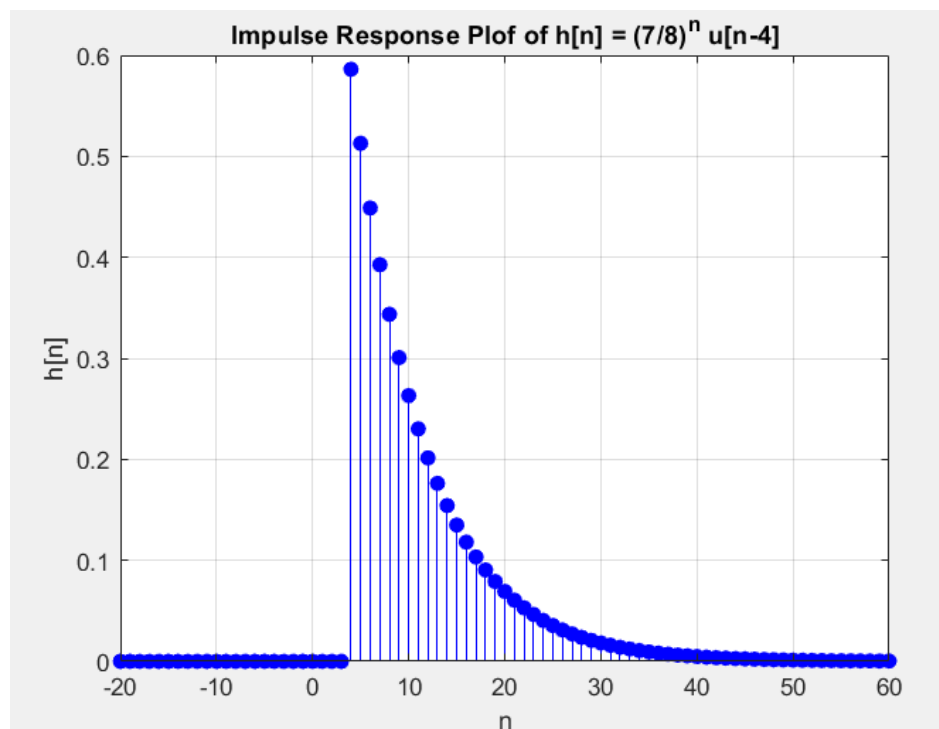


Figure 2: Impulse Response Plot

## Appendix B: Figures of Question 1.a

```
1 % Numerical Result
2 range1 = 100;
3 range2 = -range1:1:range1;
4 uh = zeros(size(range2));
5 uh(range2 >= 4) = 1;
6 impulse = (7/8).^range2 .* uh;
7 r = (-range1/2):1:(range1/2);
8 x1 = zeros(size(r));
9 x1((r <= 8) & (r >= 0)) = 3;
10 y1 = zeros(size(r));
11 for k = -(range1/2):(range1/2)
12     a = impulse(r-k+range1+1) .* x1(k+(range1/2)+1);
13     y1 = y1 + a;
14 end
15
16 % Plot Numerical Result
17 figure;
18 stem(-10:50, y1(41:101), 'filled');
19 xlabel('n');
20 ylabel('y[n] = h[n]*x1[n]');
21 title('Numerical Result of y_1[n]');
22 grid on;
23
24 % Analytic Result
25 range2 = -10:100;
26 y1_2 = zeros(size(range2));
27 y1_2((range2 >= 4) & (range2 <= 12)) = 24 * ((7/8).^4 - (7/8).^(5:13));
28 y1_2((range2 >= 12)) = 24 * ((7/8).^(4:92) - (7/8).^(13:101));
29
30 % Plot Analytic Result
31 figure;
32 stem((-10:50), y1_2(1:61), 'filled', 'r');
33 xlabel('n');
34 ylabel('y[n] = T[x1[n]]');
35 title('Analytical Result of y_1[n]');
36 grid on;
```

Figure 3: MatLab Code of Question 1.a

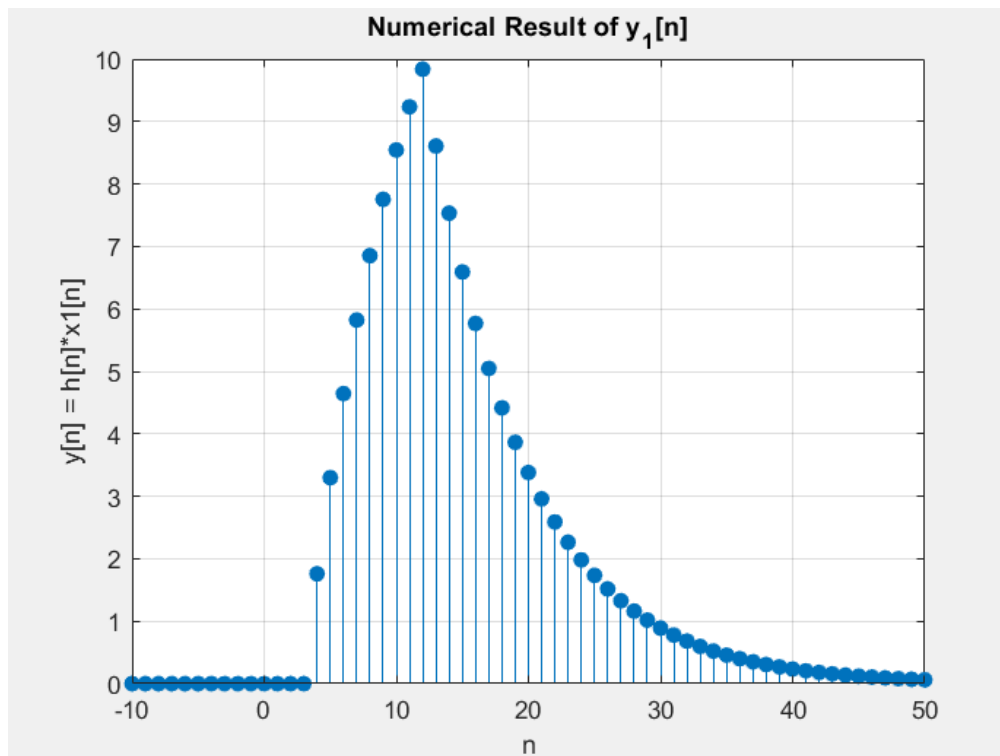


Figure 4: Plot of Numerical Result of  $y_1[n]$

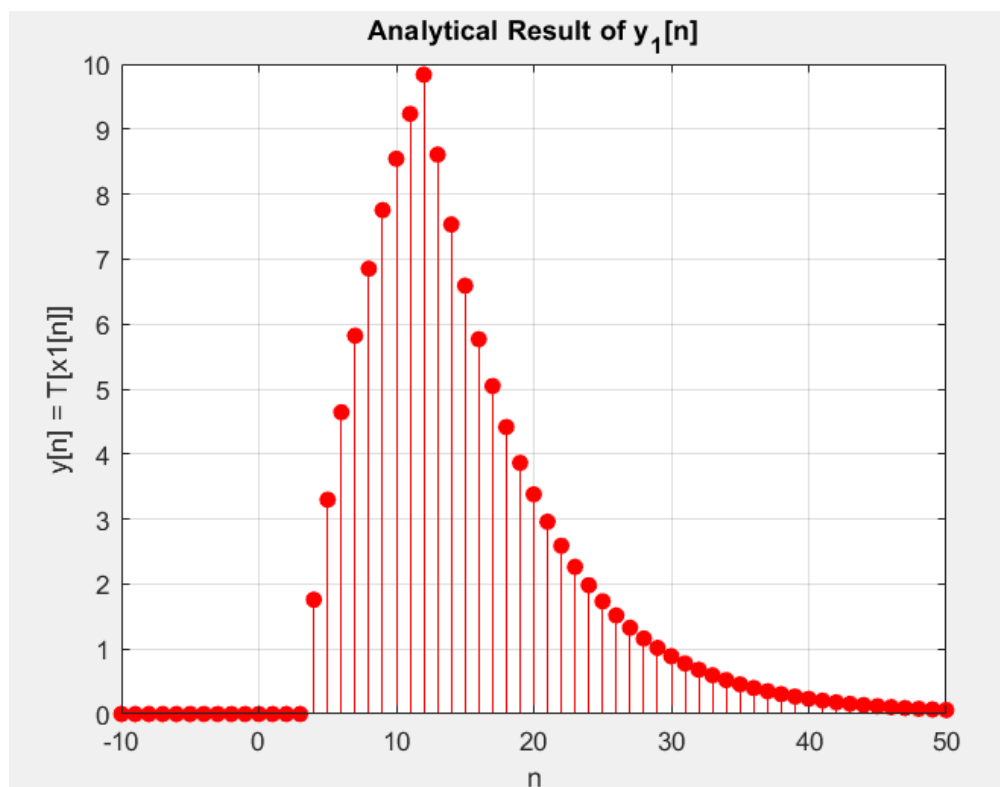


Figure 5: Plot of Analytical Result of  $y_1[n]$

## Appendix C: Figures of Question 1.b

```

1 % Numerical Result
2 range1 = 100;
3 range2 = -range1:1:range1;
4 uh = zeros(size(range2));
5 uh(range2 >= 4) = 1;
6 impulse = (7/8).^range2 .* uh;
7 r = (-range1/2):1:(range1/2);
8 x2 = zeros(size(r));
9 x2((r <= 4) & (r >= 0)) = 3;
10 x2((r <= 8) & (r >= 5)) = -3;
11 x2((r <= 13) & (r >= 9)) = -6;
12 y2 = zeros(size(r));
13 for k = -(range1/2):(range1/2)
14     a = impulse(r-k+range1+1) .* x2(k+(range1/2)+1);
15     y2 = y2 + a;
16 end
17
18 % Plot Numerical Result
19 figure;
20 stem(-10:50, y2(41:101), 'filled');
21 xlabel('n');
22 ylabel('y[n] = h[n]*x2[n]');
23 title('Numerical Result of y_2[n]');
24 grid on;
25
26 % Analytic Result
27 range2 = -10:100;
28 y2_2 = zeros(size(range2));
29 y2_2((range2 >= 4) & (range2 <= 9)) = 24 * ((7/8).^4 - (7/8).^(5:10));
30 y2_2((range2 >= 9) & (range2 <= 12)) = 24 * ((7/8).^4 - (7/8).^(10:13))-48*((7/8).^4 - (7/8).^(5:8));
31 y2_2((range2 >= 12) & (range2 <= 17)) = 24 * ((7/8).^(4:9) - (7/8).^(13:18))-48*((7/8).^4 - (7/8).^(8:13));
32 y2_2(range2 >= 17) = 24 * ((7/8).^(9:92) - (7/8).^(18:101))-48*((7/8).^(4:87) - (7/8).^(13:96));
33
34 % Plot Analytic Result
35 figure; % Open another figure window
36 stem((-10:50), y2_2(1:61), 'filled', 'r');
37 xlabel('n');
38 ylabel('y[n] = T[x2[n]]');
39 title('Analytical Result of y_2[n]');
40 grid on;
41

```

Figure 6: MatLab Code of Question 1.b

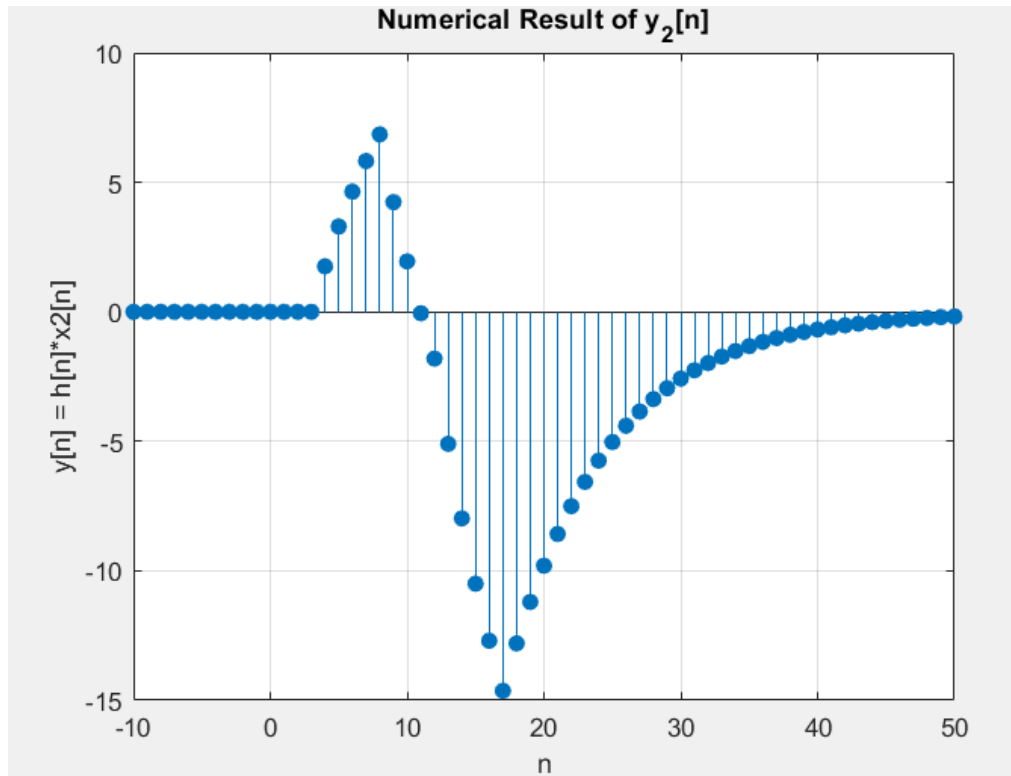


Figure 7: Plot of Numerical Result of y<sub>2</sub>[n]

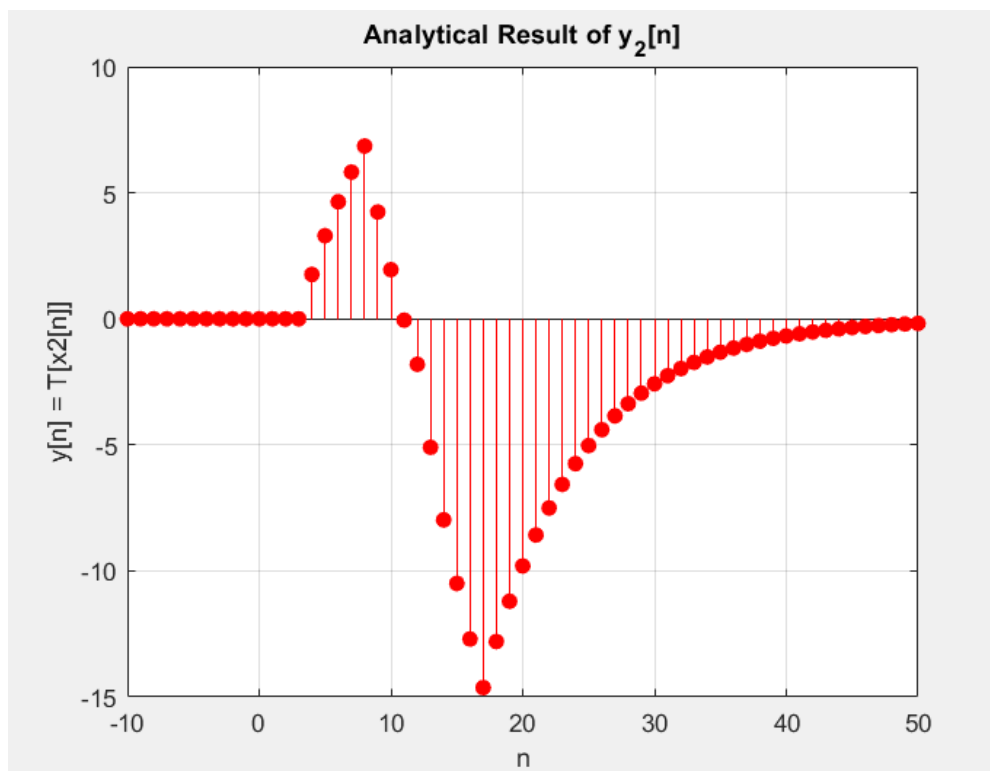


Figure 8: Plot of Analytical Result of  $y_2[n]$

## Appendix D: Figures of Question 1.c

```

1  % Numerical Result
2  range1 = 100;
3  range2 = -range1:1:range1;
4  uh = zeros(size(range2));
5  uh(range2 >= 4) = 1;
6  impulse = (7/8).^range2 .* uh;
7  r = (-range1/2):1:(range1/2);
8  x3 = zeros(size(r));
9  x3((r <= 20) & (r >= 2)) = exp((2:20).*1/3*1i);
10 y3 = zeros(size(r));
11 for k = -(range1/2):(range1/2)
12     a = impulse(r-k+range1+1) .* x3(k+(range1/2)+1);
13     y3 = y3 + a;
14 end
15
16 % Plot Numerical Result
17 figure; % Open a new figure window
18 stem(r,real(y3),'filled');
19 xlabel('n');
20 ylabel('Real Part of y[n] = h[n]*x3[n]');
21 title('Numerical Result for Real Part of y_3[n]');
22 grid on;
23
24 figure;
25 stem(r,imag(y3),'filled');
26 xlabel('n');
27 ylabel('Imaginary Part of y[n] = h[n]*x3[n]');
28 title('Numerical Result for Imaginary Part of y_3[n]');
29 grid on;
30

```

Figure 9: MatLab Code of Question 1.c

```

31 % Parameters
32 range2 = -10:100;
33 y3_2 = zeros(size(range2));
34 j = sqrt(-1);
35
36 y3_2((range2 >= 6) & (range2 <= 24)) = (exp(j/3).^range2((range2 >= 6) & (range2 <= 24))) .* ...
37     (((7/8) * exp(-j/3))^4 - ((7/8) * exp(-j/3)).^(range2((range2 >= 6) & (range2 <= 24)) - 1)) ...
38     / (1 - (7/8) * exp(-j/3));
39
40 y3_2((range2 >= 24)) = (exp(j/3).^range2((range2 >= 24))) .* ...
41     (((7/8) * exp(-j/3)).^(range2((range2 >= 24)) - 20) - ((7/8) * exp(-j/3)).^(range2((range2 >= 24)) - 1)) ...
42     / (1 - (7/8) * exp(-j/3));
43
44 % Plot the result
45 figure;
46 stem((-10:50), real(y3_2(1:61)), 'filled', 'r'); % Plot real part of y3[n]
47 xlabel('n');
48 ylabel('Real Part of y3[n]');
49 title('Analytical Result for Real Part y3[n]');
50 grid on;
51
52
53 % Plot the result
54 figure;
55 stem((-10:50), imag(y3_2(1:61)), 'filled', 'r'); % Plot real part of y3[n]
56 xlabel('n');
57 ylabel('Imaginary Part of y3[n]');
58 title('Analytical Result for Imaginary Part for y3[n]');
59 grid on;

```

Figure 10: MatLab Code of Question 1.c

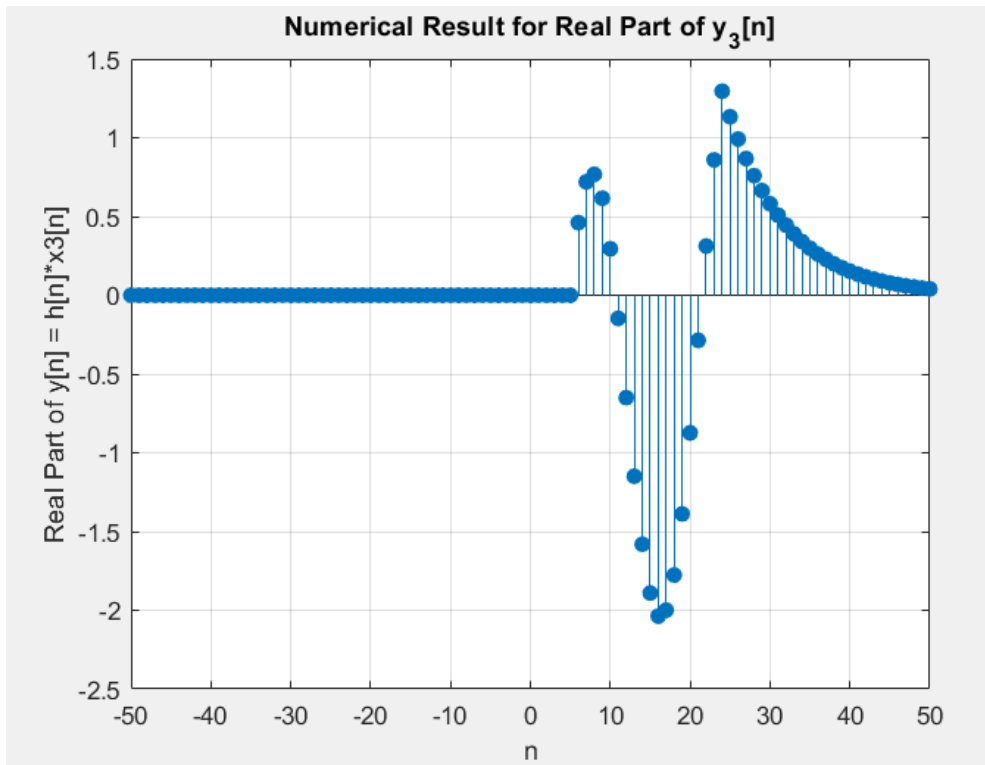


Figure 11: Plot of Numerical Result for Real Part of  $y_3[n]$

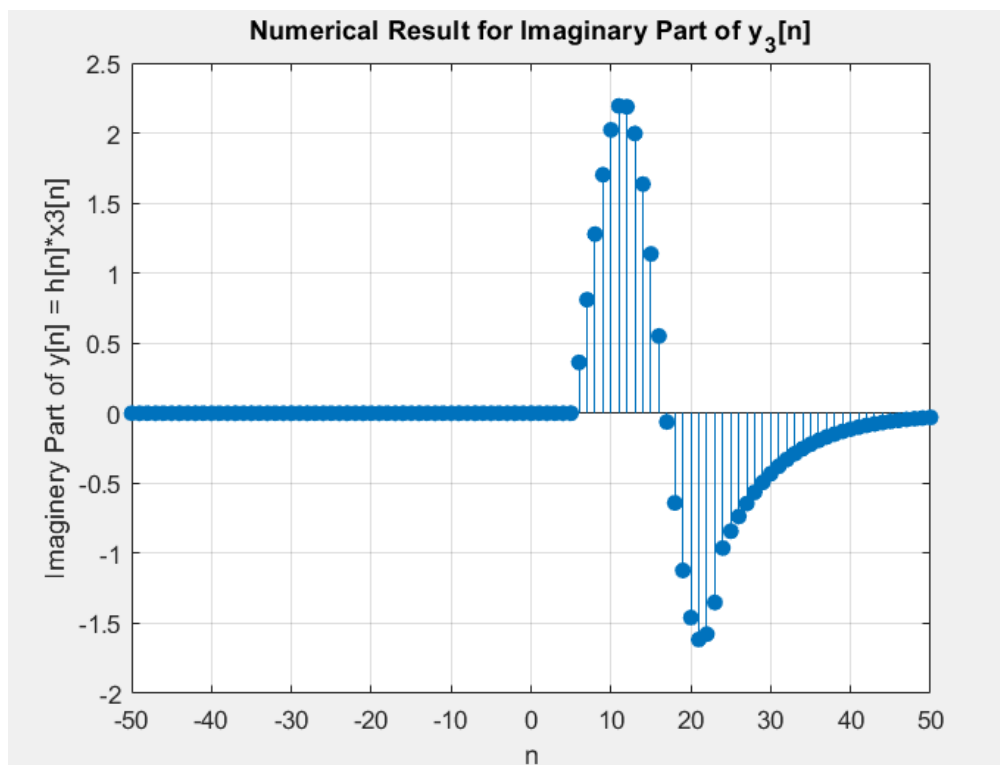


Figure 12: Plot of Numerical Result for Imaginary Part of  $y_3[n]$

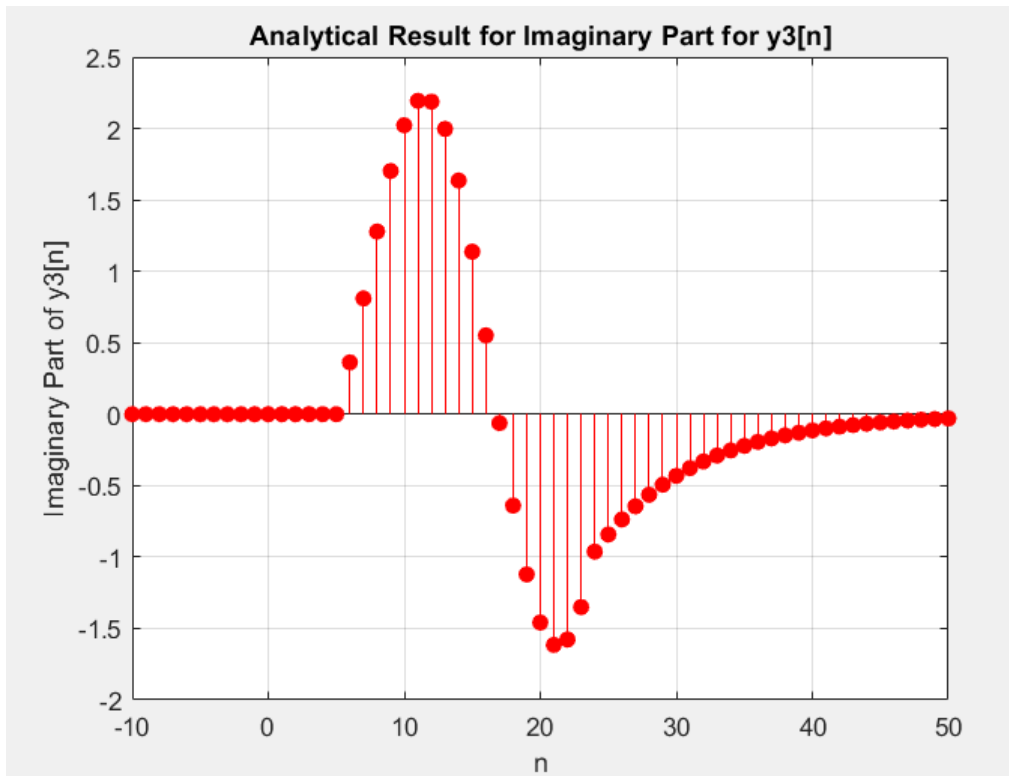


Figure 13: Plot of Analytical Result for Imaginary Part of  $y_3[n]$

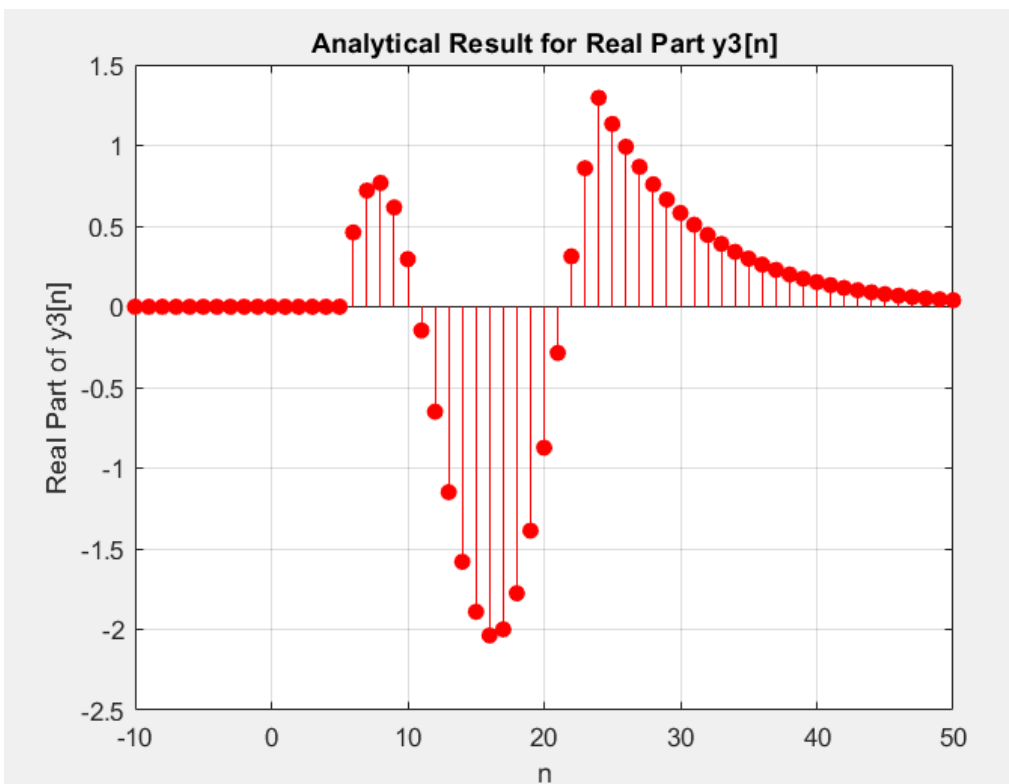


Figure 14: Plot of Analytical Result for Real Part of  $y_3[n]$



## Appendix E: Figures of Question 1.d

```

1 % Numerical Result
2 range1 = 100;
3 range2 = -range1:1:range1;
4 uh = zeros(size(range2));
5 uh(range2 >= 4) = 1;
6 impulse = (7/8).^range2 .* uh;
7 r = (-range1/2):1:(range1/2);
8 x4 = zeros(size(r));
9 x4((r <= 20) & (r >= 2)) = -3*sin((2:20).*1/3);
10 y4 = zeros(size(r));
11 for k = -(range1/2):(range1/2)
12     a = impulse(r-k+range1+1) .* x4(k+(range1/2)+1);
13     y4 = y4 + a;
14 end
15
16 % Plot Numerical Result
17 figure;
18 stem(-10:50,y4(41:101),'filled');
19 xlabel('n');
20 ylabel('y[n] = h[n]*x4[n]');
21 title('Numerical Result of Y_4[n]');
22 grid on;
23
24 range2 = -10:100;
25 y3_2 = zeros(size(range2));
26 j = sqrt(-1);
27
28 y3_2((range2 >= 6) & (range2 <= 24)) = (exp(j/3).^range2((range2 >= 6) & (range2 <= 24))) .* ...
29     ((7/8) * exp(-j/3))^4 - ((7/8) * exp(-j/3)).^(range2((range2 >= 6) & (range2 <= 24)) - 1) ...
30     / (1 - (7/8) * exp(-j/3));
31
32 y3_2((range2 >= 24)) = (exp(j/3).^range2((range2 >= 24))) .* ...
33     (((7/8) * exp(-j/3)).^(range2((range2 >= 24)) - 20) - ((7/8) * exp(-j/3)).^(range2((range2 >= 24)) - 1)) ...
34     / (1 - (7/8) * exp(-j/3));
35 % Plot -3 * Im{y3[n]}
36 figure;
37 stem(-10:50, -3 * imag(y3_2(1:61)), 'filled', 'r'); % Plot -3 times the imaginary part of y3[n]
38 xlabel('n');
39 ylabel('Y_4[n] = -3 * Im{y3[n]}');
40 title('Analytical Result for Y_4[n]');
41 grid on;

```

Figure 15: MatLab Code of Question 1.d

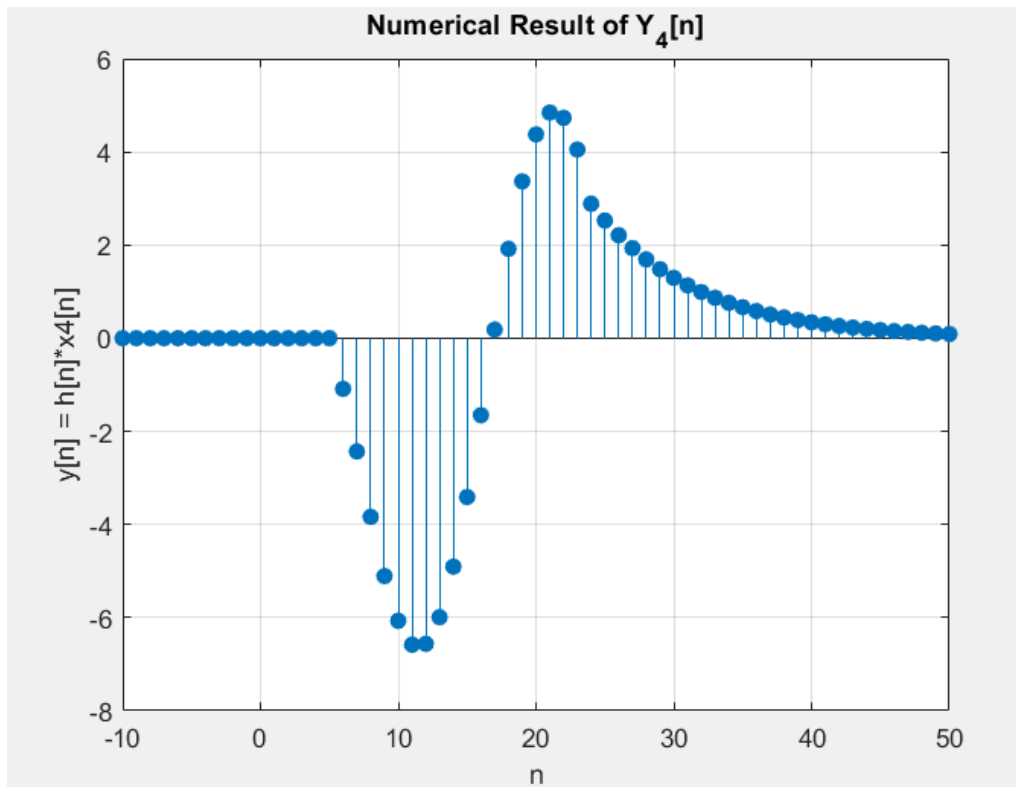


Figure 16: Plot of Numerical Result of y<sub>4</sub>[n]

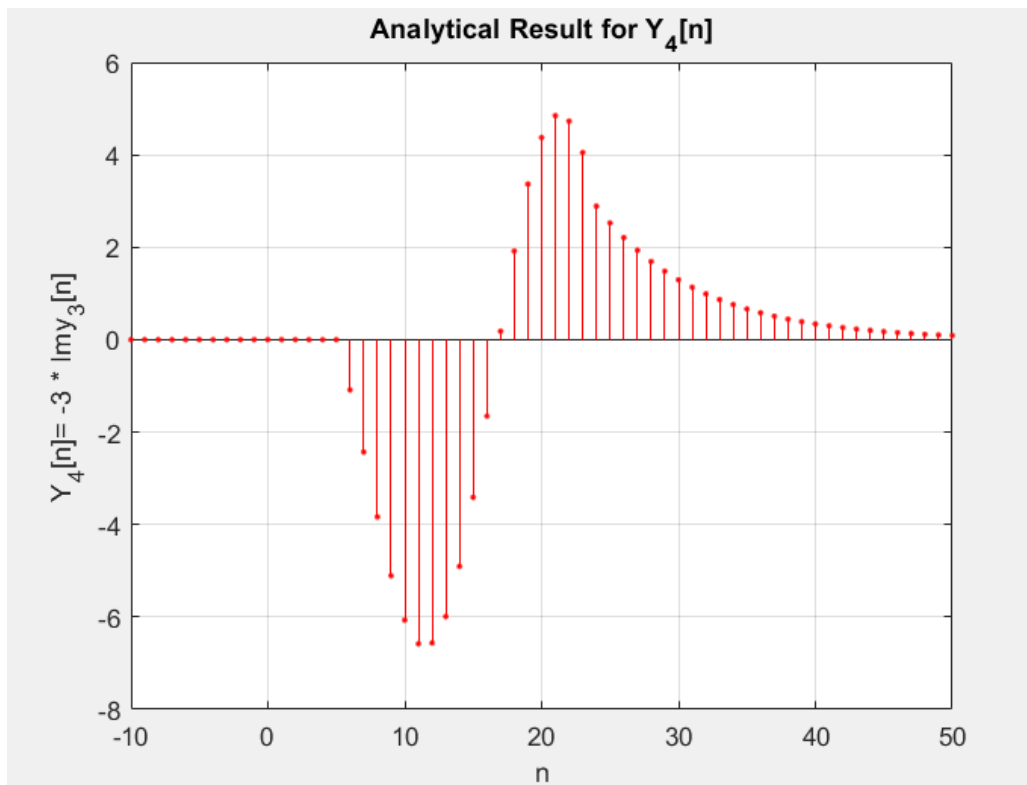


Figure 17: Plot of Analytical Result for  $y_4[n]$

## Appendix F: Figures of Question 1.e

```

1 % Numerical Result
2 range1 = 100;
3 range2 = -range1:1:range1;
4 uh = zeros(size(range2));
5 uh(range2 >= 4) = 1;
6 impulse = (7/8).^range2 .* uh;
7 r = (-range1/2):1:(range1/2);
8 x5 = zeros(size(r));
9 x5((r <= 20) & (r >= 2)) = 2*cos((2:20).*1/3);
10 y5 = zeros(size(r));
11 for k = -(range1/2):(range1/2)
12     a = impulse(r-k+range1+1) .* x5(k+(range1/2)+1);
13     y5 = y5 + a;
14 end
15 % Plot Numerical Result
16 figure; % Open a new figure window
17 stem(-10:50,y5(41:101),'filled');
18 xlabel('n');
19 ylabel('y[n] = h[n]*x5[n]');
20 title('Numerical Result of Y_5[n]');
21 grid on;
22
23 range2 = -10:100;
24 y3_2 = zeros(size(range2));
25 j = sqrt(-1);
26
27 ind1 = (range2 >= 6) & (range2 <= 24);
28 y3_2(ind1) = (exp(j/3).^range2(ind1)) .* ...
29     (((7/8) * exp(-j/3)).^4 - ((7/8) * exp(-j/3)).^(range2(ind1) - 1)) ...
30     / (1 - (7/8) * exp(-j/3));
31
32 ind2 = (range2 > 24);
33 y3_2(ind2) = (exp(j/3).^range2(ind2)) .* ...
34     (((7/8) * exp(-j/3)).^(range2(ind2) - 20) - ((7/8) * exp(-j/3)).^(range2(ind2) - 1)) ...
35     / (1 - (7/8) * exp(-j/3));
36 y3_re = 2 * real(y3_2);
37 figure;
38 stem(-10:50), y3_re(1:61), 'filled', '.r'); % 2 * Re{y3[n]} sinyalini yeşil renkte çiz
39 xlabel('n');
40 ylabel('2 \cdot Re\{y3[n]\}');
41 title('Analytical Result for Y_5[n]');
42 grid on;

```

Figure 18: MatLab Code of Question 1.e

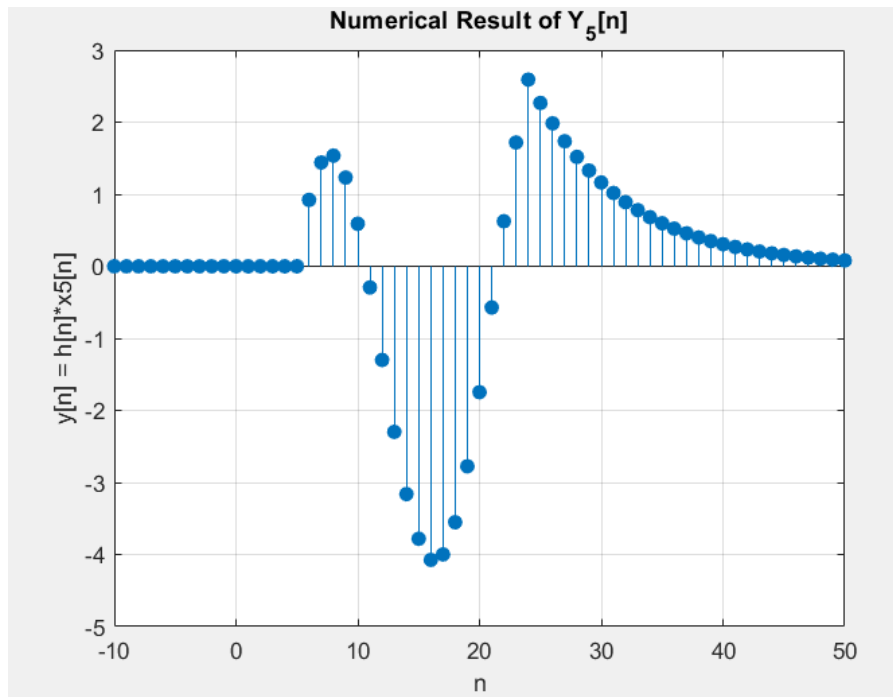


Figure 19: Plot of Numerical Result of  $y5[n]$

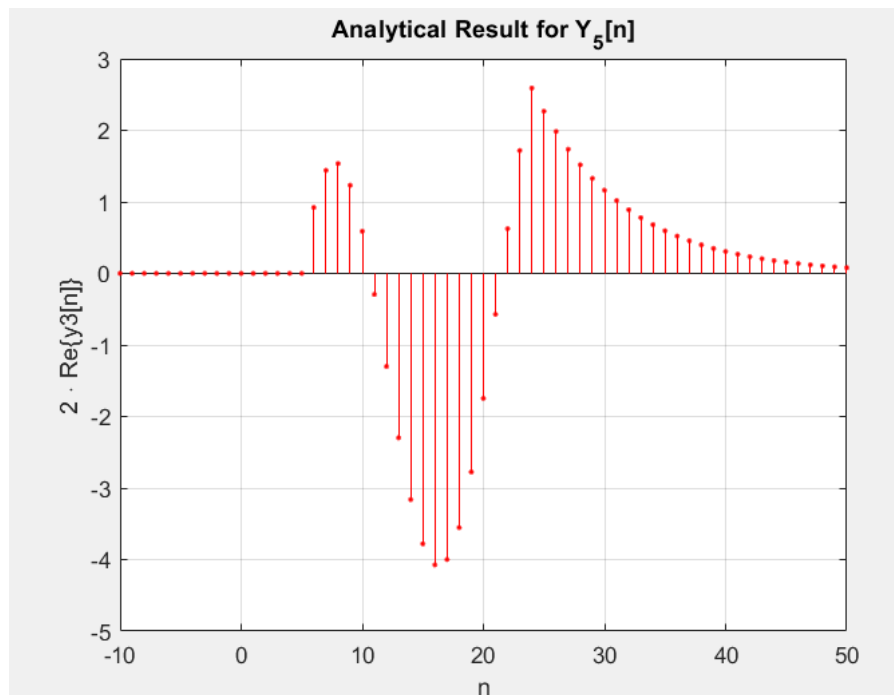


Figure 20: Plot of Analytical Result of  $y_5[n]$

## Appendix G: Figures of Question 1.f

```

1  % Numerical Result
2  range1 = 100;
3  range2 = -range1:1:range1;
4  uh = zeros(size(range2));
5  uh(range2 >= 4) = 1;
6  impulse = (7/8).^range2 .* uh;
7  r = (-range1/2):1:(range1/2);
8
9  x1 = zeros(size(r));
10 x1((r <= 8) & (r >= 0)) = 3;
11
12 x2 = zeros(size(r));
13 x2((r <= 4) & (r >= 0)) = 3;
14 x2((r <= 8) & (r >= 5)) = -3;
15 x2((r <= 13) & (r >= 9)) = -6;
16
17 y6 = zeros(size(r));
18 x6=x1+2*1i*x2;
19
20 for k = -(range1/2):(range1/2)
21     a = impulse(r-k+range1+1) .* x6(k+(range1/2)+1);
22     y6 = y6 + a;
23 end
24
25 % Plot Numerical Result
26 figure; % Open a new figure window
27 stem(-10:50,real(y6(41:101)),'filled');
28 xlabel('n');
29 ylabel('Real Part of y[n] = h[n]*x6[n]');
30 title('Numerical Result for Real Part of y_6[n]');
31 grid on;
32
33 figure; % Open a new figure window
34 stem(-10:50,imag(y6(41:101)),'filled');
35 xlabel('n');
36 ylabel('Imaginary Part of y[n] = h[n]*x6[n]');
37 title('Numerical Result for Imaginary Part of y_6[n]');
38 grid on;
39

```

Figure 21: MatLab Code of Question 1.f

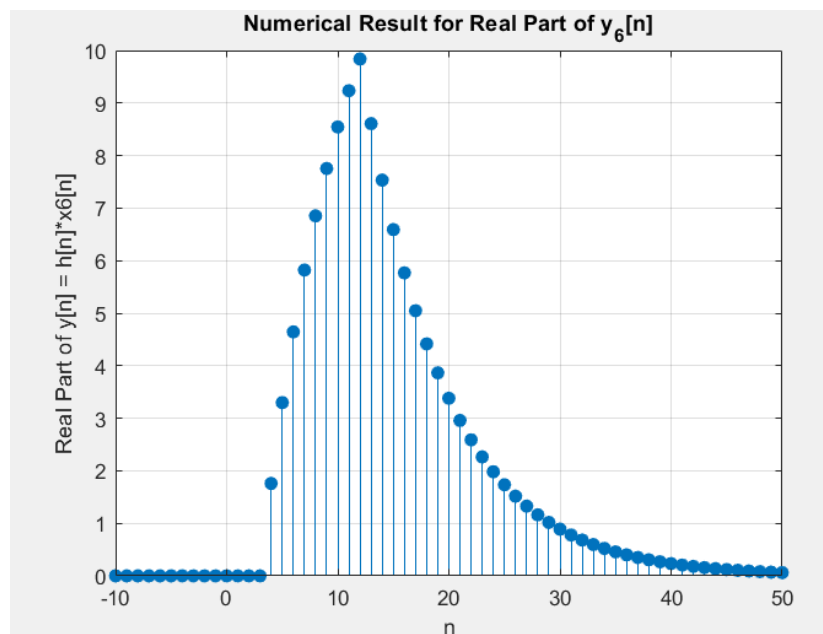


Figure 22: Plot of Numerical Result for the Real Part of  $y_6[n]$

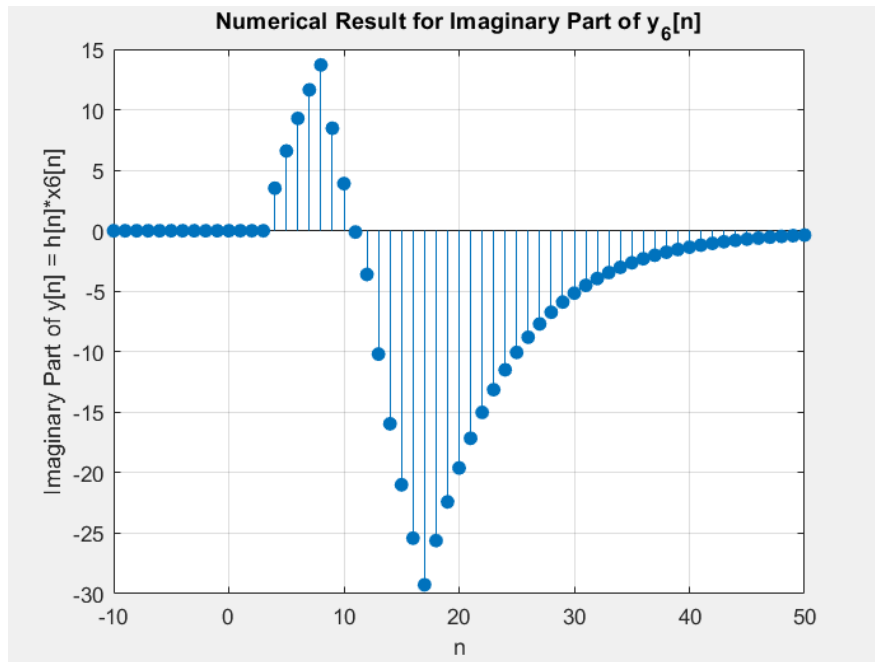


Figure 23: Plot of Numerical Result for the Imaginary Part of  $y_6[n]$

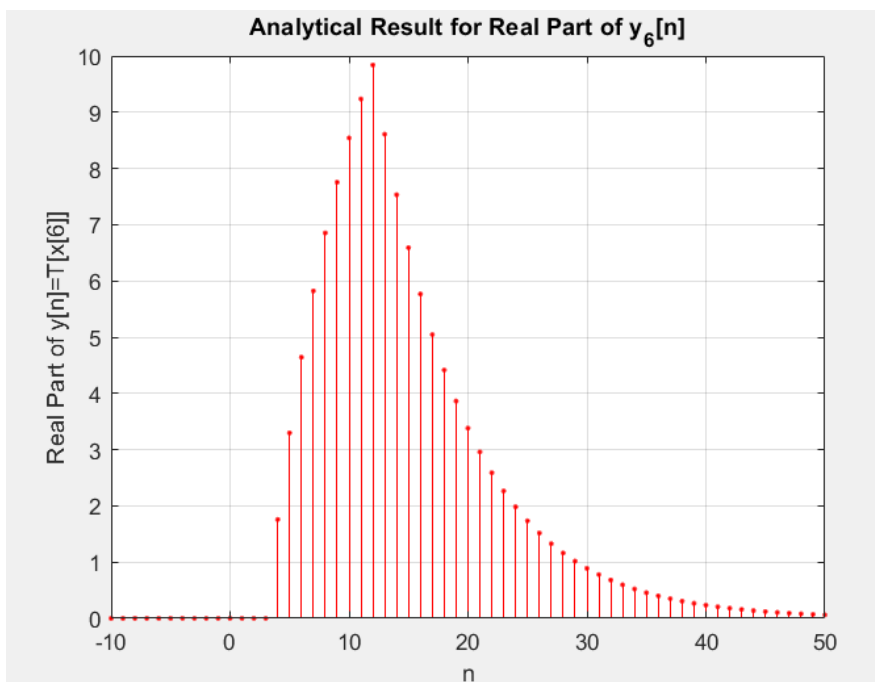


Figure 24: Plot of Analytical Result for the Real Part of  $y_6[n]$

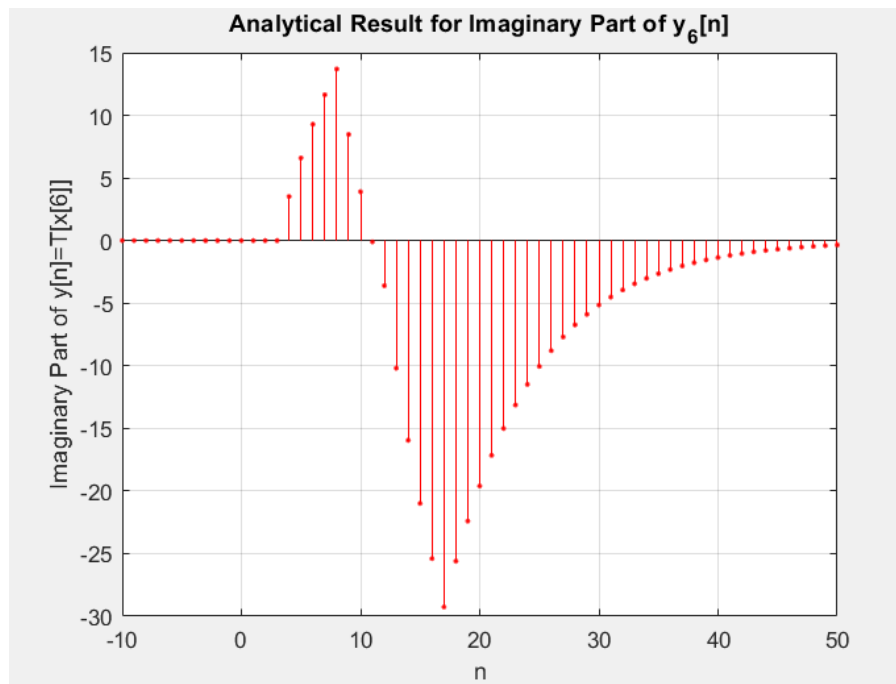


Figure 25: Plot of Analytical Result for the Imaginary Part of  $y_6[n]$