EEE2035F Class Test

28 April 2006

Name:

Student number:

Information

- The test is closed-book.
- This test has *three* questions, totalling 30 marks.
- There is a bonus question for 5 marks.
- Answer *all* the questions.
- You have 45 minutes.

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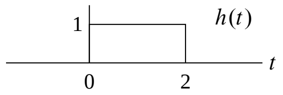
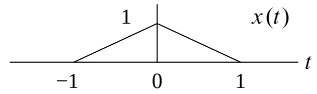
1. (10 marks) A LTI system has an impulse response



Find the response of the system to the input



2. (10 marks) A system is described by the equation

$$y(t) = \int_{-\infty}^{t/3} x(\lambda)d\lambda.$$

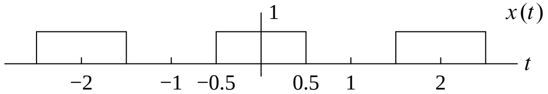
(a) Is the system causal?

(b) Is the system stable?

(c) Is the system time-invariant?

Justify your answer in each case.

3. (10 marks) The signal



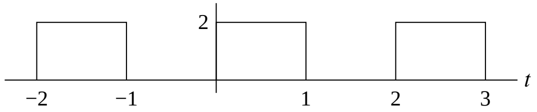
has a Fourier series representation

$$x(t) = \sum_{k=-\infty}^{\infty} c_k e^{jk\pi t},$$

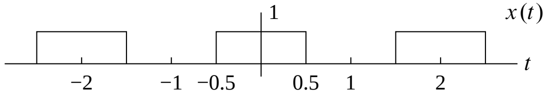
where

$$c_k = \begin{cases} 1/2 & k = 0 \\ \frac{1}{k\pi}\sin(k\pi/2) & \text{otherwise.} \end{cases}$$

Use this information to find a Fourier series expansion for the signal $y(t)$ below:



4. (**Bonus question:** 5 marks) The signal



has a Fourier series representation

$$x(t) = \sum_{k=-\infty}^{\infty} c_k e^{jk\pi t},$$

where

$$c_k = \begin{cases} 1/2 & k = 0 \\ \frac{1}{k\pi}\sin(k\pi/2) & \text{otherwise.} \end{cases}$$

What proportion of the total signal power is contained in the frequency range $|\omega| \leq 3\pi$? Recall that Parseval's theorem states that

$$\frac{1}{T}\int_{-T/2}^{T/2} x^2(t)dt = \sum_{k=-\infty}^{\infty} |c_k|^2.$$