EDISP 2007/2008 – Test 1, 27.11.2007 **version A**

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For the short problems, try to write the answer in the provided space. Put your calculations and longer solutions on the reverse or on an additional sheet marked with your name.

1. A DT system is described as follows:

$$T(x[n]) = \sum_{l=-L}^{L} x[n-l]$$

   (a) (2 p.) is T -stable? yes/no: ☐   -linear? yes/no: ☐
       Please present detailed proof.

   (b) (1 p.) find the impulse respone of the system (L=2) ....

2. (2 p.) A periodic signal $x(t)$ with the period of 0.09 ms was sampled with sampling frequency of 10 kHz.

   (a) Calculate normalized frequency f_n and normalized angular frequency θ of $x[n]$.
       Answer: $f_n = $ ☐ , $\theta = $ ☐ . Calculation: ....
       ....

   (b) What is the period of the resulting signal $x[n]$? Answer: ☐ . Calculation: ....
       ....

3. (1 p.) A 1024-point FFT takes 10 ms on a certain computing platform. Calculate approximate time needed for a 4096-point transform. Answer: ☐ . Calculations: ....
   ....

4. (2 p.) Plot an absolute value of a Fourier transform and an 8-point DFT of a signal
   $x(n) = \delta(n) + \delta(n-1)$

5. (1 p.) A signal $x[n]$ consists of two identical impulses of $N = 18$ consecutive nonzero samples. The impulses are spaced by $N = 18$ zero samples. An LTI system is described by an impulse response $h[n]$ that consists of $L = 10$ consecutive nonzero samples. Calculate maximum possible number of nonzero samples in the response of the system $h[n]$ to signal $x[n]$. Answer: ☐ .
   Calculations: ....

6. (1 p.) How many sidelobes has the amplitude of Fourier transform of a rectangular impulse of length 16?
   Answer: ☐ . Calculation: ....

7. (2 p.) An LTI system has known **step response** $k(n)$ (an output signal for an $u(n)$ at the input). Find a response $y(n)$ for a rectangular impulse of length L.
   Answer: ....

$\Sigma = 12p$ $T = 45$ min