PRINT YOUR NAME HERE:

HONOR CODE PLEDGE: "I have neither given nor received aid on this exam, nor have I concealed any violations of the honor code." Closed book; 2 sides of 8.5×11 "cheat sheet."

SIGN YOUR NAME HERE:

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20 multiple-choice questions, worth 5 points each, for a total of 100 points. **LECTURE** Write your answer to each question in the space to the right of that question. **SESSION** Do NOT write your answers on a separate sheet of paper or in a blue book.
NOTE: No partial credit if an error on one problem leads to an error on another problem.
NOTE: Multiple-choice problems vary in difficulty. Some problems are harder than others.
NOTE: Don't spend too much time on any one problem! If trouble, go on to another one.

$\sin\frac{\pi}{6} = \cos\frac{\pi}{3} = \frac{1}{2}$; $\sin\frac{\pi}{4} = \cos\frac{\pi}{4} = \frac{\sqrt{2}}{2}$; $\sin\frac{\pi}{3} = \cos\frac{\pi}{6} = \frac{\sqrt{3}}{2}$; $\sin\frac{\pi}{2} = \cos(0) = 1$.

For #1-#4: L=Linear; TI=Time-Invariant; C=Causal; S=BIBO Stable.

NOTE: "Can't tell" means it can't be told, not just that YOU can't tell!

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1. The system $y[n] = x[n] + nx[n-1] + n^2x[n-2] + n^3x[n-3]$ is:
(a) L AND TI **(b)** L NOT TI **(c)** TI NOT L **(d)** NOT L;NOT TI **(e)** Can't tell

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2. The system $y[n] = 5x[n] - 7x[n-1]$ is:
(a) L AND TI **(b)** L NOT TI **(c)** TI NOT L **(d)** NOT L;NOT TI **(e)** Can't tell

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3. The system $y[n] = \sum_{i=0}^{100} ix[n-i]$ for all integers n is: (HINT: Look closely)
(a) C AND S **(b)** C NOT S **(c)** S NOT C **(d)** NOT C;NOT S **(e)** Can't tell

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4. The system $y[n] - y[n-1] = x[n]$ is: (HINT: What does this system do to $x[n]$?)
(a) C AND S **(b)** C NOT S **(c)** S NOT C **(d)** NOT C;NOT S **(e)** Can't tell

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5. The **period** of $x[n] = 3\cos(2\pi 0.075n + 1)$ for **integer** n is:
(a) 1 **(b)** 1/0.075 **(c)** 40 **(d)** 75 **(e)** not periodic

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6. The period of the discrete-time sinusoid $\cos(\frac{\pi}{6}n + 0.1) + 2\cos(\frac{2\pi}{15}n - 0.2)$ is:
(a) 6 **(b)** 24 **(c)** 30 **(d)** 60 **(e)** Not periodic

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7. $\sin(24\pi t) + \sin(96\pi t)$ is sampled at 60 Hz, then *ideally* interpolated. The result is:
(a) 0 **(b)** $\sin(12\pi t)$ **(c)** $2\sin(12\pi t)$ **(d)** $\sin(24\pi t)$ **(e)** $2\sin(24\pi t)$

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8. $\sin(20\pi t) + 2\sin(80\pi t)$ and which of these are identical after sampling at 50Hz:
(a) 0 **(b)** $-\sin(20\pi t)$ **(c)** $3\sin(20\pi t)$ **(d)** $-\sin(80\pi t)$ **(e)** $3\sin(80\pi t)$

CONTINUED ON THE OTHER SIDE!

For #9-#10: We observe the following two input-output pairs for an LTI system: The response to $\{\underline{2}, 3\}$ is $\{\underline{2}, 9, 13, 6\}$. The response to $\{\underline{2}, 4\}$ is $\{\underline{2}, 10, 16, 8\}$.

9. The response of the system to the input $\{\underline{3}, 5\}$ is:
(a) $\{\underline{2}, 9, 13, 6\}$ **(b)** $\{\underline{3}, 13, 18, 8\}$ **(c)** $\{\underline{3}, 14, 21, 10\}$ **(d)** $\{\underline{3}, 12, 15, 6\}$ **(e)** $\{\underline{3}, 7, 10, 13\}$

10. The impulse response is: **(a)** $\{\underline{1}, 2\}$ **(b)** $\{\underline{1}, 2, 3\}$ **(c)** $\{\underline{1}, 2, 2\}$ **(d)** $\{\underline{1}, 3, 2\}$ **(e)** $\{\underline{1}, 4, 2\}$

11. The convolution $\{2, 3, 5\} * \{1, 4, 6\} =$: **(a)** $\{2, 14, 44, 42, 30\}$ **(b)** $\{12, 24, 29, 17, 5\}$
(c) $\{2, 11, 29, 38, 30\}$ **(d)** $\{5, 17, 29, 24, 12\}$ **(e)** $\{30, 38, 29, 11, 2\}$

12. The impulse response of $y[n] = 2x[n] + x[n-2] + 3x[n-3]$ is:
(a) $\{2, 1, 3\}$ **(b)** $\{2, 0, 1, 3\}$ **(c)** $\{2, 0, 0, 1, 3\}$ **(d)** $\{3, 1, 2\}$ **(e)** $\{3, 0, 1, 2\}$

13. The value of the line spectrum of $\cos(0.2\pi n + 1) + 2\cos(0.6\pi n + 3)$ at $\omega = -1.8\pi$ is:
(a) 0 **(b)** $0.5e^{j}$ **(c)** $0.5e^{-j}$ **(d)** e^{j3} **(e)** e^{-j3}

14. Discrete-time signal $\cos(1.4\pi n + \frac{\pi}{3})$ has the same spectrum as:
(a) 0 **(b)** $\cos(0.6\pi n + \frac{\pi}{3})$ **(c)** $\cos(0.6\pi n - \frac{\pi}{3})$ **(d)** $\cos(0.7\pi n + \frac{\pi}{3})$ **(e)** $\cos(0.7\pi n - \frac{\pi}{3})$

15. $x[n] = (1+j)e^{j2\pi n/3} + je^{j2\pi n/5} + (1-j)e^{-j2\pi n/3} - je^{-j2\pi n/5}$. The DFT of $x[n]$ is computed using N=period of $x[n]$. Then $X_4 =$: **(a)** 0 **(b)** 1+j **(c)** 1-j **(d)** j **(e)** -j

16. Average power of $2 + 6\cos(\frac{\pi}{2}n) + 4\cos(\pi n)$ is: **(a)** 0 **(b)** 12 **(c)** 30 **(d)** 38 **(e)** 56

17. The DFT of $\{24, 20, 8, 4\}$ is: **(a)** $\{56, 16-16j, 8, 16+16j\}$ **(b)** $\{56, 16+16j, 8, 16-16j\}$
(c) $\{14, 4-4j, 4, 4+4j\}$ **(d)** $\{14, 4-4j, 2, 4+4j\}$ **(e)** $\{14, 4+4j, 2, 4-4j\}$

18. The 4-point DFT of $\{3, 2, 1, x\}$ has $X_2 = 0$ if $x =$: **(a)** 0 **(b)** 1 **(c)** 2 **(d)** -2 **(e)** -6

19. The DFT of $x[n] = 2\sin(\frac{\pi}{4}n)$ is: **(a)** $\{0, 0, -j, 0, 0, 0, j, 0\}$ **(b)** $\{0, -j, 0, 0, 0, 0, 0, j\}$
(c) $\{0, j, 0, 0, 0, 0, 0, -j\}$ **(d)** $\{0, -j, 0, 0, 0, 0, j, 0\}$ **(e)** $\{0, j, 0, 0, 0, 0, -j, 0\}$

20. The impulse response of $\rightarrow \overline{|h[n] = 3^n u[n]|} \rightarrow z[n] \rightarrow \overline{|y[n] = z[n] - 3z[n-1]|} \rightarrow$ is:
(a) $\delta[n]$ **(b)** $3^n u[n] + \{\underline{1}, -3\}$ **(c)** $(3^n + 3^{n-1})u[n]$ **(d)** $\delta[n] - 3\delta[n-1]$ **(e)** 0

DID YOU REMEMBER TO SIGN THE HONOR PLEDGE?