DESCRIPTION OF THE COURSES

- Course code: ***ELR1315***
- Course title: ***Signal and Systems***
- Language of the lecturer: *English*

Course form	***Lecture***	***Classes***	***Laboratory***	***Project***	***Seminar***
*Number of hours/week**	*2*	*1*			
*Number of hours/semester**	*30*	*15*			
Form of the course completion	*Test*	*Test*			
ECTS credits	***3***	***2***			
Total Student's Workload	***90***	***60***			

- Level of the course (basic/advanced): ***Advanced***
- Prerequisites: ***Mathematics, Linear Algebra, Basic Circuit Theory***
- Name, first name and degree of the lecturer/supervisor: ***Tomasz Sikorski, PhD***
- Names, first names and degrees of the team's members: ***Leonowicz Zbigniew, PhD***

  Jacek Rezmer, PhD

  Piotr Ruczewski, PhD

- Year:.....***2***..... Semester:.....***III***.....
- Type of the course (obligatory/optional): ***Optional***
- Aims of the course (effects of the course):
  Effect of the course: generalization of electrical circuit using system approach, characteristic of systems in time, operator and frequency domain, state variable method. The ability to determine stability of the system. Digital simulation of analog systems, signal flow graphs, block diagrams, transfer function, Z-transform. Some aspects of digital filters synthesis.
- Form of the teaching (traditional/e-learning): ***Traditional***
- Course description:
  The course provides crucial aspects of signal transmission process through Linear Stationary Systems. Firstly, description of signals and systems in time domain are introduced, taking special consideration into Duhamel integral and significance of convolution and distributions. Further lectures aim to introduce operator domain and frequency domain. Provided definitions of Laplace and Fourier transform leads to description of signals and systems in booth domains, simultanously. Introduced transfer function develops stability of LSS systems. Next topics concerns introduction to digital domain with difference equations, signal flow graphs and block diagrams. Defined two sided Z-transform serves as a tool for analysis of digital systems, especially on the basis of poles and zeros of transfer function. Some aspects of synthesis of digital filters are also introduced.
- Lecture:

Particular lectures contents	*Number of hours*

1. Description of signals and systems in time domain. Duhamel integral and significance of convolution and distributions.	2h
2. Two-sided Laplace Transform. Regions of convergence. Inverse Laplace transform - Riemann - Mellin equation. Properties of the transform. Form of operator transmittance for LSS systems.	3h
3. Two-sided Fourier transform in normal and wide sense. Inverse Fourier Transform. Two sided Laplace'a transform vs. two sided Fourier transform. Properties of the transform. Form of spectrum transmittance for LSS systems.	3h
4. Description of analog systems by state variables. Methods for solving state equations systems. Multi dimensional systems. Transfer function matrix.	4h
5. Reasonability. Hilbert's equations. Minima phase systems. Realization of systems - Paley – Wiener law. Stability of LSS systems- criteria of stability.	2h
6. Impulse and digital signal. Elements of equations for digital systems. Difference equations solutions. Signal flow graphs and block diagrams.	2h
7. Recursive and non recursive equations – transient state and stabile state of difference equations solutions. Stabile state of solutions.	2h
8. Two-sided *Z*-transform. Coherences between Fourier, Laplace and *Z*-transform. Region of convergence.	2h
9. Sampling Theorem. Spectrum of digital signal. Discrete convolution.	2h
10. Digital simulation of analog systems. Method of non-changeable impulse response.	2h
11. Digital simulation of analog systems. Methods based on transfer function of digital systems. Poles and zeros of transfer function.	2h
12. Digital systems description by state variables equations. Solving of differential equations using state variables.	2h
13. Synthesis of digital systems. Digital filters. Chosen design methods of digital filters with FIR and IIR.	2h

- Classes – the contents:

1. LSS system response calculation in time, operator and frequency domain.
2. Transfer functions. Stability of LSS.
3. Recursive and non recursive equations - signal flow graphs and block diagrams.
4. Z-transform. Region of convergence. Relations to Laplace transform.
5. Digital simulation of analogue systems. Poles and zeros of transfer function
6. Properties of digital systems. Characteristics of digital filters.
7. Synthesis of digital systems. Digital filters.

- Basic literature:

[1] S. Haykin, B. Van Veen – ***Signals and systems***, John Wiley & Sons, Inc., 1999.
[2] S T.H. Glisson – ***Introduction to system analysis***, McGraw-Hill, Inc, 1985.
[3] G. E. Carlson – ***Signal and linear system analysis***, John Wiley & Sons, Inc., 1998.
[4] Ch.T. Chen – ***System and signal analysis***, Oxford University Press, 1994..

- Additional literature:

[1] A. D. Poularikas - ***The handbook of formulas and tables for signal processing***, CRC Press, 2000.
[2] S. K. Mitra, J. F. Kaiser – ***Digital signal processing***, John Wiley & Sons, Inc., 1993.
[3] W. L. Chen - ***The circuits and filters handbook***, CRC Press, 1995.

- Conditions of the course acceptance/credition: ***Passed test in classes***

Passed test in lectures

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