EECS 206 EXAM #3 Fall 2004

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:

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26 multiple-choice questions, worth 5 points each, and two 10-point questions. **LECTURE**
Write your answer to each question in the space to the right of that question. **SESSION**:
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 problems #1-5: An LTI system has transfer function $H(z) = \frac{(z-1)(z-6)}{(z-2)(z-3)}$.

1. The zeros, poles, and BIBO stability of the system are: **(a)** $\{1,6\};\{2,3\}$;stable **(b)** $\{1,6\};\{2,3\}$;unstable **(c)** $\{2,3\};\{1,6\}$;stable **(d)** $\{2,3\};\{1,6\}$;unstable

2. The difference equation for the system is:
(a) $y[n]-7y[n-1]+6y[n-2]=x[n]-5x[n-1]+6x[n-2]$
(b) $6y[n]-7y[n-1]+y[n-2]=6x[n]-5x[n-1]+x[n-2]$
(c) $y[n]-5y[n-1]+6y[n-2]=x[n]-7x[n-1]+6x[n-2]$
(d) $6y[n]-5y[n-1]+y[n-2]=6x[n]-7x[n-1]+x[n-2]$

3. The response of the system to $x[n]=\{1,-5,6\}$ is $y[n]=$:
(a) $\{1,-7,6\}$ **(b)** $(2)^{n+1}u[n]-2(3)^n u[n]$ **(c)** $\{6,-7,1\}$ **(d)** $\delta[n]+(2)^{n+1}u[n]-2(3)^n u[n]$

4. The response of the system to $x[n]=\cos(\pi n)$ is $y[n]=$:
(a) 0 **(b)** $\frac{7}{6}\cos(\pi n)$ **(c)** ∞ **(d)** $1.22\cos(\pi n-0.165)$ **(e)** $1.22\cos(\pi n+0.165)$

5. The impulse response of the system is $h[n]=$:
(a) $\{1,-7,6\}$ **(b)** $(2)^{n+1}u[n]-2(3)^n u[n]$ **(c)** $\{6,-7,1\}$ **(d)** $\delta[n]+(2)^{n+1}u[n]-2(3)^n u[n]$

For problems #6-10: $5y[n]+3y[n-1]+y[n-2]=7x[n]+6x[n-1]-x[n-2]$.

6. TRANSFER FUNCTION $H(z)=$: **(a)** $\frac{7z^2+6z-1}{z^2+3z+5}$ **(b)** $\frac{5z^2+3z+1}{7z^2+6z-1}$ **(c)** $\frac{z^2+3z+5}{-z^2+6z+7}$ **(d)** $\frac{7z^2+6z-1}{5z^2+3z+1}$ **(e)** $\frac{-z^2+6z+7}{z^2+3z+5}$

7. System is C=CAUSAL S=STABLE **(a)** C AND S **(b)** C NOT S **(c)** S NOT C **(d)** NOT S;NOT C

8. Response to $x[n]=2\cos(\omega n)$ is $y[n]=0$ for $\omega=$: **(a)** 0 **(b)** $\frac{\pi}{3}$ **(c)** $\frac{\pi}{2}$ **(d)** $\frac{2\pi}{3}$ **(e)** π

9. The frequency response function is $H(\omega)=$:
(a) $\frac{6+7e^{j\omega}-e^{-j\omega}}{3+e^{j\omega}+5e^{-j\omega}}$ **(b)** $\frac{3+5e^{j\omega}+e^{-j\omega}}{6+7e^{j\omega}-e^{-j\omega}}$ **(c)** $\frac{3+e^{j\omega}+5e^{-j\omega}}{6-e^{j\omega}+7e^{-j\omega}}$ **(d)** $\frac{6+7e^{j\omega}-e^{-j\omega}}{3+5e^{j\omega}+e^{-j\omega}}$ **(e)** $\frac{6-e^{j\omega}+7e^{-j\omega}}{3+e^{j\omega}+5e^{-j\omega}}$

10. 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)** ∞

For problems #11-15: The pole-zero diagram is: $-\underbrace{X}_{-2/3}-\underbrace{X}_{-1/3}------\underbrace{O}_{1}-$

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11. The difference equation for the system is: **(a)** $9y[n]+9y[n-1]+2y[n-2]=9x[n-1]-9x[n-2]$ **(b)** $2y[n]+9y[n-1]+9y[n-2]=9x[n]-9x[n-1]$ **(c)** $y[n]-y[n-1]=x[n]+x[n-1]+\frac{2}{9}x[n-2]$ **(d)** $y[n]+y[n-1]+\frac{2}{9}y[n-2]=x[n]-x[n-1]$

12. The output $y[n]=0$ if the input $x[n]=$:
(a) $(-\frac{1}{3})^n u[n]$ **(b)** $\{\underline{9},9,2\}$ **(c)** 1 for all n **(d)** $\cos(\pi n)$ **(e)** None of these

13. The output $y[n]\to\infty$ if the input $x[n]=$:
(a) $(-\frac{1}{3})^n u[n]$ **(b)** $\{\underline{9},9,2\}$ **(c)** 1 for all n **(d)** $\cos(\pi n)$ **(e)** None of these

14. The output $y[n]=9\delta[n-1]$ if the input $x[n]=$:
(a) $\mathcal{Z}^{-1}\{\frac{z-1}{z^2+z+\frac{2}{9}}\}$ **(b)** $\{\underline{9},9,2\}$ **(c)** $\{\underline{9},9,2\}*u[n]$ **(d)** $\mathcal{Z}^{-1}\{\frac{z^2+z+\frac{2}{9}}{z-1}\}$

15. The impulse response $h[n]=$:
(a) $12(-\frac{1}{3})^n u[n]-7.5(-\frac{2}{3})^n u[n]$ **(b)** $12(-\frac{1}{3})^n u[n]-7.5(-\frac{2}{3})^n u[n]-4.5\delta[n]$
(c) $5(-\frac{2}{3})^n u[n]-4(-\frac{1}{3})^n u[n]$ **(d)** $5(-\frac{2}{3})^{n-1}u[n-1]-4(-\frac{1}{3})^{n-1}u[n-1]-\delta[n]$

Problems #16-20 involve z-transforms and inverse z-transforms.

16. The z-transform of $\{\underline{1},1,1\}+u[n]$ is:
(a) $\frac{2z^3-1}{z^3-z^2}$ **(b)** $1+z^{-1}+z^{-2}$ **(c)** $z^2+z+1+\frac{z}{z-1}$ **(d)** $\frac{z^3-2}{z^3-z^2}$

17. The z-transform of $(2)^n u[n]+(-4)^n u[n]$ is:
(a) $\frac{1}{z^2+2z-8}$ **(b)** $\frac{z^2+z}{z^2+2z-8}$ **(c)** $2\frac{z^2+z}{z^2+2z-8}$ **(d)** $\frac{z^2-z}{z^2+2z-8}$ **(e)** $2\frac{z^2-z}{z^2+2z-8}$

18. The z-transform of $\{\underline{1},-3,2\}*u[n]$ is:
(a) $\frac{z-2}{z}$ **(b)** $\frac{2z^3-4z^2+5z-2}{z^3-z^2}$ **(c)** $1+3z^{-1}+2z^{-2}+\frac{z}{z-1}$ **(d)** $1-2z$

19. The inverse z-transform of $\frac{2z}{z^2+1}$ is:
(a) $(-1)^n$ **(b)** $2\cos(\pi n)u[n]$ **(c)** $2\sin(\pi n)u[n]$ **(d)** $2\cos(\frac{\pi}{2}n)u[n]$ **(e)** $2\sin(\frac{\pi}{2}n)u[n]$

20. The inverse z-transform of $\frac{z^2-5z+6}{z^2(z-1)}$ is:
(a) $\{\underline{1},-5,6\}*u[n]$ **(b)** $\{\underline{1},-6\}$ **(c)** $\{\underline{1},-5,6\}*u[n-1]$ **(d)** $\{\underline{0},1,-6\}$

For problems #21-23: the frequency response function is $H(\omega)=1+4e^{-j\omega}+3e^{-j3\omega}$

21. The response to $x[n]=\cos(\frac{\pi}{3}n)$ is $y[n]=$:
(a) 0 **(b)** $\frac{1}{2}\cos(\frac{\pi}{3}n+\frac{\pi}{3})$ **(c)** $\sqrt{3}\cos(\frac{\pi}{3}n-\frac{\pi}{3})$ **(d)** $2\sqrt{3}\cos(\frac{\pi}{3}n-\frac{\pi}{2})$ **(e)** ∞

22. 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)** $8+2\sqrt{2}\cos(\frac{\pi}{2}n-\frac{\pi}{4})-18\cos(\pi n)$

23. The difference equation implementing the given $H(\omega)$ is:
(a) $y[n]=x[n]+4x[n-1]+3x[n-2]$ **(b)** $y[n]+4y[n-1]+3y[n-2]=x[n]$
(c) $y[n]=x[n]+4x[n-1]+3x[n-3]$ **(d)** $y[n]+4y[n-1]+3y[n-3]=x[n]$

24. The notch filter eliminating 300 Hz from a signal sampled at 0.9 kHz is:
(a) $\{1,1,1\}$ **(b)** $\{1,-1,1\}$ **(c)** $\{1,\frac{1}{2},1\}$ **(d)** $\{1,-\frac{1}{2},1\}$ **(e)** $\{1,\frac{\sqrt{3}}{2},1\}$

25. 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)** $\{1,.27,-1.46,.27,1\}$

26. The purpose of an antialias filter in a DSP system is: **(a)** Increase the sampling rate **(b)** Sharpen the signal **(c)** Ensure there are no frequencies above the Nyquist rate **(d)** Eliminate noise **(e)** Eliminate any TV series starring Jennifer Garner

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(10) 27. A LTI system has $H(z) = [(z - 0.9e^{j\pi/3})(z - 0.9e^{-j\pi/3}]/[(z - 0.9e^{j2\pi/3})(z - 0.9e^{-j2\pi/3})]$. Sketch the relative magnitude of its frequency response (i.e., gain) on the plot below.

$-\pi$ 0 π

(10) 28. Draw the **pole-zero plot** for a filter that will eliminate a signal having period=8 while having as little effect as possible on any other signals that may be present.

DID YOU REMEMBER TO SIGN THE HONOR PLEDGE?