Fourier Analysis

INSTRUCTIONS: Solve for the requested quantities, showing all work (including defining equations). Use complete sentences to answer essay questions. Box final answers.

1. Define the following terms:

   a) Periodic waveform
   b) Fundamental
   c) Harmonic
   d) Period
   e) Average

2. What is another name for the DC component of a waveform?

3. Define the terms time domain and frequency domain. What is the difference between these two domains?

4. What is a Fourier Series?

5. A certain waveform is described in the time-domain as follows:

   $f(t) = 25\ e^{-25t} \sin(377\ t)$

   Why can't this waveform be expressed as a Fourier Series?

6. For the following sinusoidal waves, state the following information:

   * The fundamental frequency in Hz and Rad/S
   * The period in Seconds
   * The peak value in Volts
   * The RMS or effective value in Volts

   a) $f(t) = 141 \sin (377t)$

   b) $f(t) = 25 \cos(6283t + 20\ )$

   c) $f(t) = .002 \sin(1 \text{ X } 10^6\ t)$

   d) $f(t) = 1000 \sin(50{,}000\ t)$

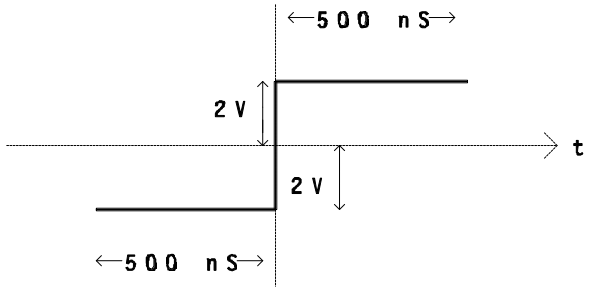
7. What is meant by the term "odd function?" Give an example of one.

8. What is meant by the term "even function?" Give an example.

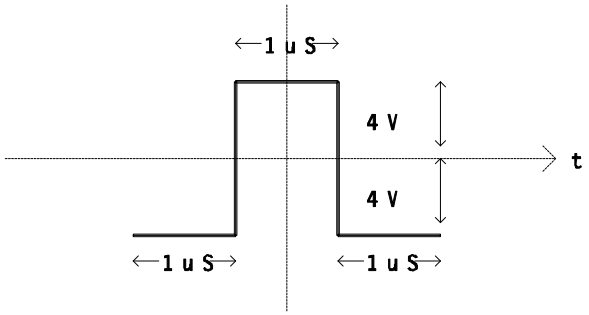
9. What is the difference between and "odd function" and an "odd-numbered harmonic" in a Fourier series?

10. For the waveforms below, determine whether they are odd, even, or asymmetrical functions.

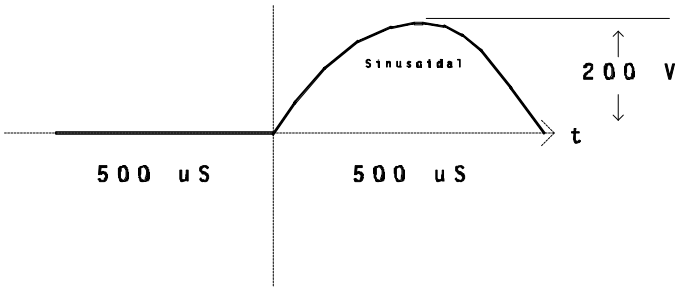
a)



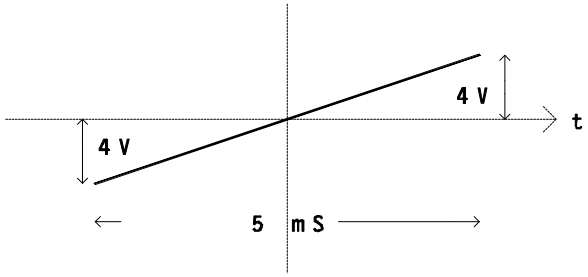
b)



c)



d)



11. For each waveform of problem 10, compute the following:

* a0, the DC level (if found by inspection, state this).
* The period T
* The fundamental frequency f in Hz.
* Whether even harmonics are present or not (half-wave mirror-image symmetry test)

12. For waveform (a) of problem 10, build a table with the following information:

* N - Harmonic Number
* F - Frequency of harmonic N
* B_N - Sine coefficient peak value
* B_N RMS - Sine coefficient RMS value

Provide enough entries to cover up to the 7th harmonic.

Use the "Sine Expansion" formula given on the handout sheet.

(Suggested Table Format)

N	F	B_N PEAK	B_N RMS
1			
2			
3			
...			

13. From the table data of problem 12, sketch a spectrogram for the waveform of 10(a).

14. Sketch a spectrogram for waveforms 10(c) and 10(d) using the expansion formulas given on the handout sheet. The spectrograms should go up to the 7th harmonic.

15. Using the Fourier integral equations, derive the formula for a "sine expansion" of a square wave as shown on the handout sheet [same as waveform 10(a)].

16. Use the Fourier integral equations to solve for the coefficients of waveform 10(d). Show a table like that of problem 12 containing your results, going up to the 7th harmonic.