

FACULTY OF ELECTRICAL  
ENGINEERING**SUBJECT CARD**

Name in Polish: **Czujniki i przetworniki**  
 Name in English: **Sensors and Transducers**  
 Main field of study (if applicable): **Electrical Engineering**  
 Specialization (if applicable):  
 Level and form of studies: **1st level, full-time**  
 Kind of subject: **optional**  
 Subject code: **ELR051205**  
 Group of courses: **NO**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU):	15		15		
Number of hours of total student workload (CNPS):	30		30		
Form of crediting:	crediting with grade		crediting with grade		
For group of courses mark (X) final course:					
Number of ECTS points:	1		1		
including number of ECTS points for practical (P) classes :			1		
including number of ECTS points for direct teacher-student contact (BK) classes:	0.70		0.70		

**PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES**

1. Has knowledge of basics of physics and electronics.
2. Knows basic of electrical metrology.
3. Ability to use basic electrical measurement devices

**SUBJECT OBJECTIVES**

- C1. Learn physical basics of sensors and converters.  
 C2. Learn most important parameters of sensors and converters, which influence their work.  
 C3. Ability to use sensors and converters. in measurement systems.

**SUBJECT LEARNING OUTCOMES***relating to knowledge:*

- PEU\_W01 Is able to describe basic laws, construction, and properties of sensors and converters.  
 PEU\_W02 Is able to describe application of sensors and converters in various physical quantities measurements and measurement systems  
 PEU\_W03 Is able to select sensors and converters for certain applications.

*relating to skills:*

- PEU\_U01 Has ability to perform measurements with sensors and converters.  
 PEU\_U03 Is able to design and make measurement system with sensors and converters and evaluate processing errors.

*relating to social competences:*

- PEU\_K01 Is aware of responsibility for own work and is ready to subordinate the rules of team work.

## PROGRAMME CONTENT

Form of classes - lecture		Number of hours:
Lec 1	Information about the subject, requirements educational effects and grading system. Classification of sensors and converters and their role in measurement chain.	2
Lec 2	Static and dynamic parameters of sensors and converters. Temperature sensors: resistive, diodes, capacitive.	2
Lec 3	Thermoelectric temperature sensors, optical fiber and pyrometric sensors, thermographic cameras.	2
Lec 4	Mechanical quantities sensors: inductive, tensometric and other. Gas sensors. Humidity and pH sensors.	2
Lec 5	Analogue converters, and their tasks in measurement systems. Measurement amplifiers, I/V and V/I converters. Standardizing, differential, integrative converters.	2
Lec 6	Mean, RMS, peak, sample and hold converters, phase-sensitive rectifiers.	2
Lec 7	Multiplying converters, halotrones, power converters. Multiplying converters, halotrones, power converters.	2
Lec 8	Test	1
Total hours:		<b>15</b>

Form of classes - laboratory		Number of hours:
Lab 1	Introduction, discussion of the form, course of the classes and grading, division into groups, health and safety training.	2
Lab 2	Investigation of measurement amplifiers properties.	2
Lab 3	Sensors in measurements of mechanical strain and pressure and their signal processing.	2
Lab 4	Investigation of temperature sensors properties.	2
Lab 5	Investigation of U/f and A/D converters properties.	2
Lab 6	Sensors in measurements of displacement and fluid level and their signal processing.	2
Lab 7	Repetition classes	2
Lab 8	Final evaluation classes	1
Total hours:		<b>15</b>

## TEACHING TOOLS USED

- N1. Lecture of problem.  
 N2. Lecture with use of audio-visual technique and multimedia presentation.  
 N3. Measurement laboratory realized in traditional students groups.

## EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

Evaluation <i>F – forming (during semester) P – concluding (at semester end)</i>	Educational effect number	Way of evaluating educational effect achievement
F1(W)	PEU_W01 PEU_W02 PEU_W03 PEU_K01	Written test.
P(W)	P=F1	
F1(L)	PEU_U01 PEU_U02 PEU_U03 PEU_K01	Preparation to the classes
F2(L)	PEU_U01 PEU_U02 PEU_U03 PEU_K01	Activity during classes.
F3(L)	PEU_U01 PEU_U02 PEU_U03 PEU_K01	Reports from classes.
P(L)	P=0,4*F1+0,3F2+0,3*F3	

<b>PRIMARY AND SECONDARY LITERATURE</b>
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<b>PRIMARY LITERATURE:</b>
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| <ul style="list-style-type: none"><li>[1] Walt Kester, Przetworniki A/C i C/A: teoria i praktyka, Wydawnictwo BTC, Legionowo 2012.</li><li>[2] Lisowski Michał Podstawy metrologii, Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2011.</li><li>[3] Nawrocki Zdzisław, Wzmacniacze operacyjne i przetworniki pomiarowe, Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2008.</li><li>[4] Sławomir Tumański, Technika pomiarowa, Warszawa WNT 2007,</li><li>[5] Nawrocki, Waldemar, Sensory i systemy pomiarowe, Wyd. Politechniki Poznańskiej, Poznań 2001</li><li>[6] Miłek Marian, Metrologia elektryczna wielkości nieelektrycznych, Oficyna wydawnicza Uniwersytetu Zielonogórskiego, Zielona Góra 2006</li><li>[7] Gajek Andrzej, Juda Zdzisław, Czujniki, WKŁ, Warszawa 2011</li><li>[8] Kaczmarek Zdzisław, Światłowodowe czujniki i przetworniki pomiarowe, Agenda wydawnicza PAK, Warszawa 2006</li></ul> |
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<b>SECONDARY LITERATURE:</b>
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| <ul style="list-style-type: none"><li>[1] Patrick F. Dunn, Fundamentals of sensors for engineering and science, Boca Raton CRC/Taylor &amp; Francis, 2011</li><li>[2] Gardner J. W.: Microsensors. Principles and applications. John Wiley and Sons. Chichester, 1995.</li><li>[3] Wagner E. i inni: Sensors. A comprehensive survey. Vol. 6. Optical sensors. VCH Weinheim 1992.</li><li>[4] Ohba R. i inni: Intelligent sensor technology. John Wiley and sons, Chichester 1992.</li><li>Fraden J.: AIP hadbook of modern sensors. Physics, designs and applications. AIP, New York 1993.</li><li>[5] Ryłski A.: Sensory i przetworniki wielkości nieelektrycznych. Skrypt Pol. Rzeszowskiej, 1994</li><li>[6] Vetelino J., Reghu A., Introduction to sensors, Boca Raton : CRC Press/Taylor and Francis Group, 2011.</li><li>[7] Fraden J., Handbook of modern sensors: physics, designs, and applications, New York [etc.] Springer, 2010.</li></ul> |
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<b>SUBJECT SUPERVISOR</b>
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