Last Name: _____

First 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 1, 2006-2-10
DO NOT TURN THIS PAGE OVER UNTIL TOLD TO BEGIN!

- This is a 50 minute in-class exam.
- It is closed book, closed notes, closed computer.
- You may use one 8.5x11" piece of paper, both sides, and a calculator.
- There are 20 problems for a total of 100 points. The questions are not necessarily in order of increasing difficulty.
- Do not spend too much time on one problem! If trouble, go on to another one. There is no partial credit.
- This exam has 4 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, and do not wait until the end to circle your answers!*
- Clearly circle your final answers on this copy of the exam, not elsewhere.

1. (5 points)
Determine $2\,\mathrm{e}^{\jmath\,\pi/3} + 2\,\mathrm{e}^{-\jmath\,2\pi/3} - 1$.
a) -1 b) 1 c) $1 + 2\sqrt{3}\jmath$ d) $1 - 2\sqrt{3}\jmath$ e) $-1 + 2\sqrt{3}\jmath$ f) $-1 - 2\sqrt{3}\jmath$

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2. (5 points)
Determine $\mathrm{Re}\{2\,\mathrm{e}^{-\jmath\,\pi/6}\,(1 + \jmath\,\sqrt{3})\}$.
a) 0 b) $\sqrt{3}$ c) $-\sqrt{3}$ d) $2\sqrt{3}$ e) $-2\sqrt{3}$ f) 4

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3. (5 points)
Determine x such that $2 = \mathrm{Im}\{(x + \jmath\,\sqrt{3})\,\mathrm{e}^{-\jmath\,\pi/2}\}$.
a) -2 b) 2 c) $\jmath\,2$ d) $-\jmath\,2$ e) $\sqrt{3}/2$ f) $-\sqrt{3}/2$

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4. (5 points)
If $M\,\mathrm{e}^{\jmath\,\phi} = \left(\sqrt{3} - \jmath\right)^{11}$, determine ϕ.
a) $\pi/6$ b) $-\pi/6$ c) $5\pi/6$ d) $-5\pi/6$ e) $11\pi/6$ f) $-11\pi/4$

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5. (5 points)
Determine A such that $3\cos(5t + \pi/2) + \cos(5t - \pi/2) = A\cos(5t + \phi)$, for some constant ϕ.
a) 0 b) 1 c) 2 d) 3 e) 4 f) 5

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6. (5 points)
Determine ϕ such that $\sin(\pi t) + \sin(\pi t + 2\pi/3) = A\cos(\pi t + \phi)$, for some constant A.
a) 0 b) $-\pi/6$ c) $\pi/6$ d) $\pi/3$ e) $-\pi/3$ f) $2\pi/3$

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7. (5 points)
For how many distinct values of A does $\cos(t) + A\cos(t + \pi/7) = 5\cos(t + \pi/4)$.
a) 0 b) 1 c) 2 d) 3 e) 4 f) ∞

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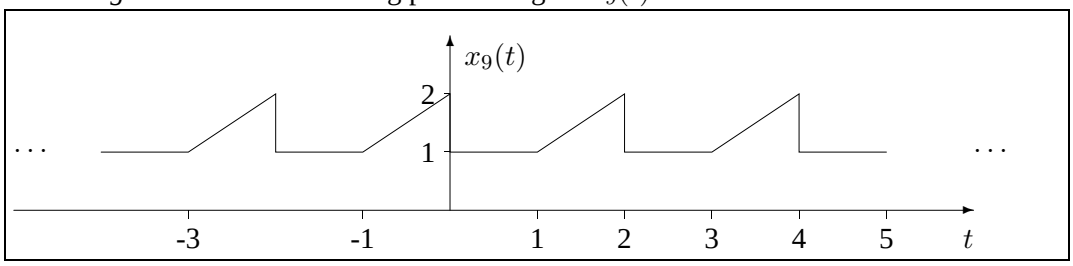
8. (5 points)
Let $x(t) = \sin(3\pi t + \pi/4) + \cos(4\pi t + \pi/5)$ and $y(t) = \cos(2\pi t + \pi/3)$.
Determine the average power of $x(t) + y(t)$.
a) $1/4$ b) $1/2$ c) $3/4$ d) 1 e) $3/2$ f) 3

9. (5 points)
Determine the *average value* of the following periodic signal $x_9(t)$.



a) 1/2 b) 2/3 c) 3/4 d) 4/5 e) 5/4 f) 3/2

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10. (5 points)
Let $y(t) = x_9(3 + t/2)$, where $x_9(t)$ was defined in the figure above. Determine the fundamental period of $y(t)$.
a) 1 b) 2 c) 3 d) 4 e) 6 f) 8

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11. (5 points)
Which of the following values is closest to the average power of the signal $x_9(t)$ defined in the figure above?
a) 0 b) 1/2 c) 1 d) 4 e) 8 f) 16

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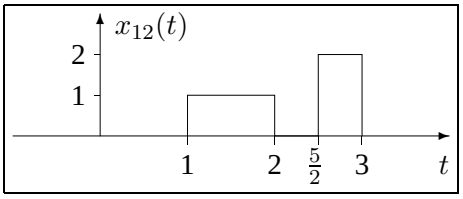
12. (5 points)



Consider the following signal $x_{12}(t)$.
Determine the *support interval* of the signal $x_{12}(1 + t/2)$.
a) [0,4] b) [1,2] c) [1,3] d) [1,5] e) [3/2,5/2] f) [2,4]

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13. (5 points)
Determine the *energy* of the signal $y(t) = x_{12}(t - 2)$, where $x_{12}(t)$ was shown in the previous problem.
a) 1 b) 3/2 c) 2 d) 5/2 e) 3 f) 5

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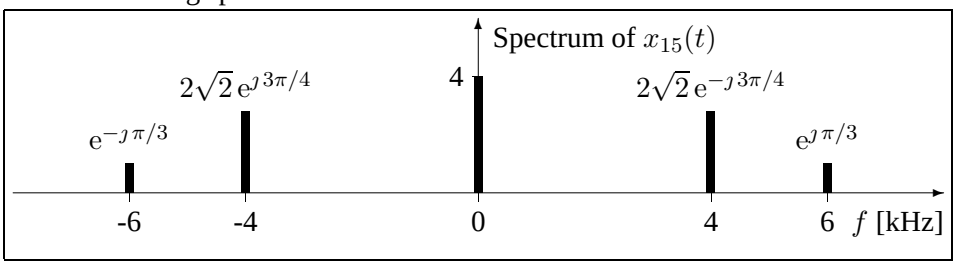
14. (5 points)
Determine the *mean squared value* of the signal $x_{12}(t)$ shown above.
a) 1 b) 3/2 c) 2 d) 5/2 e) 3 f) 5

15. (5 points)
A signal $x_{15}(t)$ has the following spectrum.



Determine the fundamental frequency of $x_{15}(t)$ in kHz.
a) 1/4 b) 1/2 c) 1 d) 2 e) 4 f) Aperiodic

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16. (5 points)
Which of the following values is closest to the RMS value of the signal $x_{15}(t)$ having the spectrum shown above?
a) 0 b) 6 c) 12 d) 18 e) 24 f) 36

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17. (5 points)
The signal $x_{15}(t)$ with spectrum shown above is passed through a filter that rejects all frequencies above 5 kHz. Determine the **mean value** of the output signal.
a) 0 b) 2 c) $2\sqrt{2}$ d) $4\sqrt{2}$ e) 4 f) $4+2\sqrt{2}$

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18. (5 points)
The signal $x_{15}(t)$ with spectrum shown above is passed through a filter that rejects all frequencies above 5 kHz. Call the output signal $y(t)$. Determine the RMS error between the input signal $x_{15}(t)$ and the output signal $y(t)$.
a) 1 b) $\sqrt{2}$ c) 2 d) $2\sqrt{2}$ e) 4 f) $4\sqrt{2}$

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19. (5 points)
The signal $x_{15}(t)$ having the spectrum shown above can be written as a sum of a few signal components. Which of the following answers is *one* of those components?
a) 8
b) $\sqrt{2}\cos(8000\pi t - 3\pi/4)$
c) $2\sqrt{2}\cos(8000\pi t - 3\pi/4)$
d) $2\sqrt{2}\cos(4000\pi t - 3\pi/4)$
e) $4\sqrt{2}\cos(8000\pi t - 3\pi/4)$
f) $4\sqrt{2}\cos(4000\pi t - 3\pi/4)$

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20. (5 points)
For the signal $x(t) = 8\cos^3(100\pi t)$, determine how many lines are in its line spectrum.
a) 1 b) 2 c) 3 d) 4 e) 5 f) 6

end