(*faculty stamp*)

COURSE DESCRIPTION

1. Course title: ELECTRONICS AND MEASUREMENTS	**2. Course code EiM**
3. Validity of course description: 2018/2019	
4. Level of studies:BSc programme	
5. Mode of studies: intramural studies	
6. Field of study: COMPUTER SCIENCE	(AEI)
7. Profile of studies: general academic	
8. Programme:	
9. Semester: 2, 3	
10. Faculty teaching the course: FACULTY OF AUTOMATIC CONTROL, ELECTRONICS AND COMPUTER SCIENCE, Institute of Electronics	
11. Course instructor: Zdzisław Filus, PhD, DSc, professor of SUT	
12. Course classification: common subjects	
13. Course status: compulsory	
14. Language of instruction: English	
15. Pre-requisite qualifications: Course attendants have to possess basic knowledge in calculus, algebra, physics and circuit theory	
16. Course objectives: The objective of the course is to make students familiar with the most important features of basic semiconductor devices and with the principles of operation of the elementary circuits realized with the use of such components, to make them acquire principles of measurement of basic electrical quantities and understand links between computer science and electronics.	

17. Description of learning outcomes:

Nr	Learning outcomes description	Method of assessment	Teaching methods	Learning outcomes reference code
1.	The student will know principles of operation, parameters and characteristics of basic semiconductor devices	examination	lecture	K1A_W03, K1A_W05
2.	The student will know structures and principles of operation of basic analog electronic circuits	examination	lecture	K1A_W07
3.	The student will know simple methods of description and analysis of analog linear and nonlinear DC circuits and basic small-signal amplifiers	examination	lecture	K1A_W06
4.	The student will know the principles of measurement of voltage and current, circuits for digital measurement of time and frequency and basic structures and features of digital-to-analog and analog-to-digital converters	examination	lecture	K1A_W04 K1A_W07
5.	The student will be able to use the learnt methods and mathematical models in the DC analysis of elementary, linear and nonlinear, analog electronic circuits	tests, examination	class	K1A_U08, K1A_U13
6.	The student will be able to use the learnt methods and small-signal mathematical models for the determination of characteristic parameters of simple linear electronic circuits	tests, examination	class	K1A_U12

7.	The student will be able to use properly chosen methods and equipment for measurement of parameters and electrical characteristics of analog electronic circuits	laboratory exercises, tests	laboratory	K1A_U13
8.	The student will be able to elaborate documentation including a discussion on the results of a realized laboratory exercise	laboratory reports	laboratory	K1A_U03
9.	The student will be able to work in a team and take responsibility for a jointly realized task	laboratory exercises and reports	laboratory	K1A_K02

18. Teaching modes and hours

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

Sem 2 - Lecture 30 h, Class 15 h, Sem 3 – Laboratory 30 h

19. Syllabus description:

Lecture

Passive components RLC, their description in the time and frequency domain and basic features. Logarithmic scale. Frequency responses of the low-pass RC and high-pass CR filters. Intrinsic and extrinsic semiconductors. Principle of operation and basic features of the p-n junction. Various types of semiconductor diodes: Zener diode, capacitance diode and Schottky diode. Basic rectifier circuits. Simple voltage regulator with a Zener diode. Bipolar transistor: principle of operation, basic parameters and static characteristics, DC models for various modes of operation. Biasing circuits for bipolar transistors. Small-signal equivalent circuits. CE, CB, CC amplifiers. Current sources. Unipolar transistors JFET and MOSFET: principle of operation, basic parameters and static characteristics. Biasing circuits for unipolar transistors. Small-signal-equivalent circuit. CS, CG, CD amplifiers. Applications of unipolar transistors: current sources, voltage controlled resistance, switches, CMOS circuits. Optoelectronic devices: LED, photoresistor, photodiode, phototransistor, optocoupler. Basic theory of feedback. Influence of negative feedback on gain stability and bandwidth of an amplifier. Power amplifiers: division into classes, efficiency, distortions. Integrated operational amplifier: ideal versus real amplifier.Basic applications of the operational amplifier: inverting amplifier, noninverting amplifier, summing amplifier, subtracting amplifier, integrator, differentiator, 1st order low-pass filter, voltage-controlled current source. Analog comparators. Principles of measurement of basic electrical quantities. Digital measurement of time and frequency. Basic methods of analog-to-digital and digital-to-analog conversion.

Class

Real and ideal operational amplifier - comparison. Basic configuration of the operational amplifier and their parameters. Analysis of linear circuits with ideal operational amplifiers. Frequency response of circuits with operational amplifiers. Response of a circuit to a given excitation. Operational amplifiers in nonlinear applications. Analysis of operation of a nonsinusoidal generator based on an operational amplifier.

Bipolar transistor – principle of operation, DC equivalent circuits. Basic methods of biasing of bipolar transistors. Method of biasing and stability of the quiescent point. DC analysis of circuits with bipolar transistors.

Small-signal analysis – idea, creation of the equivalent circuit diagram of a circuit, small-signal model of the bipolar transistor („h" and „y"). Determination of basic small-signal parameters of amplifiers (voltage gain, input and output resistance). Frequency response of transistor amplifiers.

Laboratory

1. Semiconductor diodes
2. Bipolar transistor (CE)
3. Unipolar transistor
4. Semiconductor optoelectronic devices
5. Rectifier circuits
6. Sinewave oscillators
7. Transistor power amplifier
8. Nonsinusoidal generators
9. Linear voltage regulators
10. Measurement of parameters of operational amplifiers

20. Examination: semester 3 (problems and theory in a written form)

21. Primary sources:

Horowitz P., Hill W.: Art of Electronics. Cambridge University Press, 2015
Ciążyński W. E.: Elektronika analogowa w zadaniach, t.1, 3. 4. Wydawnictwo Politechniki Śląskiej, Gliwice 2009-2010
Laboratorium elektroniki I: Elementy półprzewodnikowe i układy podstawowe. Praca zbiorowa pod red. Krzysztofa Zioło; Wydawnictwo Politechniki Śląskiej, skrypt nr 2322, Gliwice 2003
Laboratorium elektroniki II: Podstawowe układy analogowe, impulsowe i cyfrowe. Praca zbiorowa pod red. Krzysztofa Zioło; Wydawnictwo Politechniki Śląskiej, skrypt nr 2323, Gliwice 2003

22. Secondary sources:

Tietze U. Schenk Ch.: Semiconductor Circuits. Springer, 2006
Filipkowski A.: Układy elektroniczne analogowe i cyfrowe. WNT, Warszawa 2006
Chwaleba A., Moeschke B., Płoszajski G.: Elektronika. WSiP, Warszawa 2008

23. Total workload required to achieve learning outcomes

Lp.	Teaching mode :	Contact hours / Student workload hours
1	Lecture	45/15
2	Classes	15/15
3	Laboratory	30/30
4	Project	/
5	BA/ MA Seminar	/
6	Other	10/40
	Total number of hours	100/100

24. Total hours:200

25. Number of ECTS credits: 7

26. Number of ECTS credits allocated for contact hours: 5

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