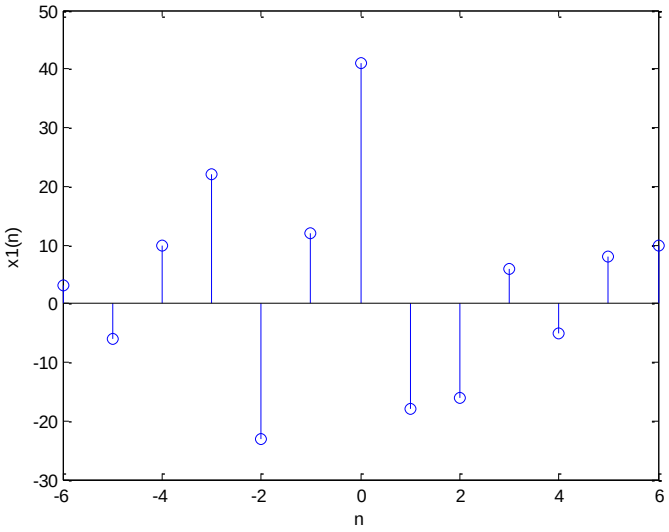
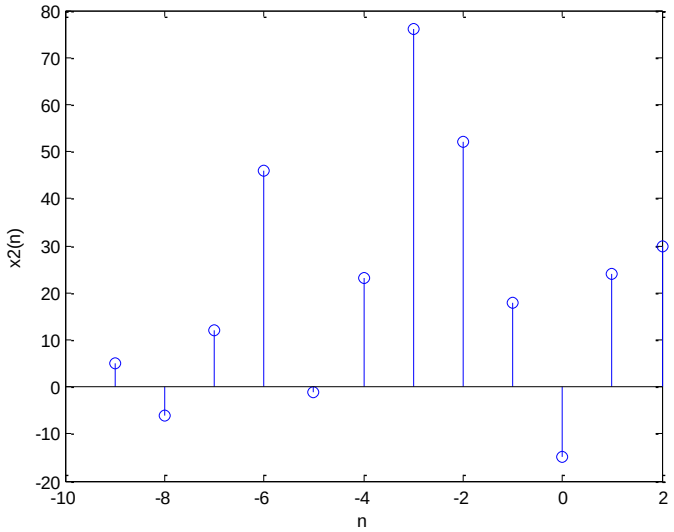
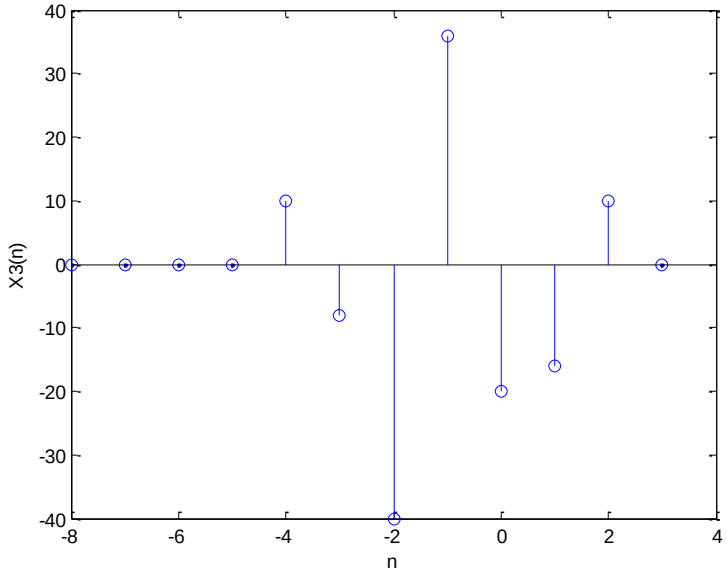
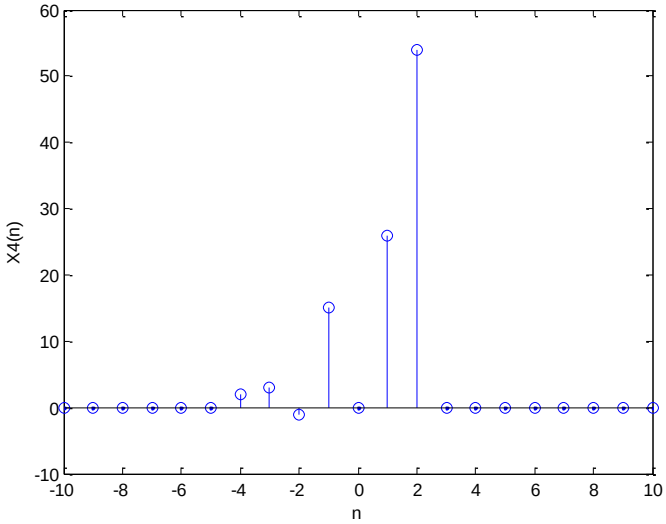
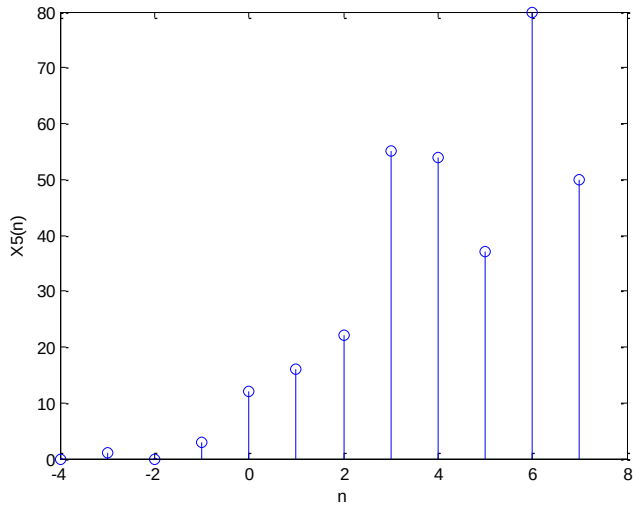
Assignment 1.2: Exercise 1:











1.2.1 $T_1[x(n)] = \sum_{0}^{n} x(k)$

a) Stable : $|x(n)| \leq M$

$\Downarrow$

$T_1[x(n)] \leq |n| \cdot M$

As $n \to \infty$, $T_1 \to \infty$. Therefore NOT stable.

b) Causal : $T_1[x(n)]$ depends on future values of x, when $n < 0$.
Therefore NOT causal

c) Linear : $T_1[ax_1(n) + bx_2(n)]$

$= \sum_{0}^{n} ax_1(k) + bx_2(k)$

$= a\,T_1[x_1(n)] + b\,T_1[x_2(n)]$

i.e. the system is linear.

d) TI : let $x_1(n) = x(n - n_0)$

$y_1(n) = y(n - n_0)$

$y(n) = T_1[x(n)]$

$T_1[x_1(n)] = \sum_{0}^{n} x_1(k) = \sum_{0}^{n} x(k - n_0)$

$\neq y_1(n) = y(n - n_0) = \sum_{0}^{n-n_0} x(k)$

i.e. NOT TI

1.2.2 $T_2[x(n)] = \sum_{n-10}^{n+10} x(k)$

Stable: $|x(n)| \leq M \Rightarrow T_2 \leq 20M$, i.e. stable

Causal: T_2 refers to future values of x, therefore NOT causal.

Linear: As in 1.2.1, i.e. linear

Ti: $T_2[x_1(n)] = \sum_{n-10}^{n+10} x_1(k)$

$$= \sum_{n-10}^{n+10} x(k - n_0)$$

$$y_1(n) = \sum_{n-n_0-10}^{n-n_0+10} x(k)$$

$$= \sum_{n-10}^{n+10} x(k-n_0) = T_2[x_1(n)]$$

i.e. Ti.

4.2.3 $T_3[x(n)] = x(-n)$

Stable: if $|x(n)| \leq M$ then also $|x(-n)| \leq M$, i.e. stable

Causal: for $n < 0$ T_3 depends on future x; i.e. NOT causal

Linear: $T_3[a x_1(n) + b x_2(n)]$

$= a x_1(-n) + b x_2(-n)$

$= a T_3[x_1(n)] + b T_3[x_2(n)]$

i.e. linear.

TI: $T_3[x_1(n)] = x(-n - n_0)$

$y_1(n) = y(n - n_0) = x(-n + n_0)$

$\neq T_3[x_1(n)]$, i.e. NOT TI.