

SOLUTIONS TO PROBLEM SET 1

a) $y[n] = x[n^2]$

Let $x_0[n] = ax_1[n] + bx_2[n]$

$$\therefore y_0[n] = x_0[n^2] \\ = ax_1[n^2] + bx_2[n^2] \quad \text{--- (1)}$$

Compare this with:

$$y'[n] = ay_1[n] + by_2[n] \\ = a[x_1[n^2]] + b[x_2[n^2]] \quad \text{--- (2)}$$

$$\therefore y_0[n] = y'[n]$$

Hence system is LINEAR.

b) $y[n] = e^{x[n]}$

Let $x_0[n] = ax_1[n] + bx_2[n]$

$$\therefore y_0[n] = e^{[ax_1[n] + bx_2[n]]} \\ = e^{ax_1[n]} \cdot e^{bx_2[n]} \quad \text{--- (1)}$$

Compare this with:

$$y'[n] = ay_1[n] + by_2[n] \\ = ae^{x_1[n]} + be^{x_2[n]} \quad \text{--- (2)}$$

Since $y_0[n] \neq y'[n]$,

the system is ~~is~~ NON-LINEAR.

a) CAUSAL

b) NON CAUSAL

c) NON CAUSAL

$$3a) y[n] = x[-n] \quad - \textcircled{1}$$

Let $x_1[n] = x[n-n_0] \rightarrow \{ \text{supplying a delayed input} \}$

$$\begin{aligned} \therefore y_1[n] &= F\{x_1[n]\} \\ &= x[-(n-n_0)] \\ &= x[-n+n_0] \quad - \textcircled{2} \end{aligned}$$

$$\begin{aligned} y[n-n_0] &= x[-(n-n_0)] \rightarrow \{ \text{Delaying output in } \textcircled{1} \} \\ &= x[-n+n_0] \quad - \textcircled{3} \end{aligned}$$

Since $y_1[n] \neq y[n-n_0]$,

the given system is said to be TIME VARIANT.

$$b) y[n] = x[n] - x[n-1] \quad - \textcircled{1}$$

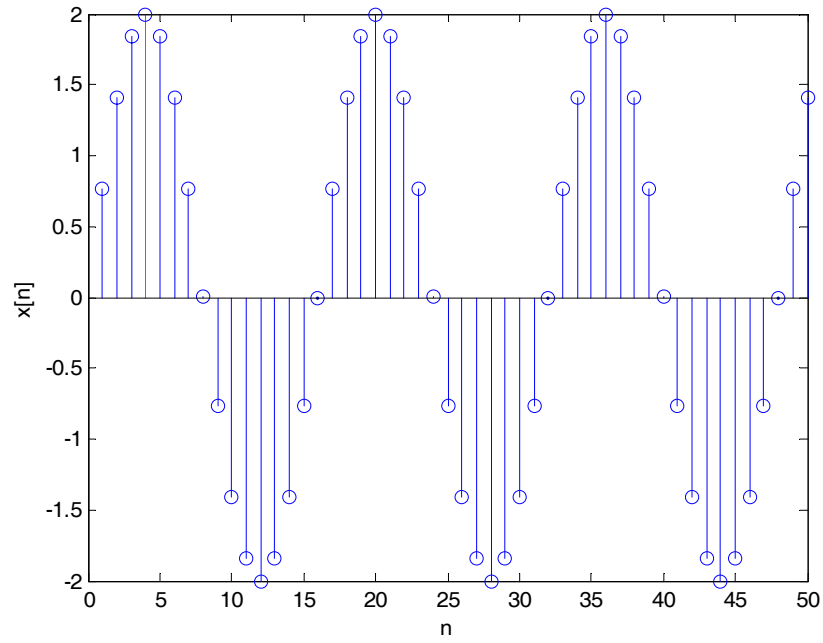
Let $x_1[n] = x[n-n_0] \rightarrow \{ \text{supplying a delayed input to the system} \}$

$$\begin{aligned} \therefore y_1[n] &= F\{x_1[n]\} \\ &= x_1[n] - x_1[n-1] \\ &= x[n-n_0] - x[n-n_0-1] \quad - \textcircled{2} \end{aligned}$$

$$y[n-n_0] = x[n-n_0] - x[n-n_0-1] \rightarrow \{ \text{Delaying the original output in } \textcircled{1} \}$$

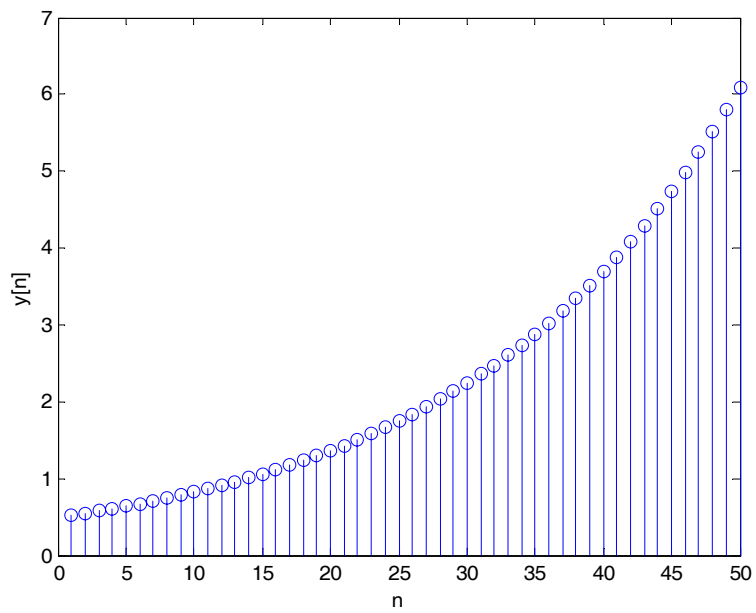
Problem 4

a) Plot of $x[n]$

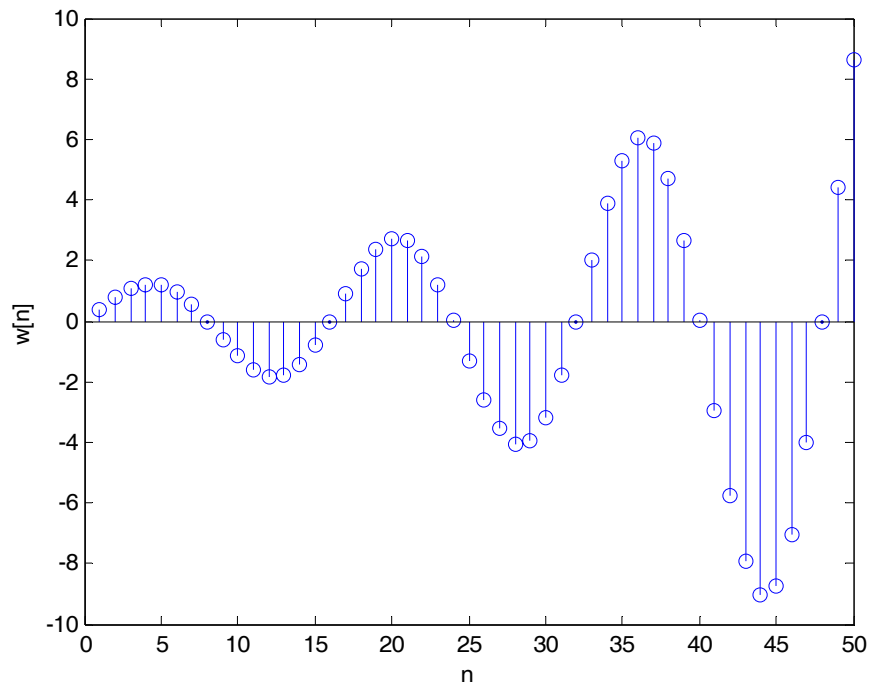


b) Period of $x[n]$ is 16

c) Plot of $y[n]$



d) Plot of $w[n]$



Matlab Code

```
% Compute and store 50 values of the functions x[n], y[n] and
% w[n]
for i=1:50
    x(i)=2*sin(pi*i/8);
    y(i)=0.5*exp(0.05*i);
    w(i)=x(i)*y(i);
end;

%Plot the above using the stem function
figure(1)
stem(x);
xlabel('n');ylabel('x[n]');
figure(2)
stem(y);
xlabel('n');ylabel('y[n]');
figure(3);
stem(w);
xlabel('n');ylabel('w[n]');
```