

NAME and SURNAME (CAPITAL LETTERS):

Signal Processing Test 1 (14.01.2013)

1. A harmonic signal is given $x(t)=\sin(100\pi t)$. What are the values of its physical frequency given in Hz and angular frequency given in rad/s. Compute.
2. Before sampling an analog signal one should:
 - a) remove DC component of a signal
 - b) measure its maximum amplitude
 - c) limit maximum frequency of a signal to a predefined value
 - d) measure its minimum and maximum amplitude
3. You want to sample an EEG signal with a sampling rate of $f_s=500$ Hz you should best use the anti-aliasing filter of a cut-off frequency equal to:
 - a) 100Hz
 - b) 200Hz
 - c) 250Hz
 - d) 500Hz
4. What kind of filter would you use to filter out power-line interference of 50 Hz? Explain in two-three short sentences.
5. Which of the difference equation defines a FIR filter:
 - a) $y(n)=x(n)+y(n-1)$
 - b) $y(n)=x(n)+2y(n-1)$
 - c) $y(n)=x(n)+x(n-10)$
 - d) $y(n)=x(n)+y(n-2)$
6. Plot a block diagram of a causal filter $y(n)=x(n)-2x(n-1)+x(n-3)$
7. Signal to quantization noise ratio for an 8-bit analog to digital (AD) converter is equal to:
 - a) ~12dB
 - b) ~24dB
 - c) ~48dB
 - d) ~60dB

show the calculations:

8. The voltage conversion range of a 10-bit AD converter is [-5 mV, +5 mV]. The quantization step of this converter is:
- a) $\sim 2.45\mu\text{V}$
 - b) $\sim 4.9\mu\text{V}$
 - c) $\sim 9.8\mu\text{V}$
 - d) $\sim 19.5\mu\text{V}$
9. The correlation coefficient is:
- a) a value comparing size of two signals
 - b) a scalar defining statistical similarity of two signals
 - c) a signal being a result of correlation of two signals
 - d) a scalar indicating the maximum value of either of the compared signals
10. Write an equation defining the Discrete Fourier Transform (either in a trigonometric or exponential version) and explain its variables
11. Define two properties of the Fourier transform and explain one of your choice:
12. A signal is sampled at a frequency $f_s=1000\text{Hz}$. How many samples N of a signal we should use in a Discrete Fourier Transform computations to obtain frequency resolution of at least 0.5 Hz? Show the calculations.