EEE4001F: Digital Signal Processing

Class Test 2

15 May 2006

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) Consider the z-transform

$$G(z) = \frac{(z^2 + 0.2z + 0.1)(z^2 - z + 0.5)}{(z^2 + 0.3z - 0.18)(z^2 - 2z + 4)}.$$

What are the possible regions of convergence for this transform? Discuss the type of inverse z-transform (left-sided, right-sided, two-sided, stable, unstable, etc.) associated with each of the ROCs. It is not necessary to compute the exact inverse transform.

2. (5 marks) Determine the z-transforms of the following sequences and their respective ROCs:

(a) $x_1[n] = \alpha^n u[n-2]$

(b) $x_2[n] = \alpha^n u[-n-3]$.

3. (5 marks) Suppose $X[k]$ is the N-point DFT of $x[n]$. If $x[n]$ is real, what symmetry does this imply on the elements of $X[k]$? Recall that if a is a real number, then $a = a^\star$.

4. (5 marks) Determine an expression for the frequency response $H(e^{j\omega})$ of a causal LTI discrete-time system characterised by the input-output relation

$$y[n] = x[n] + \alpha y[n-R], \qquad |\alpha| < 1,$$

where $x[n]$ is the input and $y[n]$ the output to the system. How many peaks and dips of the magnitude response occur in the range $0 \le \omega < \pi$, and what are their locations?