Exam in Signal analysis and representation, 7.5 credits.
Course code: dt8010
Date: 2010-10-28

Allowed items on the exam:
Tables of Signal processing formulas.
Tables of Mathematical formulas.
Calculator.

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Maximum points: 8.
In order to pass the examination with a grade 3 a minimum of 3.3 points is required.
To get a grade 4 a minimum of 4.9 points is required, and to get a grade 5 a minimum of 6.5 points is required.

Give your answer in a readable way and motivate your assumptions.

Good Luck!

1. (2p)
a) Compute the 16-point DFT of the signal:

$$x(n) = \begin{cases} \frac{1}{8} & 0 \le n \le 7 \\ 0 & 8 \le n \le 15 \end{cases}$$

Present X(k) as: $e^{-jkM} X_{real}(k)$. (1p)

b) Sketch the magnitude function. (1p)

2. (2p)
A causal FIR-system is described by its impulse response:

$$h(n) = -0.5\partial(n) + 0.5\partial(n-2).$$

a) Compute the frequency response function H(ω) of the system.
Present H(ω) as $H(\omega) = H_{real}(\omega)e^{-j\omega M}$ where $H_{real}(\omega)$ is a real function.
Also sketch the magnitude- and phase-function for $-\pi \le \omega \le \pi$. (1p)

b) Compute the response to the input $x(n) = 0.5^n u(n)$. (1p)

3. (2p)
A non-recursive FIR-system is described by the difference equation:

$$y(n) = \frac{1}{5}\sum_{k=0}^{4} x(n-k).$$

a) Determine the recursive system. (0.4p)

b) Determine the system function H(z) and sketch the pole-zero pattern.
From the pole-zero pattern find out if the system is stable. Motivate your answer! (0.8p)

c) Compute the steady state response to the input signal:

$$x(n) = \left[0.35 * \cos(\frac{\pi}{5}(n-2)) + 1.6\right]u(n). \quad \text{(0.8p)}$$

4. (2p)
The system function of a causal system is:

$$H(z) = \frac{1}{1 - \frac{1}{4}z^{-1}}.$$

Compute the output y(n), n ≥ 0 when the input is $x(n) = \left[\cos(\frac{\pi}{3}n)\right]u(n)$ and y(-1)=1. (2p)