EEE4001F: Digital Signal Processing

Class Test 2

26 April 2007

Name:

Student number:

Information

- The test is closed-book.
- This test has *four* questions, totalling 20 marks.
- Answer *all* the questions.
- You have 45 minutes.

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1. (5 marks) A stable LTI system is characterised by the following z-transform:

$$H(z) = \frac{1 + z^{-2}}{1 + 0.81z^{-2}}$$

   (a) Sketch the magnitude of the frequency response

   (b) Calculate the magnitude and the phase of the frequency response at $1/2$ the sampling frequency.

2. (5 marks) The following signals are defined on the interval $n = 0, \ldots, 7$:

$$x_1[n] = (1/2)^n \qquad x_2[n] = (-1)^n.$$

   (a) Find a closed-form expression for the 8-point DFT of $x_1[n]$.

   (b) Find the 8-point DFT of $x_2[n]$.

   (c) Using above results, compute the 8-point circular convolution $y[n] = x_1[n] \circledN x_2[n]$.

3. (5 marks) Digital audio tape (DAT) drives use a sampling frequency of 48 kHz. Compact disks (CDs) use 44.1 kHz. Explain in detail how you would transfer a recording from a DAT to a CD. Give reasons and quantify any required parameters.

4. (5 marks) Design a length-5 FIR bandpass filter with an antisymmetric impulse response $h[n]$ (i.e. $h[n] = -h[4-n]$ for $0 \leq n \leq 4$) satisfying the following magnitude response:

$$|H(e^{j\pi/4})| = 0.5 \qquad \text{and} \qquad |H(e^{j\pi/2})| = 1.$$

(Hint: calculate $h[n]$ and note that $h[2] = 0$.)