University of Toronto
Faculty of Applied Science and Engineering

FINAL EXAMINATION

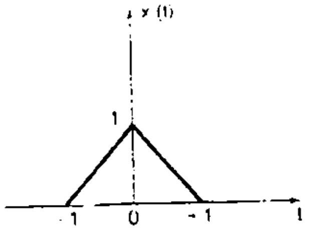
ECE310, Linear Systems & Communications
December 13, 2001, 2:00-4:30 pm
Examiners: R. Adve, I. Blake, D. Hatzinakos, D. Lavers

Exam type A
Non-programmable Calculators are allowed

Solve all four (4) problems.
All problems are equally weighted.

PROBLEM 2. (12.5 marks)

a) Calculate the Fourier transform, $X(j\omega)$, for the signal $x(t)$



b) Sketch the signal (* indicates linear convolution operation)

$$\tilde{x}(t) = x(t) * \sum_{k=-\infty}^{\infty} \delta(t-4k)$$

and find its Fourier Series coefficients.

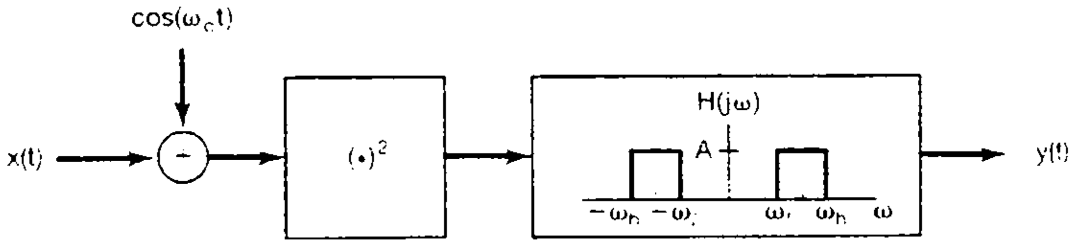
c) Is it possible to find another signal $g(t)$ such that $g(t)$ is not the same as $x(t)$ and

$$\tilde{x}(t) = g(t) * \sum_{k=-\infty}^{\infty} \delta(t-4k) \ ?$$

Explain your answer.

PROBLEM 4 (12.5 marks)

In discussing amplitude modulation systems, modulation and demodulation were carried out though the use of a multiplier. Since multipliers are often difficult to implement, many practical systems use a nonlinear element. The system in the next figure demonstrates this concept. The system consists of squaring the sum of the modulating signal and the carrier signal and then bandpass filtering to obtain the amplitude-modulated signal.



Assume that $x(t)$ is band limited, so that $X(j\omega) = 0, \ |\omega| > \omega_M$. Determine the bandpass filter parameters A, ω_l, ω_h such that $y(t) = x(t)\cos\omega_c t$. Specify the necessary constraints, if any, on ω_c, ω_M.