1. Even and Odd Components of x(t)

Given the signal:

$$x(t) = u(2t-1) + u(-2t) + r(t+1) \text{ for } t \in [-7, 7]$$

Let's compute the even and odd components, $x_e(t)$ and $x_o(t)$, using the following definitions:

$$x_e(t) = 0.5 \cdot (x(t) + x(-t))$$

$$x_o(t) = 0.5 \cdot (x(t) - x(-t))$$

Even Component: $x_e(t)$

$$x_e(t) = 0.5 \cdot (u(2t-1) + u(-2t) + r(t+1) + u(-2t+1) + u(2t) + r(-t+1))$$

Odd Component: $x_o(t)$

$$x_o(t) = 0.5 \cdot (u(2t-1) + u(-2t) + r(t+1) - u(-2t+1) - u(2t) - r(-t+1))$$

2. Even and Odd Components of x(t)

Given the signal:

$$x(t) = \begin{cases} 1, & -1 \le t < 0 \\ 2, & 0 \le t < 1 \\ 2-t, & 1 \le t < 2 \end{cases}$$

Let's compute the even and odd components, $x_e(t)$ and $x_o(t)$, using the following definitions:

$$x_e(t) = 0.5 \cdot (x(t) + x(-t))$$

$$x_o(t) = 0.5 \cdot (x(t) - x(-t))$$

Even Component: $x_e(t)$

$$x_e(t) = \begin{cases} 1, & -1 \le t < 0 \\ 2, & 0 \le t < 1 \\ 2, & 1 \le t < 2 \end{cases}$$

Odd Component: $x_o(t)$

$$x_o(t) = 0 \quad \text{for} \quad -1 \leq t < 2$$

3. System Analysis

System (a): $T[x(t)] = 2x(t-3)x(t+3)$

1. Memoryless: No, because the output depends on the input at different time instants $(t-3)$ and $(t+3)$.
2. Causal: No, because the output depends on the input at a future time instant $(t+3)$.
3. Stable: No, as the output may grow indefinitely due to the multiplication of the input values.
4. Time-invariant: Yes, as shifting the input by any τ results in the same shift in the output.
5. Linear: No, because the system involves multiplication of input values and does not satisfy the superposition principle.

System (b): $T[x[n] = \sin(3n)x[n+2]$

1. Memoryless: No, because the output depends on the input at a different time instant $(n+2)$.
2. Causal: Yes, because the output depends only on the present and past input values.
3. Stable: Yes, as the output is bounded by the input.
4. Time-invariant: Yes, as shifting the input by any τ results in the same shift in the output.
5. Linear: Yes, because the system satisfies both additivity and homogeneity properties.

System (c):

$$T\left[x[n]\right] = \begin{cases} x[n+2], & n \geq 1 \\ 0, & n = 1 \\ x[2n-3], & n < 1 \end{cases}$$

1. Memoryless: No, because the output depends on the input at different time instants.
2. Causal: Yes, because the output depends only on the present and past input values.
3. Stable: Yes, as the output is bounded by the input.
4. Time-invariant: No, because shifting the input does not result in the same shift in the output due to the piecewise definition.
5. Linear: Yes, because the system satisfies both additivity and homogeneity properties for each case.

System (d): $T[x(t)] = \int_{-\infty}^{t+2} \tau x(\tau) d\tau$

1. Memoryless: No, because the output depends on the input at different time instants.
2. Causal: Yes, because the output depends only on the present and past input values.

3. Stable: No, as the output may grow indefinitely due to the integration of the input values.
4. Time-invariant: No, because shifting the input results in a different shift in the output due to the integration.
5. Linear: Yes, because the system satisfies both additivity and homogeneity properties.

System (e): $T[x(t)] = 3\frac{dx(t)}{dt} - x(t)$

1. Memoryless: Yes, because the output depends only on the input and its derivative at the same time instant.
2. Causal: Yes, because the output depends only on the present input value and its derivative.
3. Stable: No, as the output may grow indefinitely due to the derivative operation.
4. Time-invariant: Yes, as shifting the input by any τ results in the same shift in the output.
5. Linear: Yes, because the system satisfies

4.

System (a): $T[x(t)] = 2x(t-3)x(t+3)$

Invertible: No

The system is not invertible because multiple input signals can produce the same output. For instance, consider two different input signals, $x_1(t)$ and $x_2(t)$, where $x_1(t) = 0$ and $x_2(t) = 1$ for $t = 3$ and $t = -3$ respectively, and $x_1(t) = x_2(t)$ for other values of t. Both input signals produce the same output, $T[x_1(t)] = T[x_2(t)] = 0$. This non-uniqueness of the input-output relationship implies the system is not invertible.

System (b): $T[x[n]] = \sin(3n)x[n+2]$

Invertible: No

The system is not invertible because multiple input signals can produce the same output. For instance, consider two different input signals, $x_1[n]$ and $x_2[n]$, where $x_1[n] = 0$ and $x_2[n] = 1$ for $n = 0, \frac{2\pi}{3}, \frac{4\pi}{3}, \ldots$. Both input signals produce the same output, $T[x_1[n]] = T[x_2[n]] = 0$. This non-uniqueness of the input-output relationship implies the system is not invertible.

System (c):

$$T\left[x[n]\right] = \begin{cases} x[n+2], & n \geq 1 \\ 0, & n = 1 \\ x[2n-3], & n < 1 \end{cases}$$

Invertible: No

The system is not invertible because multiple input signals can produce the same output. For instance, consider two different input signals, $x_1[n]$ and $x_2[n]$, where $x_1[n] = 0$ and $x_2[n] = 1$ for $n = 1$. Both input signals produce the same output, $T[x_1[n]] = T[x_2[n]] = 0$ for $n = 1$. This non-uniqueness of the input-output relationship implies the system is not invertible.