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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; 4 sides of 8.5×11 "cheat sheet."

SIGN YOUR NAME HERE:

CIRCLE ONE: Undergraduate Graduate

Write your answer to each question in the answer space to the right of that question. Problems #1-14 are multiple choice (same as fill-in-blank) worth 5 each; #15 is worth 10.

1. The DFT of $\{16, 8, 12, 4\}$ is: **(a)** $\{40, 4+4j, 16, 4-4j\}$ **(b)** $\{10, 1+j, 4, 1-j\}$ **(c)** $\{40, 4-4j, 16, 4+4j\}$ **(d)** $\{10, 1-j, 4, 1+j\}$ **(e)** $\{4, 1-j, 10, 1+j\}$

2. The DFT of $x[n] = \frac{1}{4}\sin(\frac{3\pi}{4}n)$ is: **(a)** $\{0, 0, -j, 0, 0, 0, j, 0\}$ **(b)** $\{0, 0, 0, -j, 0, j, 0, 0\}$ **(c)** $\{0, 0, 0, j, 0, -j, 0, 0\}$ **(d)** $\{0, 0, -j, 0, 0, j, 0, 0\}$ **(e)** $\{0, 0, j, 0, 0, -j, 0, 0\}$

3. Which of these signals is eliminated by $y[n] = x[n] - x[n-1] + x[n-2]$: **(a)** 1 **(b)** $\cos(\frac{\pi}{4}n)$ **(c)** $\cos(\frac{\pi}{3}n)$ **(d)** $\cos(\frac{\pi}{2}n)$ **(e)** $\cos(\frac{2\pi}{3}n)$

4. $\cos(\frac{\pi}{2}n)$ is input into a LTI system with $H(e^{j\omega})$=1+0.5$e^{j\omega}$+1$e^{j2\omega}$. The output is: **(a)** $\sqrt{2}\cos(\frac{\pi}{2}n)$ **(b)** $2.5\cos(\frac{\pi}{2}n)$ **(c)** $1.5\cos(\frac{\pi}{2}n)$ **(d)** $\sin(\frac{\pi}{2}n)$ **(e)** $-0.5\sin(\frac{\pi}{2}n)$

5. If $x[n] = \cos(\frac{\pi}{2}n) + 2\cos(\pi n)$ then $y[n] = y[n-1] + x[n] + x[n-1]$ yields y[n]=: **(a)** $\cos(\frac{\pi}{2}n)$ **(b)** $\cos(\pi n)$ **(c)** $2\cos(\frac{\pi}{2}n) + 3\cos(\pi n)$ **(d)** $\sin(\frac{\pi}{2}n)$ **(e)** 0

6. Which of these filters eliminates 60 Hz in a signal sampled at 240 Hz? $h[n]$ =: **(a)** $\{1, 1, 1\}$ **(b)** $\{1, -1, 1\}$ **(c)** $\{1, 0, 1\}$ **(d)** $\{1, 0, -1\}$ **(e)** $\{1, \sqrt{2}, 1\}$

7. The system having frequency response $[4 + 3e^{-j\omega}]/[1 + 2e^{-j2\omega}]$ is: **(a)** $4y[n] + 3y[n-1] = x[n] + 2x[n-2]$ **(b)** $y[n] + 2y[n-2] = 4x[n] + 3x[n-1]$ **(c)** $4y[n] + 3y[n-2] = x[n] + 2x[n-1]$ **(d)** $y[n] + 2y[n-1] = 4x[n] + 3x[n-2]$

8. Which system eliminates $3\cos(\frac{\pi}{2}n) + 4\cos(\pi n)$? **(a)** $y[n] = x[n] + x[n-1]$ **(b)** $y[n] = x[n] + x[n-2]$ **(c)** $y[n] = x[n] + x[n-1] + x[n-2]$ **(d)** $y[n] = x[n] - x[n-4]$

9. The frequency response function of $y[n] + y[n-1] = x[n] - x[n-1]$ is: **(a)** $\tan(\frac{\omega}{2})$ **(b)** $j\tan(\frac{\omega}{2})$ **(c)** $\cot(\frac{\omega}{2})$ **(d)** $-j\cot(\frac{\omega}{2})$ **(e)** $\cos(\frac{\omega}{2})$

10. The system y[n]+3y[n-1]+ay[n-2]=x[n-1] has zero phase for all frequencies for a=: **(a)** 1/2 **(b)** 1 **(c)** 2 **(d)** 3 **(e)** No values of a

11. The DTFS of $\{\ldots 1, 1, -1, -1, \underline{1}, 1, -1, -1, 1, 1, -1, -1 \ldots\}$ is: **(a)** $2+\cos(\frac{\pi}{2}n)+\cos(\pi n)$ **(b)** $\cos(\frac{\pi}{2}n)+2\cos(\pi n)$ **(c)** $1+2\cos(\frac{\pi}{2}n)+\cos(\pi n)$ **(d)** $1+2\cos(\frac{\pi}{2}n)$ **(e)** $\sqrt{2}\cos(\frac{\pi}{2}n-\frac{\pi}{4})$

12. Which one of these functions *cannot* be the DTFT of any $x[n]$: **(a)** $\cos(2\omega)$ **(b)** $\sin(2\omega)$ **(c)** $\cos(\omega/2)$ **(d)** $|\sin(\omega/2)|$ **(e)** $\sin(\omega)$

13. The *cyclic* convolution $\{\underline{6}, 9, 3\}$Ⓒ$\{\underline{3}, 1, 8\}$ is: **(a)** $\{\underline{18}, 33, 66, 75, 24\}$ **(b)** $\{\underline{88}, 104, 28\}$ **(c)** $\{\underline{8}, 108, 90\}$ **(d)** $\{\underline{51}, 66, 99\}$ **(e)** $\{\underline{93}, 57, 66\}$

14. If $\sqrt{2}\cos(\frac{\pi}{4}n - \frac{\pi}{4})$=x[n]+x[n-2], which of these could be x[n]? **(a)** $\cos(\frac{\pi}{4}n - \frac{\pi}{4})$ **(b)** $\frac{\sqrt{2}}{2}\cos(\frac{\pi}{4}n)$ **(c)** $\cos(\frac{\pi}{4}n)+3\cos(\frac{\pi}{2}n)$ **(d)** $\sqrt{2}\cos(\frac{\pi}{4}n)$ **(e)** $\cos(\frac{\pi}{4}n)+3\cos(\pi n)$

[10] 15. For the system $5y[n] + 3y[n-1] + y[n-2] = 7x[n] + 6x[n-1] - x[n-2]$, the response to $x[n] = 9 + 2\cos(\frac{\pi}{2}n) + 3\cos(\pi n)$ is $y[n] =$: **(a)** 0 **(b)** $12 + 4\cos(\frac{\pi}{2}n)$ **(c)** $\frac{27}{4} + 10\cos(\frac{\pi}{2}n + 37^o) + \frac{9}{2}\cos(\frac{\pi}{2}n)$ **(d)** $10\cos(\frac{\pi}{2}n + 37^o) + 3\cos(\frac{\pi}{2}n)$ **(e)** ∞

[10] 16. $x[n] \rightarrow \overline{|y[n] = x[n] + x[n-1] + \ldots + x[n-7]|} \rightarrow y[n]$. Make a stem plot of $y[n]$.

You only know $x[n]$ is: (1) real-valued; (2) periodic with period=8; (3) mean=1.

0 1 2 3 4 5

(10) 17. A LTI system has $H(z) = \frac{(z-1)(z-j)(z+1)(z+j)}{(z-0.99e^{j\pi/4})(z-0.99e^{-j\pi/4})(z-0.99e^{j3\pi/4})(z-0.99e^{-j3\pi/4})}$. Sketch the relative magnitude of its frequency response on the plot below.

$-\pi$ 0 π