EE 261 The Fourier Transform and its Applications
## Fall 2004
Midterm Exam

- There are 4 questions for a total of 80 points.

- Please write your answers in the exam booklet provided, and make sure that your answers stand out.

- Don't forget to write your name on your exam book!

1. (10 points) Two signals are plotted below. Without computing the Fourier transforms, determine if one can be the Fourier transform of the other. Explain your reasoning, and give at least two reasons for your conclusion.
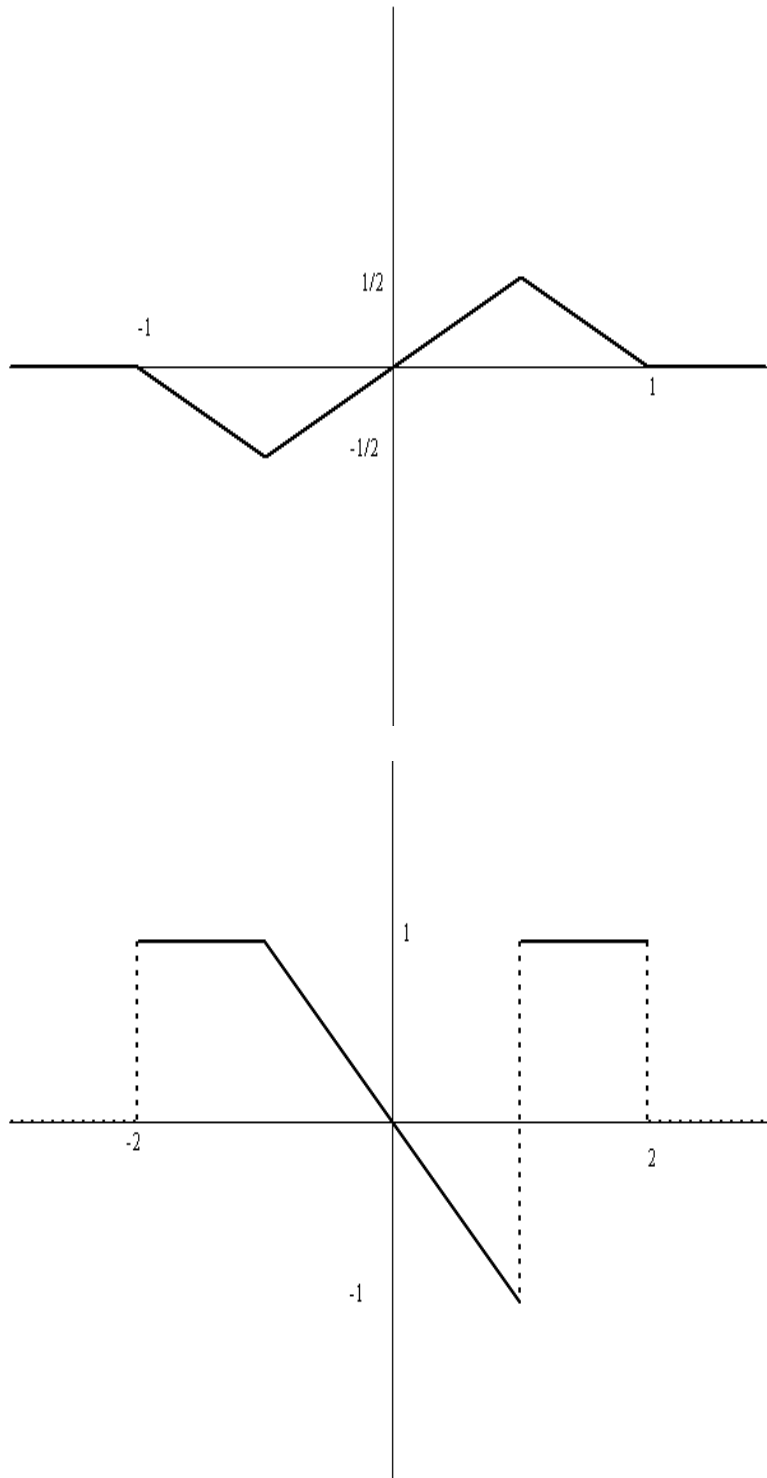
2. (10 points each)

(a) If $f(t) * g(t) = h(t)$ what is $f(t-1) * g(t+1)$?

The next three parts are related.

(b) Show that the following relation holds for any two functions u and v:

$$\int_{-\infty}^{\infty} u(t)v(-t)dt \;=\; \int_{-\infty}^{\infty} \mathcal{F}u(s)\mathcal{F}v(s)ds$$

(c) Using the result derived in the previous part (even if you couldn't derive it), show that the following holds for any two functions f and g:

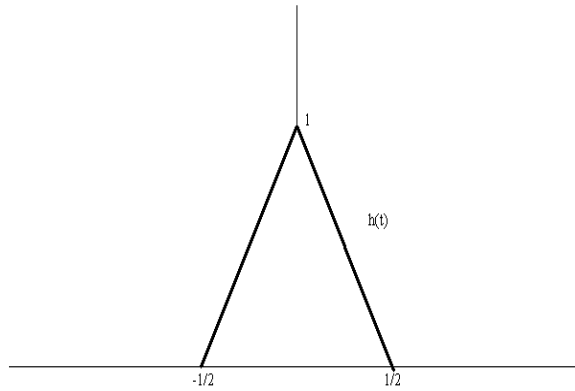$$\int_{-\infty}^{\infty} f(t)\mathcal{F}g(t)dt \;=\; \int_{-\infty}^{\infty} \mathcal{F}f(s)g(s)ds$$

(d) Calculate the following integral:

$$\int_{-\infty}^{\infty} \frac{e^{\pi it}\operatorname{sinc}(t)}{1+4\pi^2 t^2}dt$$

3. (15 points) (a) Find the Fourier coefficients of the signals $f(t)$ and $g(t)$ shown below; assume period 1 for each. (Hint: it should be sufficient to do the calculation for just one of the signals.)

f(t)

1

-1/2   1/2

g(t)

1

-1/2   1/2
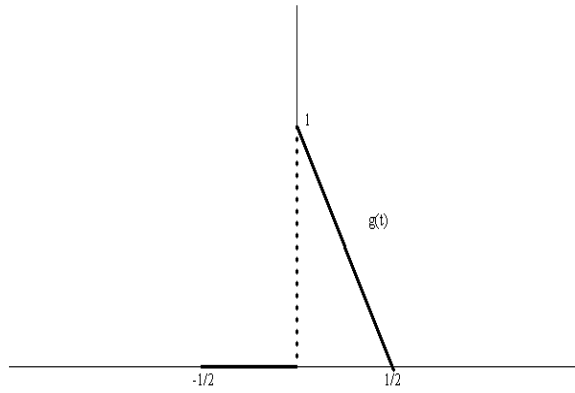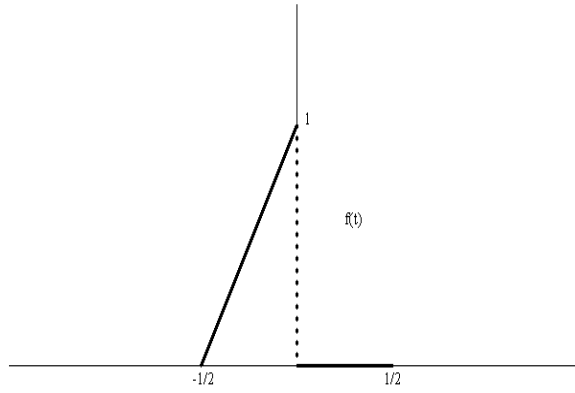
(c) Find the Fourier series for the signal $h(t)$ shown below. Again assume period 1.

h(t)

1

-1/2   1/2

4. (15 points) Sketch the Fourier transform of the periodic cosine pulse shown below. Explain your work.