Name: _____

ID Number: _____

Lab section: _____

Lecture section: _____

I have neither given nor received aid on this examination, nor have I concealed any violation of the Honor Code.

Signature: _____

EECS 206 Exam 2, 2002-11-7
DO NOT TURN THIS PAGE OVER UNTIL TOLD TO BEGIN!

- This is a 90 minute exam.
- It is closed book, closed notes, closed computer.
- You may use two 8.5x11" piece of papers, both sides, and a calculator.
- There are 11 problems. The questions are not necessarily in order of increasing difficulty.
- This exam has 6 pages. Make sure your copy is complete.
- Continuing to write *anything* after the ending time is announced will be considered an honor code violation. *Fill out your name etc. above now.*
- For problem 1, show all of your work.
  For problems 2-10, clearly circle the letter(s) for your answer in this table. There are no intentional "none of the above" answers on this exam, but there is always the slim possibility of a typographical error. If you are confident that the correct answer is "none of the above" in any problem, then make a clear mark in this table and show your work clearly near that problem.
  Problems 2-4 may require multiple answers, and some partial credit may be awarded for some of these problems. Problems 5-10 each only have a single answer, and no partial credit will be given.

2.	a	b	c	d	e	f
3.	a	b	c	d	e	f
4.	a	b	c	d	e	f
5.	a	b	c	d	e	f
6.	a	b	c	d	e	f
7.	a	b	c	d	e	f
8.	a	b	c	d	e	f
9.	a	b	c	d	e	f
10.	a	b	c	d	e	f

1. (14 points)
A discrete-time signal $x[n]$ has the following 8-point DFT:

$$X[k] = \begin{cases} 1, & k \text{ even} \\ 0, & k \text{ odd.} \end{cases}$$

Determine the 8-point DFT of the signal $y[n] = 3 + (-1)^n + x[n]$. *Show your work clearly and graph your answer.*

2. (6 points)
A discrete-time system has the following input/output relation: $y[n] = 2x[n-1] - x[n] + 2$.
Which of the following correctly describe this system? **Circle all that apply on the answer page.**

a) Linear
b) Nonlinear
c) Time-invariant
d) Time varying
e) Causal
f) Noncausal

3. (10 points)
The following continuous-time signal $x(t)$ is sampled at f_s samples/sec:

$$x(t) = 1 + \sin(20\pi t + \pi/3) + 2\cos(30\pi t - \pi/6) - \cos(10\pi t).$$

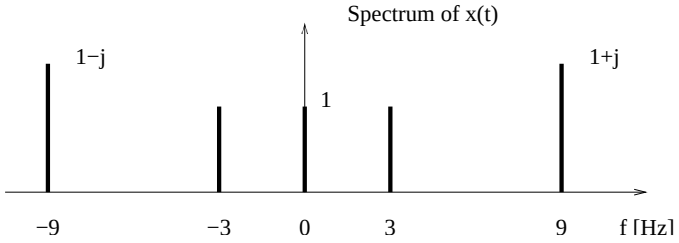
Which of the following conditions is/are sufficient to ensure that aliasing cannot occur?
Circle all that apply on the answer page.

a) 15 Hz $< f_s$
b) 20 Hz $< f_s \leq$ 30 Hz
c) $f_s <$ 60 Hz
d) 30 Hz $< f_s \leq$ 60 Hz
e) 30 Hz $\leq f_s$
f) 30 Hz $\leq f_s \leq$ 60 Hz

4. (10 points)
A sinusoidal signal $x(t)$ is sampled at rate $f_s = 100$Hz yielding the discrete-time signal $x[n] = \cos((\pi/2)n + \pi/5)$.
Determine which of the following signals could have been the original $x(t)$.
Circle all that apply on the answer page.

a) $\cos(25\pi t + \pi/5)$
b) $\cos(50\pi t + \pi/5)$
c) $\cos(150\pi t + \pi/5)$
d) $\cos(200\pi t + \pi/5)$
e) $\cos(350\pi t - \pi/5)$
f) $\cos(450\pi t + \pi/5)$

5. (10 points)

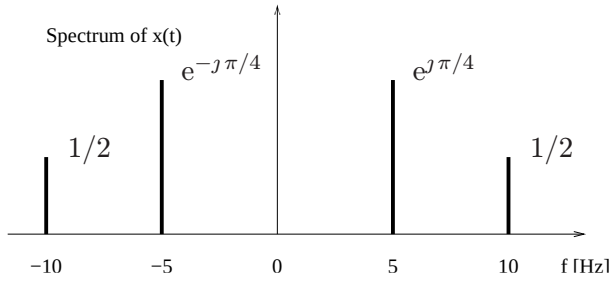


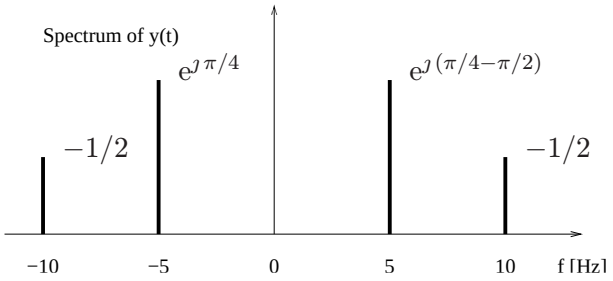
Determine which one of the following continuous-time signals corresponds to the above spectrum.

a) $1 + \cos(3\pi t) + 2\sqrt{2}\cos(9\pi t)$
b) $1 + 2\cos(3\pi t) + \sqrt{2}\cos(9\pi t + \pi/4)$
c) $1 + 2\cos(3\pi t) + \cos(9\pi t)$
d) $1 + 2\cos(6\pi t) + 2\sqrt{2}\cos(18\pi t + \pi/4)$
e) $1 + \cos(6\pi t) + \sqrt{2}\cos(18\pi t - \pi/4)$
f) $1 + \cos(6\pi t) + \sqrt{2}\cos(18\pi t)$

6. (10 points)

The spectra of two continuous-time signals $x(t)$ and $y(t)$ are shown below.





Determine the relationship between $x(t)$ and $y(t)$.

a) $y(t) = x(t - \pi/4)$
b) $y(t) = x(t - \pi/2)$
c) $y(t) = x(-t)$
d) $y(t) = -x(t)$
e) $y(t) = x(t - 1/10)$
f) $y(t) = x(t - 1/20)$

7. (10 points)

An AM radio signal is described by

$$x(t) = [10 + \cos(2\pi 500t)]\cos(2\pi 1200t).$$

If $x(t)$ is periodic, determine its fundamental frequency.

a) $x(t)$ is aperiodic
b) 100 Hz
c) 200 Hz
d) 700 Hz
e) 1000 Hz
f) 1200 Hz

8. (10 points)

The 32-point DFT of a set of time samples of a continuous time signal $x(t)$ is given by the following table of values:

k	0	1	...	12	13	14	15	16	17	18	19	20	...	30	31
$X[k]$	0	0	...	0	0	-$\jmath$/2	0	0	0	$\jmath$/2	0	0	...	0	0

These samples correspond to which of the following?

a) $\sin(2\pi 7000t)$ sampled at 14K samples/sec.
b) $\sin(2\pi 7000t)$ sampled at 16K samples/sec.
c) $\sin(2\pi 7000t)$ sampled at 18K samples/sec.
d) $\sin(2\pi 9000t)$ sampled at 14K samples/sec.
e) $\sin(2\pi 9000t)$ sampled at 16K samples/sec.
f) $\sin(2\pi 9000t)$ sampled at 18K samples/sec.

9. (10 points)

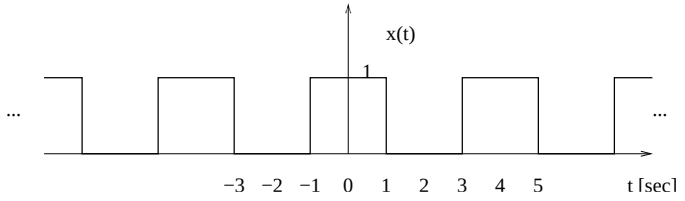
The 2-point DFT of a signal $x[n]$ is $X[k] = \begin{cases} 3/2, & k = 0 \\ 1/2, & k = 1. \end{cases}$

Determine the two signal values: $(x[0], x[1])$.

a) (0,1) b) (0,2) c) (1,1) d) (1,2) e) (2,1) f) (2,2)

10. (10 points)

Let $\{\alpha_k\}$ denote the Fourier series coefficients of the following periodic signal $x(t)$:



Determine $\alpha_5 + \alpha_{-5}$.

a) $\frac{-1}{5\pi}$ b) 0 c) $\frac{1}{\pi k}$ d) $\frac{\sin((\pi/2)k)}{\pi k}$ e) $\frac{2}{5\pi}$ f) $\frac{1}{10\pi}$

Extra credit problem. (Show all work clearly and box your final answer. No partial credit.)

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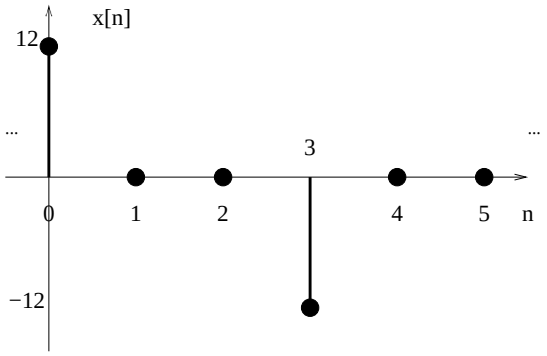
11. (10 points)
A signal $x(t)$ was sampled without aliasing at rate $f_s = 100$Hz to yield the following 6-periodic discrete-time signal $x[n]$:



Find a simple expression for the input signal $x(t)$.

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