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:

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: Problems vary in difficulty. Some problems are harder than others.

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

1. $\sqrt{2}e^{j4\pi/3} + \sqrt{3}e^{j3\pi/4} =$: **(a)** 0 **(b)** $-\frac{\sqrt{2}}{2} - \frac{\sqrt{6}}{2}$ **(c)** $-\frac{\sqrt{2}}{2} - j\frac{\sqrt{6}}{2}$ **(d)** $-\frac{j}{8}$ **(e)** $e^{-j\pi/6}$

2. $(\sqrt{3}+j)^{-3} =$: **(a)** 0 **(b)** $-\frac{\sqrt{2}}{2} - \frac{\sqrt{6}}{2}$ **(c)** $-\frac{\sqrt{2}}{2} - j\frac{\sqrt{6}}{2}$ **(d)** $-\frac{j}{8}$ **(e)** $e^{-j\pi/6}$

3. $Im[(1+jx)e^{-j\pi/3}] = 0$ for $x =$: **(a)** 0 **(b)** 2 **(c)** $\sqrt{3}$ **(d)** $\frac{\pi}{3}$ **(e)** -1

4. $\frac{1+j\sqrt{3}}{\sqrt{3}-j}\frac{j-1}{j+1} =$: **(a)** 0 **(b)** 2 **(c)** $\sqrt{3}$ **(d)** $\frac{\pi}{3}$ **(e)** -1

5. $\cos(t) + \cos(t+\frac{\pi}{2}) + \cos(t+\frac{2\pi}{2}) + \cos(t+\frac{3\pi}{2}) =$:
   (a) 0 **(b)** $\sqrt{2}\cos(t+\frac{\pi}{2})$ **(c)** $2\cos t$ **(d)** $2\sin(t)$ **(e)** $\sqrt{2}\cos(t-\frac{\pi}{2})$

6. $\cos(t+\frac{\pi}{3}) + \sqrt{3}\cos(t-\frac{\pi}{6}) =$:
   (a) 0 **(b)** $\sqrt{2}\cos(t+\frac{\pi}{2})$ **(c)** $2\cos t$ **(d)** $2\sin(t)$ **(e)** $\sqrt{2}\cos(t-\frac{\pi}{2})$

7. $2\cos(t+\frac{\pi}{3}) + A\cos(t+\frac{5\pi}{4}) = B\cos t$ for $A =$: **(a)** 1 **(b)** $\frac{\sqrt{2}}{2}$ **(c)** $\sqrt{2}$ **(d)** $\sqrt{3}$ **(e)** $\sqrt{6}$
   Here B is a constant; you don't have to know what B is to solve this problem.

8. $4(\cos^3 t)(\sin t) - 4(\cos t)(\sin^3 t) =$: HINT: $(e^{jt})^4 = e^{j4t}$
   (a) $\cos 4t$ **(b)** $\sin 4t$ **(c)** $\sin 4t + \cos 4t$ **(d)** $\sin 4t - \cos 4t$ **(e)** $\sin 2t$

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9. If $x(t)$ has support $[1,3]$ then $y(t) = 5x(4t-3)$ has support:
(a) $[0,1]$ **(b)** $[4,6]$ **(c)** $[1,1.5]$ **(d)** $[1,9]$ **(e)** $[3.25,3.75]$

10. For any $x(t)$, $C(x,-x) =$: **(a)** $M(x)$ **(b)** $E(x)$ **(c)** $-E(x)$ **(d)** $MS(x)$ **(e)** $-MS(x)$

For #11-#15: Let $x(t) = (3-j4)e^{-j2t} + (1+j)e^{-jt} + (1-j)e^{jt} + (3+j4)e^{j2t}$.

11. The average power of $x(t)$ is: **(a)** 0 **(b)** $5+\sqrt{2}$ **(c)** $10+2\sqrt{2}$ **(d)** 27 **(e)** 54

12. The sinusoidal component at $\omega = 1$ is:
(a) $\sqrt{2}\cos(t+\frac{\pi}{4})$ **(b)** $\sqrt{2}\cos(t-\frac{\pi}{4})$ **(c)** $2\sqrt{2}\cos(t+\frac{\pi}{4})$ **(d)** $2\sqrt{2}\cos(t-\frac{\pi}{4})$ **(e)** 0

13. If $x(t)$ is passed through a **high-pass filter** that passes frequencies **above 1 Hz** and rejects frequencies **below 1 Hz**, the result is:
(a) $\sqrt{2}\cos(t+\frac{\pi}{4})$ **(b)** $\sqrt{2}\cos(t-\frac{\pi}{4})$ **(c)** $2\sqrt{2}\cos(t+\frac{\pi}{4})$ **(d)** $2\sqrt{2}\cos(t-\frac{\pi}{4})$ **(e)** 0

14. The fundamental period of $x(t)$ is: **(a)** 1 **(b)** 2 **(c)** π **(d)** 2π **(e)** not periodic

15. To sample $x(t)$ so that no aliasing occurs, $T_s <$: **(a)** $\frac{1}{2}$ **(b)** 4 **(c)** 2π **(d)** $\frac{\pi}{2}$ **(e)** $\frac{1}{2\pi}$

16. Fundamental period of $\cos(\frac{5\pi}{3}t) + \sin(3\pi t)$ is: **(a)** 6 **(b)** 15π **(c)** $\frac{1}{15}$ **(d)** $\frac{\pi}{3}$ **(e)** $\frac{15}{2}$

17. Fundamental period of $\cos(1.25\pi n)$ is: **(a)** 3 **(b)** 4 **(c)** 5 **(d)** 8 **(e)** not periodic

18. Line spectrum of $1 + 2\cos(3t-1)$ at $\omega = -3$: **(a)** 0 **(b)** e^j **(c)** e^{-j} **(d)** $2e^j$ **(e)** $2e^{-j}$

19. Spectrum of $1 + 2\cos(\frac{\pi}{2}n - 1)$ at $\omega = -4.5\pi$: **(a)** 0 **(b)** e^j **(c)** e^{-j} **(d)** $2e^j$ **(e)** $2e^{-j}$

20. $2\cos(\frac{3+\omega}{2}t)\cos(\frac{3-\omega}{2}t) =$: **(a)** $\cos(3t) + \cos(\omega t)$ **(b)** $\cos(3t) - \cos(\omega t)$ **(c)** $\cos(\frac{3}{2}t) + \cos(\frac{\omega}{2}t)$ **(d)** $\cos(\frac{3}{2}t) - \cos(\frac{\omega}{2}t)$ **(e)** $\cos(3t)$

DID YOU REMEMBER TO SIGN THE HONOR PLEDGE?