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; 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 #1-15 are multiple choice (here same as fill-in-the-blank) worth 5 points each.

1. The DFT of $\{12,8,4,8\}$ is: **(a)** $\{8,1+j2,4,1-j2\}$ **(b)** $\{8,1-j2,4,1+j2\}$ **(c)** $\{32,4-j8,16,4+j8\}$ **(d)** $\{8,2,0,2\}$ **(e)** $\{32,8,0,8\}$
2. The DFT of $\cos(\frac{\pi}{4}n)$ is: **(a)** $\{4,0,0,0,0,0,0,4\}$ **(b)** $\{0,4,0,0,0,0,0,4\}$ **(c)** $\{0,0,4,0,0,0,4,0\}$ **(d)** $\{0,4,0,0,0,0,4,0\}$ **(e)** $\{0,0,0,4,4,0,0,0\}$
3. Which signal is eliminated by $y[n]-y[n-1]=x[n]+x[n-1]+x[n-2]$: **(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. Which of these filters eliminates 375 Hz in a signal sampled at 1 kHz? $h[n]=$: **(a)** $\{1,1,1\}$ **(b)** $\{1,-1,1\}$ **(c)** $\{1,0,1\}$ **(d)** $\{1,0,-1\}$ **(e)** $\{1,\sqrt{2},1\}$
5. The response of $y[n]=8x[n]+3x[n-1]+4x[n-2]$ to $x[n]=\cos(\frac{\pi}{2}n)$ is: **(a)** $9\cos(\frac{\pi}{2}n)$ **(b)** $5\cos(\frac{\pi}{2}n+37^o)$ **(c)** $15\cos(\frac{\pi}{2}n)$ **(d)** $5\cos(\frac{\pi}{2}n-37^o)$ **(e)** $9\sin(\frac{\pi}{2}n)$
6. If $x[n]=\cos(\frac{\pi}{2}n)+\cos(\pi n)$ then $y[n]=x[n]+x[n-1]+x[n-2]+x[n-3]=$: **(a)** $\cos(\frac{\pi}{2}n)$ **(b)** $\cos(\pi n)$ **(c)** $2\cos(\frac{\pi}{2}n)+3\cos(\pi n)$ **(d)** $4x[n]$ **(e)** 0
7. The system having frequency response $[2e^{-j\omega}]/[1+3e^{-j2\omega}]$ is: **(a)** $y[n-1]=\frac{1}{2}x[n]+\frac{3}{2}x[n-2]$ **(b)** $y[n]+3y[n-2]=2x[n-1]$ **(c)** $y[n]=x[n]+3x[n-2]$ **(d)** $y[n]+3y[n-1]=2x[n]$ **(e)** $y[n]+3y[n-1]=2x[n-1]$
8. The filter eliminating discrete-time frequencies $\omega=\frac{\pi}{3}$ and $\omega=\frac{2\pi}{3}$ is: **(a)** $\{1,0,1,0,1\}$ **(b)** $\{1,0,1.25,0,1\}$ **(c)** $\{1,0,1.75,0,1\}$ **(d)** $\{1,.27,-1.46,.27,1\}$
9. The frequency response function of $y[n]+y[n-2]=x[n]-x[n-2]$ is: **(a)** $\tan(\omega)$ **(b)** $j\tan(\omega)$ **(c)** $\cot(\omega)$ **(d)** $-j\cot(\omega)$ **(e)** $\frac{1-e^{-j\omega}}{1+e^{-j\omega}}$
10. The system y(n)=x(n+1)+3x(n)+ax(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 system y(n)=x(n)+x(n-1)+ax(n-2) has a stable and causal inverse for a=: **(a)** 1/2 **(b)** 1 **(c)** 2 **(d)** 3 **(e)** No values of a
12. Which function *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 $\{\underline{3},1,4\}©\{\underline{2},7,1\}$ is: **(a)** $\{\underline{6},23,18,29,4\}$ **(b)** $\{\underline{24},52,4\}$ **(c)** $\{\underline{6},52,22\}$ **(d)** $\{\underline{10},52,18\}$ **(e)** $\{\underline{35},27,18\}$

14. Which system has gain function $\sqrt{(3+4\cos\omega)^2+16\sin^2\omega}/\sqrt{(1+2\cos\omega)^2+4\sin^2\omega}$?
(a) $3y[n]+4y[n-1]=x[n]+2x[n-1]$ **(b)** $y[n]+2y[n-1]=3x[n]+4x[n-1]$
(c) $4y[n]+3y[n-1]=2x[n]+x[n-1]$ **(d)** $2y[n]+y[n-1]=4x[n]+3x[n-1]$
(e) $y[n]=x[n]+x[n-1]$

[10] 15. For $H(\omega)=1+4e^{-j\omega}+3e^{-j3\omega}$, the response to $x[n]=1+2\cos(\frac{\pi}{2}n)+3\cos(\pi n)$ is $y[n]=$:
(a) 0 **(b)** $8+4\sqrt{2}\cos(\frac{\pi}{2}n-\frac{\pi}{4})$ **(c)** $4\sqrt{2}\cos(\frac{\pi}{2}n-\frac{\pi}{4})-18\cos(\pi n)$
(d) $8+4\sqrt{2}\cos(\frac{\pi}{2}n+\frac{\pi}{4})-18\cos(\pi n)$ **(e)** $8+2\sqrt{2}\cos(\frac{\pi}{2}n-\frac{\pi}{4})-18\cos(\pi n)$

[10] 16. (Period=8, real, even) $x[n] \rightarrow \boxed{y[n]=x[n]-x[n-2]+x[n-4]-x[n-6]} \rightarrow y[n]$

Make a stem plot of $y[n]$ on the axis below. Don't worry about the vertical scale.
HINT: $(z^6-z^4+z^2-1)(z^2+1)=(z^8-1)$. What do the zeros do to periodic $x[n]$?

0 1 2 3 4 5

[10] 17. A LTI system has $H(z)=[(z-e^{j2\pi/3})(z-e^{-j2\pi/3}]/[(z-0.99e^{j\pi/3})(z-0.99e^{-j\pi/3})]$.
Sketch the relative magnitude of its frequency response (i.e., gain) on the plot below.

$-\pi$ 0 π