UNIVERSITY OF VICTORIA

FINAL EXAMINATION, AUGUST 2000

ELEC 260 SIGNAL ANALYSIS I

SECTION K01

INSTRUCTOR: Dr. Lawrence Pitt

TIME: 3 HOURS

TO BE ANSWERED IN BOOKLETS PROVIDED.

WORK ALL 10 QUESTIONS.

STUDENTS MUST COUNT THE NUMBER OF PAGES IN THIS EXAMINATION PAPER BEFORE BEGINNING TO WRITE AND REPORT ANY DISCREPANCIES IMMEDIATELY TO THE INVIGILATOR.

THIS QUESTION PAPER HAS 6 PAGES.

CANDIDATES ARE NOT PERMITTED ANY REFERENCE MATERIAL NOR ARE CALCULATORS PERMITTED.

TOTAL MARKS 58. THE MARKS FOR EACH QUESTION ARE INDICATED IN SQUARE BRACKETS.

ALL STEPS MUSY BE CLEARLY SHOWN

RESULTS HAVE TO BE SIMPLIFIED.

GOOD LUCK

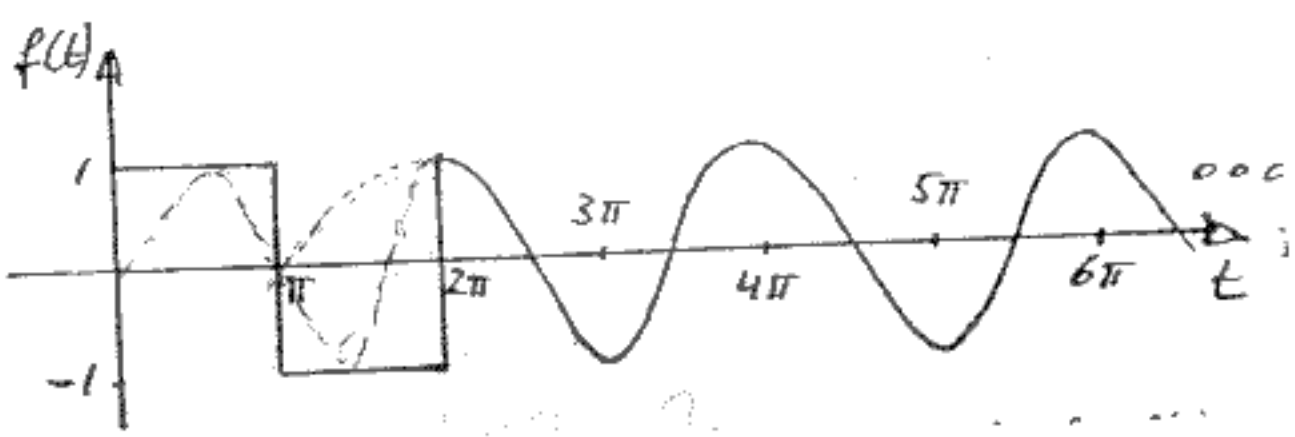
HAVE A GREAT SUMMER (What's left of it!)

Marks

1. [4] a) Write expressions for the magnitude and phase spectrum if the spectral density function is:

$$F(\omega) = \frac{1}{2 + j\omega} - \frac{1}{2 - j\omega}$$

[2] b) Sketch the magnitude and phase spectrum



2. [3] a) Using unit step functions, write an expression for $f(t)$.

[4] b) Find the Laplace transform of $f(t)$.

3. [6] Use partial fractions to find $f(t)$ if:

$$F(s) = \frac{s^2}{(s+2)(s^2+4)}$$

Marks

4. [4] Indicate if the following transfer function meets BIBO conditions of stability. Explain you answer.

$$H(s) = \frac{2s^2 + 6s + 6}{(s+2)(s^2 + 2s + 2)}$$

5. [5] Find the complex Fourier series for $f(t) = t, \quad -\pi < t < \pi$. Assume a period $T = 2\pi$.

6. [6] For the signals (a), (b), (c), (d) on page 4:

(i) indicate which signals are odd, even or neither.

(ii) which signal, if any, has a Fourier series with all coefficients *real* ?

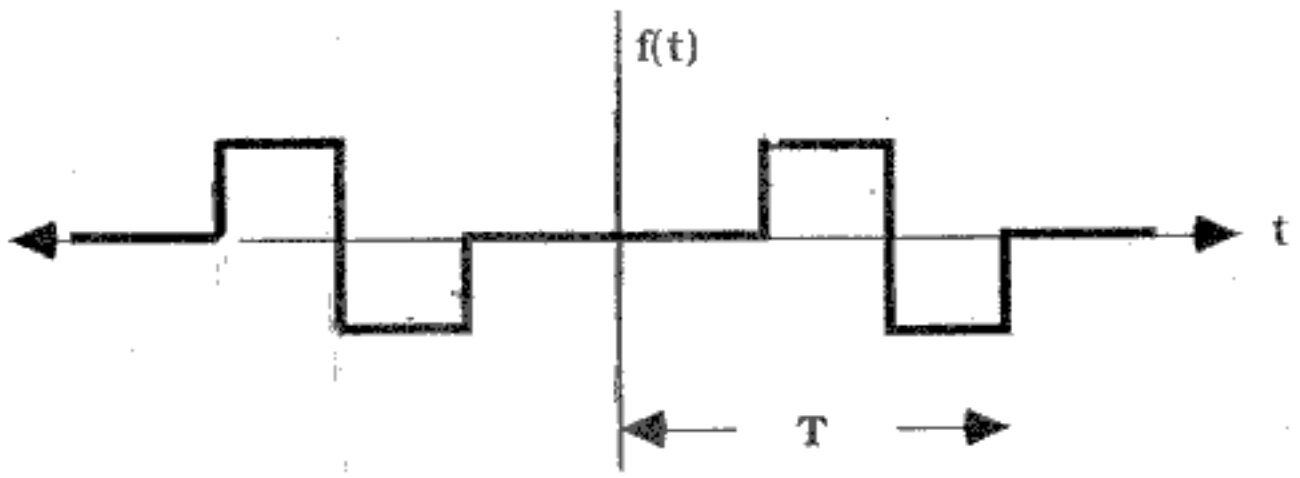
(iii) which signal, if any, has a Fourier series with all coefficients *imaginary* ?

(iv) which signal has a *real* Fourier transform?

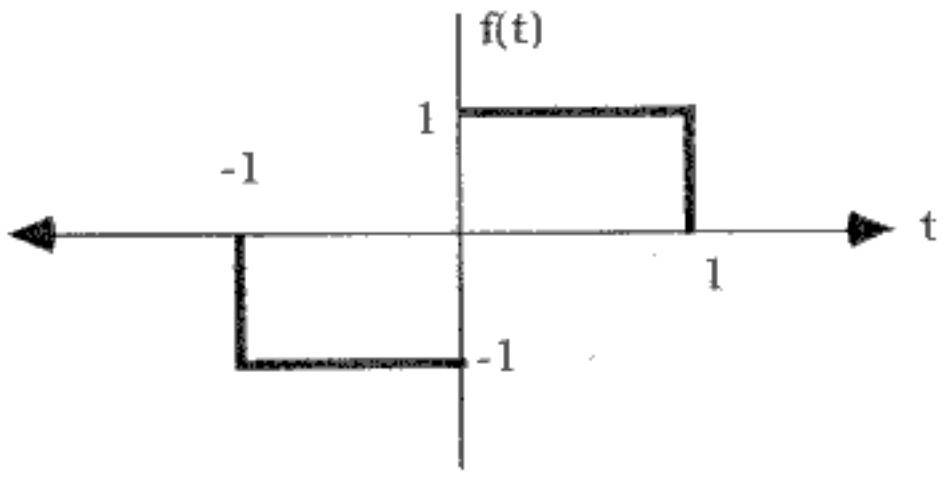
(v) which signal has an *imaginary* Fourier transform?

(vi) which signal, (a) or (c), has a D.C. component?

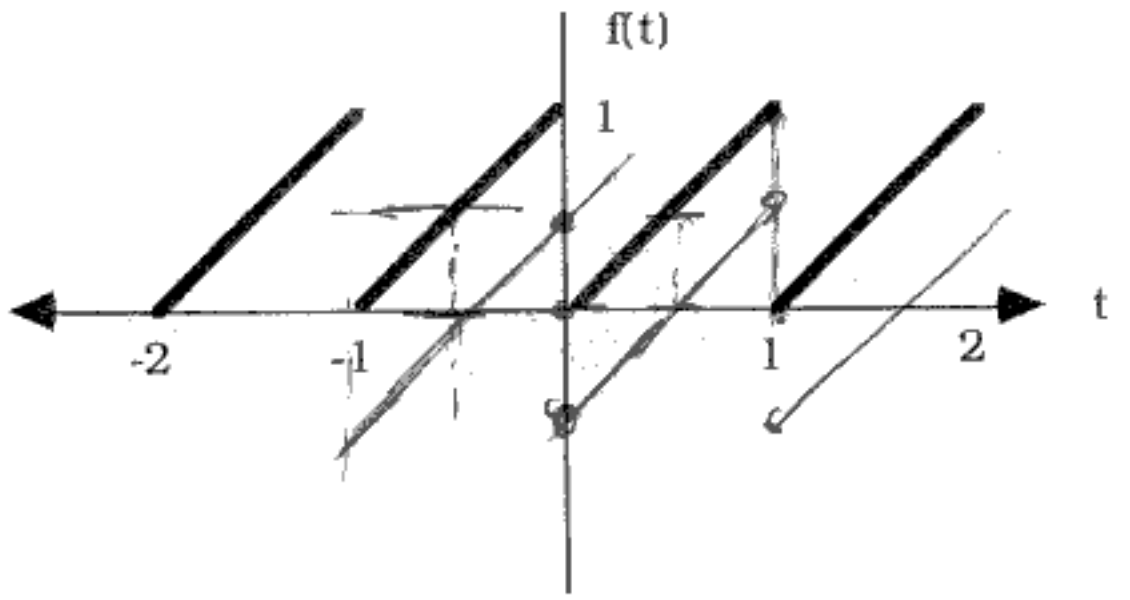
a)



b)



c)



d) $f(t) = \exp(-a|t|)$, a>0

Marks

7. [5] Find the inverse Fourier transform if the amplitude spectrum is:

$$|F(\omega)| = \begin{cases} 1, & -\omega_0 < \omega < +\omega_0 \\ 0, & \text{elsewhere} \end{cases}$$

and the phase spectrum is:

$$\theta(\omega) = \begin{cases} \omega t_0, & -\omega_0 < \omega < +\omega_0 \\ 0, & \text{otherwise} \end{cases}$$

8. [3] a) Sketch the following spectral density function:

$$F(\omega) = \frac{2a}{a^2 + (\omega - \omega_0)^2} - \frac{2a}{a^2 + (\omega + \omega_0)^2}$$

[4] b) Use the modulation property to find the corresponding time domain signal.

9. [4] a) Use convolution in the frequency domain to find the Fourier transform of:

$$f(t) = e^{-a^2 t^2} \sin \omega_0 t$$

[2] b) Sketch the amplitude spectrum.

Marks

10. A transmission cable only transmits signals of relatively low frequency. Thus, higher frequencies are attenuated as a signal passes through the cable. For each of the following pairs of signals, use your knowledge of the frequency content of signals to indicate which signal of the pair would be least distorted if the signals were to be transmitted via the cable. Justify your answers.

[2] a) $f_1(t) = A$

$f_2(t) = \delta(t)$

[2] b) $f_3(t) = u(t + \frac{1}{2}) - u(t - \frac{1}{2})$

$f_4(t) = u(t + 10) - u(t - 10)$

[2] c) $f_5(t) = e^{-3a^2t^2}$

$f_6(t) = e^{-a^2t^2}$

— END —