DESCRIPTION OF THE COURSES

- Course code: ARR1306
- Course title: **DIGITAL SIGNAL PROCESSING**
- Language of the lecturer: Polish

Course form	***Lecture***	***Classes***	***Laboratory***	***Project***	***Seminar***
*Number of hours/week**	*1*		*2*		
*Number of hours/semester**	*15*		*30*		
Form of the course completion	*Tests*		*reports*		
ECTS credits	*2*		*2*		
Total Student's Workload	*60*		*60*		

- Level of the course (basic/advanced): advanced
- Prerequisites: *Laplace and Fourier transform, Matlab programming.*
- Name, first name and degree of the lecturer/supervisor:

Jacek Rezmer, Ph.D

- Names, first names and degrees of the team's members:

1. *Przemysław Janik Ph.D.*
2. *Zbigniew Leonowicz Ph.D.*
3. *Jerzy Piotrowicz Ph.D.*
4. *Tomasz Sikorski Ph.D.*
5. *Zbigniew Wacławek Ph.D.*

- Year:...III..... Semester:....5.....
- Type of the course (obligatory/optional): obligatory
- Aims of the course (effects of the course):

Understanding and applying issues of digital signal processing, description, analysis digital systems in time and frequency domain, algorithms, project and implementation of simple digital systems. signal processors programming.

- Form of the teaching (traditional/e-learning): traditional
- Course description:

The course contains the basic problems of digital signal processing: discrete-time signals, modeling of discrete-time, sampling theorem, models and equations of discrete-time systems, z-transform, basic properties of z-transform, difference equations, convolution, transfer function, DFT, frequency-domain analysis, digital filters, finite impulse response filters (FIR) structures and design, infinite impulse response filters (IIR) filters design, FFT realization.

- Lecture:

Particular lectures contents	*Number of hours*
1. Introduction, program, bibliography, conditions for course crediting, basic definitions. Discrete-time signals, signals classification, modeling of discrete-time	2

signals, frequency spectrum, aliasing. 2. Discrete-time systems, LTI systems properties, models of systems, difference equations, convolution, impulse response, block diagrams, state space, systems classification. Analog-to-digital conversion, periodic sampling, examples, sampling theorem, sampling of band pass signals.	2
3. The z-transform, introduction, definition of the z-transform, relationship between the z-transform and the Laplace transform, basic properties. The inverse z-transform, methods and examples, partial fraction expansion, contour integration, region of convergence, solved problems.	2
4. Using z-transform, transform analysis of systems, solving difference equations, system function, stability and causality. The discrete Fourier transform (DFT), introduction, definition and properties of the DFT, examples, relationship between the z-transform and the DFT. The inverse discrete Fourier transform (IDFT), overlapping effect, windows methods, and frequency resolution.	2
5. Digital filters, introduction, notations, structures for FIR and IIR systems, the zero-pole method for filter design, filter specifications and classification, examples of filters.	2
6. FIR filters, linear phase FIR design using windows, properties, design procedures, examples IIR filters, introduction, structures for IIR filters, IIR filters design, impulse-invariant transformation, bilinear transformation.	2
7. The Fast Fourier Transform, relationship between the FFT and the DFT, FFT algorithm, introductions, examples, radix-2 decimation-in-time FFT.	1
8. Test	2

- Classes – the contents:
- Seminars – the contents:
- Laboratory – the contents:

Particular laboratory contents	*Number of hours*
1. Introduction, laboratory organization, preparing to exercises, instruction manual for software tool to build programs for TMS.	2
2. Discrete-time signals and systems, analog-to-digital conversion, convolution, aliasing (Matlab).	2
3. Digital signal processor programming, introduction, signals generation, echo application, aliasing (TMS).	2
4. The z-transform, notations, signals and systems analysis in z-transform domain, characteristics, block diagrams (Matlab).	2
5. Signals and systems parameters determining, example of measurements application. (TMS)	2
6. Spectral analysis, parameters of discrete Fourier transform (Matlab).	2
7. Fast Fourier Transform programming, signals analysis in real time (TMS).	2
8. Digital filters, introduction, zero-pole method for filters design, filters comparison (Matlab).	2
9. Communications interface between PC and TMS, example applications (TMS)	2

10. FIR filters, characteristics, filter design using windows method (Matlab).	
11. FIR filters programming and analyzing. (TMS)	2
12. IIR filters, characteristics, filter design using bilinear transformation (Matlab).	2 2
13. IIR filters implementation and analyzing. (TMS)	
14. Practical test	2
15. Supplementary exercises, acceptance of laboratory projects.	2 2

- Project – the contents:
- Basic literature:
  1. A. V. Oppenheim, R. W. Schafer „**Digital Signal Processing**“, Prentice Hall 1975
  2. R. G. Lyons „ **Understanding digital signal processing",** Prentice-Hall 2000.
  3. S. Haykin, B. Van Veen, "**Signals and Systems**" Wiley 1999.
- Additional literature:
  1. G. Marven, G. Ewers „ **A Simple Approach to Digital Signal Processing**" Wiley 1996
  2. R. Gabel, R. Roberts „ **Signals and Linear Systems**" Wiley 1973
  3. K. Steiglitz „ **An Introduction to Discrete Systems**" Wiley 1973
- Conditions of the course acceptance/credition: Written tests. Positive passed laboratory reports, practical test.

***** - depending on a system of studies