



[Discrete Time Signal Processing Oppenheim 3rd Edition Solution Pdf Torrent](#)

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2.1. (a) $T(x[n]) = g[n]x[n]$

- **Stable:** Let $|x[n]| \leq M$ then $|T(x[n])| \leq |g[n]|M$. So, it is stable if $|g[n]|$ is bounded.
- **Causal:** $y_1[n] = g[n]x_1[n]$ and $y_2[n] = g[n]x_2[n]$, so if $x_1[n] = x_2[n]$ for all $n < n_0$, then $y_1[n] = y_2[n]$ for all $n < n_0$, and the system is causal.
- **Linear:**

$$\begin{aligned} T(ax_1[n] + bx_2[n]) &= g[n](ax_1[n] + bx_2[n]) \\ &= ag[n]x_1[n] + bg[n]x_2[n] \\ &= aT(x_1[n]) + bT(x_2[n]) \end{aligned}$$

So this is linear.

- **Not time-invariant:**

$$\begin{aligned} T(x[n - n_0]) &= g[n]x[n - n_0] \\ &\neq y[n - n_0] = g[n - n_0]x[n - n_0] \end{aligned}$$

which is not TI.

- **Memoryless:** $y[n] = T(x[n])$ depends only on the n^{th} value of x , so it is memoryless.

(b) $T(x[n]) = \sum_{k=n_0}^n x[k]$

- **Not Stable:** $|x[n]| \leq M \rightarrow |T(x[n])| \leq \sum_{k=n_0}^n |x[k]| \leq |n - n_0|M$. As $n \rightarrow \infty$, $T \rightarrow \infty$, so not stable.
- **Not Causal:** $T(x[n])$ depends on the future values of $x[n]$ when $n < n_0$, so this is not causal.
- **Linear:**

$$\begin{aligned} T(ax_1[n] + bx_2[n]) &= \sum_{k=n_0}^n ax_1[k] + bx_2[k] \\ &= a \sum_{k=n_0}^n x_1[k] + b \sum_{k=n_0}^n x_2[k] \\ &= aT(x_1[n]) + bT(x_2[n]) \end{aligned}$$

The system is linear.

- **Not TI:**

$$\begin{aligned} T(x[n - n_0]) &= \sum_{k=n_0}^n x[k - n_0] \\ &= \sum_{k=0}^{n-n_0} x[k] \\ &\neq y[n - n_0] = \sum_{k=n_0}^{n-n_0} x[k] \end{aligned}$$

The system is not TI.

- **Not Memoryless:** Values of $y[n]$ depend on past values for $n > n_0$, so this is not memoryless.

(c) $T(x[n]) = \sum_{k=n-n_0}^{n+n_0} x[k]$

- **Stable:** $|T(x[n])| \leq \sum_{k=n-n_0}^{n+n_0} |x[k]| \leq \sum_{k=n-n_0}^{n+n_0} x[k]M \leq |2n_0 + 1|M$ for $|x[n]| \leq M$, so it is stable.
- **Not Causal:** $T(x[n])$ depends on future values of $x[n]$, so it is not causal.
- **Linear:**

$$\begin{aligned} T(ax_1[n] + bx_2[n]) &= \sum_{k=n-n_0}^{n+n_0} ax_1[k] + bx_2[k] \\ &= a \sum_{k=n-n_0}^{n+n_0} x_1[k] + b \sum_{k=n-n_0}^{n+n_0} x_2[k] = aT(x_1[n]) + bT(x_2[n]) \end{aligned}$$



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