1.

#	a	b	c	d	e	f	g	h	i	j	k	l	m	n
S	Y	N	Y	N	Y	Y	Y	Y	N	N	Y	N	Y	Y
L	N	Y	Y	Y	N	N	N	Y	Y	Y	N	Y	N	Y
TI	Y	Y	N	N	Y	Y	Y	N	N	N	Y	N	Y	Y
C	Y	N	Y	N	Y	Y	Y	Y	N	N	Y	N	Y	Y
S	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y

Key: S=static; L=linear; TI=time-invariant; C=causal; S=stable.

2.

#	a	b	c	d	e	f	g	h
True?	Y	Y	Y	Y	Y	N	N	Y

2i. Consider $\mathcal{T}_1\{x(n)\} = x(n+1); \mathcal{T}_2\{x(n)\} = x(n-2) \rightarrow \mathcal{T}_1\mathcal{T}_2\{x(n)\} = x(n-1)$.
Consider $\mathcal{T}_1\{x(n)\} = e^{x(n)}; \mathcal{T}_2\{x(n)\} = \log x(n) \rightarrow \mathcal{T}_1\mathcal{T}_2\{x(n)\} = x(n)$.

3. **2.10:** Since system is time-invariant, advance $x_3(n)$ by one: $\{0,0,1\} \rightarrow \{1,2,1\}$.
Suppose system linear. $\{0,0,3\} \rightarrow 3\{1,2,1\} = \{3,6,3\} \neq \{0,1,0,2\}$. **Nonlinear**.

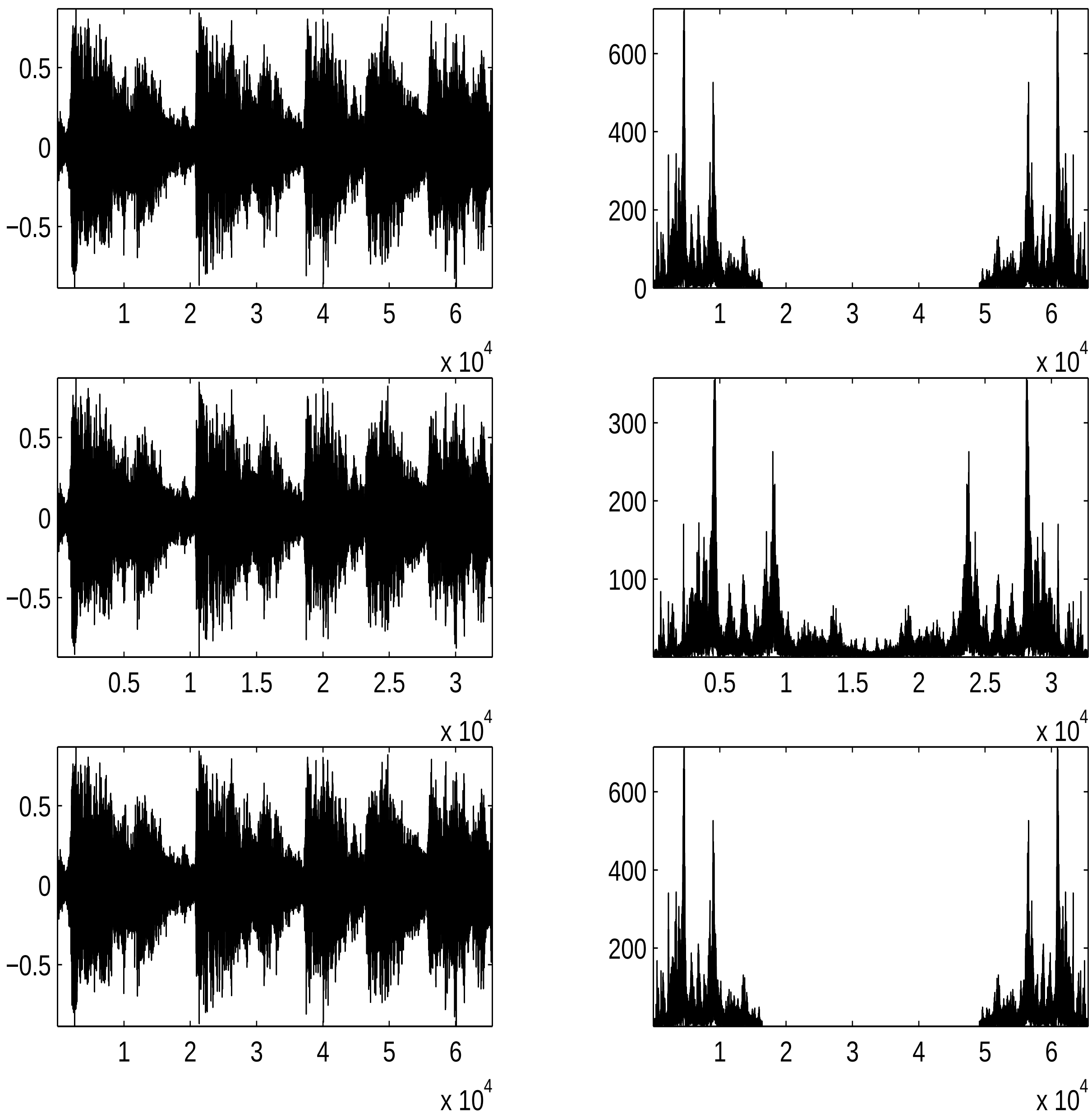
3. **2.11:** Since system linear: $x_1(n) + x_2(n) = \delta(n) \rightarrow y_1(n) + y_2(n) = \{0, \underline{3}, -1, 2, 1\}$.
$x_2(n) + x_3(n) = \delta(n+1) \rightarrow y_2(n) + y_3(n) = \{-1, \underline{2}, 2, 3\}$. **Not time invariant**.

4a. $\sum y(n) = \sum\sum h(i)x(n-i) = \sum_i h(i)(\sum_n x(n-i)) = \sum_i h(i)\sum_n x(n)$.

4b. (1) $\{1,2,4\} * \{1,1,1,1,1\} = \{1,3,7,7,7,6,4\}$. Check: (7)(5)=35.
(2) $\{1,2,-1\} * \{1,2,-1\} = \{1,4,2,-4,1\}$. Check: (2)(2)=4.
(5) $\{1,-2,3\} * \{0,0,1,1,1,1\} = \{0,0,1,-1,2,2,1,3\}$. Check: (2)(4)=8.
(7) $\{0,1,4,-3\} * \{1,0,-1,-1\} = \{0,1,4,-4,-5,-1,3\}$. Check: (2)(-1)=-2.

5. See overleaf. Easy to confirm Z=X to roundoff error (check **max(X-Z)**).

5c. By lowpass filtering the original signal, we have halved its bandwidth.
Hence the Nyquist rate is also halved, and we can *downsample* or *subsample* (take every other sample) without losing information.



0.5
0
−0.5
1 2 3 4 5 6
x 10^4
600
400
200
0
1 2 3 4 5 6
x 10^4
0.5
0
−0.5
0.5 1 1.5 2 2.5 3
x 10^4
300
200
100
0.5 1 1.5 2 2.5 3
x 10^4
0.5
0
−0.5
1 2 3 4 5 6
x 10^4
600
400
200
1 2 3 4 5 6
x 10^4