EDISP 2013/2013 – Test 1, 3.12.2013 **version A**

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2	
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4	
5	
6	
$\sum$	

Name:_____

For 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 ($a = 0.9$) :

$$T(x[n]) = \sum_{l=0}^{+\infty} a^l x[n-l]$$

   (a) (1 p.) Can the system be analyzed with impulse response? yes/no:[ ] . Verify the conditions formally, present proof on the reverse side.

   (b) (2 p.) If the answer in 1a is yes, verify stability using $h(n)$, else - calculating the B_y. Present calculations on the reverse side. Is the system stable? yes/no:[ ] .

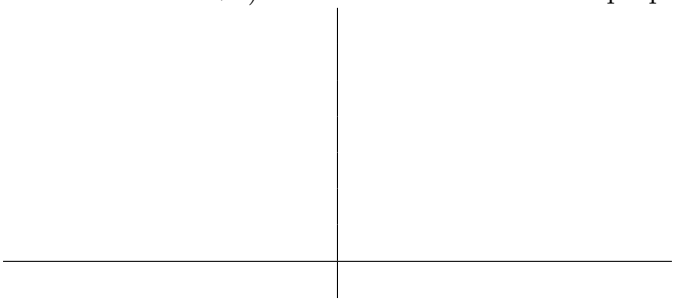
2. (2 p.) A periodic signal $x(t)$ with the period of 9.5 ms was sampled with sampling frequency of 1 kHz.

   (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. (3 p.) Let $x[n]$ be defined as $x(n) = \delta(n-1)+\delta(n+1)$. Plot (on one picture) the amplitude of Fourier transform of $x[n]$ and of the 8 point DFT of $x[n]$ (assume the DFT summation interval from $n = -4$ to $+3$) Mark the horizontal axis apropriately for both cases.



5. (2 p.) A signal $x[n] = \delta(n) + \delta(n-40)$ is applied to the input of an LTI system described by its impulse response $h(n) = u(n) - u(n-5)$. Calculate total number of nonzero samples in the output signal. Answer:[ ].
   Calculations: .....

6. (2 p.) Let $X(k)$ be an N-point DFT of a certain signal $x(n)$ ($x[n]$ nonzero for $n = 0 \ldots N-1$. Calculate an N-point DFT $X_s(k)$ of another signal $x_s(n) = x(n)+x(N-n)$. Assume N is even.
   Answer: .....

$\Sigma = 13p$ $T = 45$ min

EDISP 2013/2013 – Test 1, 3.12.2013 **version B**

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$\sum$	

Name:_____

For 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 ($a = 1.1$) :

$$T(x[n]) = \sum_{l=0}^{+\infty} a^{-l} x[n-l]$$

   (a) (1 p.) Can the system be analyzed with impulse response? yes/no:[ ] . Verify the conditions formally, present proof on the reverse side.

   (b) (2 p.) If the answer in 1a is yes, verify stability using $h(n)$, else - calculating the B_y. Present calculations on the reverse side. Is the system stable? yes/no:[ ] .

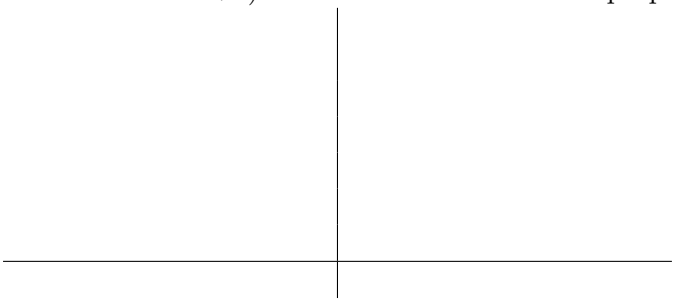
2. (2 p.) A periodic signal $x(t)$ with the period of 4.5 ms was sampled with sampling frequency of 1 kHz.

   (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 256-point transform. Answer:[ ]. Calculations: .....
   .....

4. (3 p.) Let $x[n]$ be defined as $x(n) = \delta(n-1) - \delta(n+1)$. Plot (on one picture) the amplitude of Fourier transform of $x[n]$ and of the 8 point DFT of $x[n]$ (assume the DFT summation interval from $n = -4$ to $+3$) Mark the horizontal axis apropriately for both cases.



5. (2 p.) A signal $x[n] = \delta(n) + \delta(n-30)$ is applied to the input of an LTI system described by its impulse response $h(n) = u(n) - u(n-7)$. Calculate total number of nonzero samples in the output signal. Answer:[ ].
   Calculations: .....

6. (2 p.) Let $X(k)$ be an N-point DFT of a certain signal $x(n)$ ($x[n]$ nonzero for $n = 0 \ldots N-1$. Calculate an N-point DFT $X_s(k)$ of another signal $x_s(n) = x(n) - x(N-n)$. Assume N is even.
   Answer: .....

$\Sigma = 13p$ $T = 45$ min