(*faculty stamp*)

COURSE DESCRIPTION

1. Course title: FUNDAMENTALS OF SIGNAL PROCESSING	**2. Course code**
3. Validity of course description: 2016/2017	
4. Level of studies: 1st cycle of higher education	
5. Mode of studies: intramural studies	
6. Field of study: AUTOMATIC CONTROL AND ROBOTICS, ELECTRONICS, TELECOMMUNICATION AND INFORMATICS	RAU
7. Profile of studies: general	
8. Programme: n/a	
9. Semester: 5	
10. Faculty teaching the course: Faculty of Automatic Control, Electronics and Computer Science	
11. Course instructor: Katarzyna Moscinska, PhD	
12. Course classification: common courses	
13. Course status: compulsory	
14. Language of instruction: English	
15. Pre-requisite qualifications: Algebra, Calculus, Circuit Theory. Course attendants should possess satisfactory knowledge of the following issues: complex numbers, derivatives and integrals, AC circuits, frequency description of systems. Students are supposed to possess basic computer programming skills.	
16. Course objectives: The goal of the course is to make students acquainted with various methods of signals and systems representation. Course participants become familiar with fundamental methods of analog and digital signal processing. The course serves as foundation to more specialized courses, like digital signal processing and analog circuit design.	

17. Description of learning outcomes:

Nr	Learning outcomes description	Method of assessment	Teaching methods	Learning outcomes reference code
W1	Knows various methods of signal and analog system description in time and frequency domain	short test, assessment test	lecture	K_W5
W2	Knows various methods of discrete systems description	short test, assessment test	lecture	K_W5, K_W13
U1	Can apply basic theorems for signal processing	short test, assessment test	lecture	K_U13
U2	Knows how to calculate basic parameters of the signal	laboratory exercise	laboratory	K_U13
U3	Can analyze properties of selected signal processing systems	laboratory exercise	laboratory	K_U9, K_U13
U4	Knows how to apply LabVIEW environment for signal processing	laboratory exercise	laboratory	K_U20

18. Teaching modes and hours

Lecture 30 / **BA /MA Seminar / Class / Project / Laboratory** 30

19. Syllabus description:

Lecture:

1. Introduction to signal processing: definition of signal, signal properties, some special signals of interest.
2. Periodic signals: orthogonality. Parseval's theorem. Trigonometric Fourier series. Periodic signals in linear, shift invariant systems. Equivalent forms of Fourier series. Discrete spectrum.

3. Frequency representation of aperiodic signals. Power and energy signals. Fourier transform: definition, properties.
4. Signal modulation: amplitude and frequency modulation – basic terms, description in time and frequency domain. Bandwidth and efficiency. Realization of modulation/demodulation.
5. Ideal and realizable filters. Relation of frequency characteristic to impulse response. Sampling and its implication: ideal sampling in the time and frequency domain. Shannon's theorem. Aliasing.
6. Discrete –time description of signals and systems: basic sequences, linear – time invariant systems, convolution, causality criterion.
7. Fourier transform of discrete – time signals: definition, properties, use in signal processing.
8. Z transform: definition, region of convergence, properties. System function of a digital filter.
9. Representation of a digital circuit: difference equation, block diagram, system function, pole – zero pattern.
10. DFT and FFT. Definition and properties of DFT. Linear vs circular convolution. Linear convolution with DFT. FFT decimation-in-time algorithm.

Laboratory:

1. Basic operations on signals.
2. Transfer function of a filter.
3. Fourier Transform.
4. Measurement of signal spectrum.
5. Individual task – Fourier series expansion and reconstruction.
6. Rectifiers and amplitude modulation.
7. Pulse amplitude modulation.
8. Signal generation and convolution.
9. Z Transform and system function H(z)
10. Discrete Fourier Transform

20. Examination: assessment test

21. Primary sources:

1. Oppenheim A.V., Willsky A.S., *Signals and Systems*, Prentice-Hall, 1997
2. Lyons R. G., *Understanding Digital Signal Processing*, Addison-Wesley, 1997.

22. Secondary sources:

1. Kraniauskas P., *Transforms in Signals and Systems*, Addison-Wesley, 1992.
2. Oppenheim A.V., Schafer R.W., *Digital Signal Processing*, Prentice-Hall, 1975.
3. Kuc R., *Introduction to Digital Signal Processing*, McGraw-Hill, 1988.

23. Total workload required to achieve learning outcomes

Nr	Teaching mode :	Contact hours / Student workload hours
1	Lecture	30/5
2	Classes	/
3	Laboratory	30/40
4	Project	/
5	BA/ MA Seminar	/
6	Other	5/15
	Total number of hours	65/60

24. Total hours:125

25. Number of ECTS credits: 5

26. Number of ECTS credits allocated for contact hours: 3

27. Number of ECTS credits allocated for in-practice hours (laboratory classes, projects): 3

26. Comments:

Approved:

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(date, Instructor's signature)

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(*date , the Director of the Faculty Unit signature)*