

FACULTY OF ELECTRICAL  
ENGINEERING**SUBJECT CARD**

Name in Polish: **Pomiary przemysłowe**  
 Name in English: **Industrial Measurement**  
 Main field of study (if applicable): **Control Engineering and Robotics**  
 Specialization (if applicable):  
 Level and form of studies: **1st level, full-time**  
 Kind of subject: **obligatory**  
 Subject code: **ARR043305**  
 Group of courses: **NO**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU):	30		30		
Number of hours of total student workload (CNPS):	90		60		
Form of crediting:	examination		crediting with grade		
For group of courses mark (X) final course:					
Number of ECTS points:	3		2		
including number of ECTS points for practical (P) classes :			2		
including number of ECTS points for direct teacher-student contact (BK) classes:	2.10		1.40		

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

1. He has basic knowledge in the field of linear circuits with sinusoidal signal. He knows the rules of the modeling of electrical circuits and their mathematical description
2. He or she has basic knowledge of metrology
3. He has basic knowledge of the dynamic properties of sensors and transducers. Know and understand the method of calculation of basic electrical value
4. He is Able to do basic measurements of electrical devices using analog and digital oscilloscope
5. He can take measurements of static and dynamic characteristics of sensors and transducers, and is able to present the results in numerical and graphical form, make a proper interpretation and draw conclusions

**SUBJECT OBJECTIVES**

- C1. Understanding the static and dynamic properties of sensors, transducers, methods and systems of sensors which avoid errors of the measurement method.
- C2. Understanding the practical metrological characteristics of sensors and measuring transduce
- C3. Knowledge of mathematical models of measuring circuits and data processing systems.
- C4. Ability to optimize and correcting the properties of dynamic and static measurement systems
- C5. Acquisition and consolidation of social skills including emotional intelligence skills involving the cooperation of a group of students with a view to effective problem solving. Responsibility, honesty and fairness in the procedure observance force in academia and society

**SUBJECT EDUCATIONAL EFFECTS***relating to knowledge:*

- PEK\_W01 Know the design, operation and performance of processing the most common transducers  
 PEK\_W02 He has a broad knowledge of the methods and systems for measuring various non-electrical quantities. He knows the physical quantities of the processing of the electrical quantities  
 PEK\_W03 Can assess the impact of external factors affecting the essential elements of measurement circuit on the result

*relating to skills:*

- PEK\_U01 He or she can to choose the measuring tool for measuring non-electrical  
 PEK\_U02 Can use the tools to measure temperature, pressure, stress, vibration - vibration, moisture content, chemical composition, flow rates of gases and liquids.  
 PEK\_U03 He or she has ability to assess the impact of external factors on the result. He can estimate the error of the measurement method and enter the amendment.

*relating to social competences:*

- PEK\_K01 He or she is aware of their own responsibility for their work and a willingness to comply with the principles of teamwork. He searches information and its critical analysis, properly identifies and resolves the dilemmas of working in the profession

### PROGRAMME CONTENT

Form of classes - lecture		Number of hours:
Lec 1	Processing of non-electrical quantities into electrical signals - general issues	2
Lec 2	Strain gauge transducers, torque measurement, power measurement	2
Lec 3	Flow measurement of gases and liquids	2
Lec 4	Measurement of pressure	2
Lec 5	PH and conductivity measurements	2
Lec 6	Temperature measurements: the scale of temperature, measurement methods	2
Lec 7	Resistance thermometers and thermocouples	2
Lec 8	Methods for measuring the temperature of solids, liquids and gases	2
Lec 9	Temperature measurements in industrial engineering	2
Lec 10	Measurement of humidity	2
Lec 11	The measurements of the chemical composition	2
Lec 12	Measurements of linear and angular displacement, Level measurement	3
Lec 13	Vibration measurements	2
Lec 14	Data acquisition system composed of multiple sensors	2
Lec 15	Heat flux measurement	1
Total hours:		30

Form of classes - laboratory		Number of hours:
Lab 1	Presentation of the safety rules and principles of assessment laboratory. Presentation of laboratory	2
Lab 2	Temperature measurement - determining the characteristics of temperature sensors	2
Lab 3	Measurements of strain - the characteristics of transducers, force transducers study	2
Lab 4	Determination of characteristics the sensors and pressure transmitters	2
Lab 5	Measurements of the gas flow	2
Lab 6	Optical Measurement - Study the contrast of outdoor lighting	2
Lab 7	Linearyzation of temperature sensors characteristics	2
Lab 8	Measurements of properties between sample & hold circuit	2
Lab 9	Determination of the emission of gray body	2
Lab 10	Determination of metrological parameters of length and angle transducers	2
Lab 11	Measurements of strain - Study the effect of temperature on strain gauges	2
Lab 12	Measurement of humidity	2
Lab 13	Measurements of pH and conductivity of the liquid	2
Lab 14	Sound level measurement	2
Lab 15	Summary	2
Total hours:		30

### TEACHING TOOLS USED

- N1. Traditional Lecture with audio-visual techniques  
 N2. Laboratory run in the traditional manner of exercises + student groups, reports

### EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

Evaluation <i>F - forming (during semester) P - concluding (at semester end)</i>	Educational effect number	Way of evaluating educational effect achievement
F1(w)	PEK_W01 PEK_W02 PEK_W03	exam
P(w)	P=F1	
F1(L)	PEK_U01 PEK_U02 PEK_U03 PEK_K01	Assessment of reports
P(L)	P=F1 average value of report's mark	

<b>PRIMARY AND SECONDARY LITERATURE</b>
---

<b>PRIMARY LITERATURE:</b>
----------------------------

- |   |
|---|
| <ul style="list-style-type: none"><li>[1] Zajda Z., Żebrowski L., Urządzenia i układy automatyki PWr. Wrocław, 1993</li><li>[2] Miłek M., Metrologia elektryczna wielkości nieelektrycznych, Uniwersytet Zielonogórski 2006.</li><li>[3] Janiczek R., Elektryczne miernictwo przemysłowe, Wydawnictwo Politechniki Częstochowskiej 2006.</li><li>[4] Rząsa M., Kiczma B., Elektryczne i elektroniczne czujniki temperatury, WKŁ Warszawa 2005.</li><li>[5] Romer R., Miernictwo przemysłowe, wyd 3. PWN, Warszawa, 1978</li></ul> |
|---|

<b>SECONDARY LITERATURE:</b>
------------------------------

- |   |
|---|
| <ul style="list-style-type: none"><li>[1] Stryburski W. Przetworniki tensometryczne – konstrukcja, projektowanie, użytkowanie, WNT, Warszawa 1971.</li><li>[2] <a href="http://www.czujniki.pl">www.czujniki.pl</a></li><li>[3] Editors: Erika Kress-Rogers and Christopher J. B. Brimelow - Instrumentation and sensors for the food industry, second edition, CRC Press 2001</li><li>[4] Nestor O. Shpak, Vadim P. Deynega Nikolay V. Kirianaki and Sergey Y. Yurish - Data Acquisition And Signal Processing For Smart Sensors, John Wiley &amp; Sons 2002</li></ul> |
|---|

<b>SUBJECT SUPERVISOR</b>
---------------------------

Grzegorz Kosobudzki, <a href="mailto:grzegorz.kosobudzki@pwr.edu.pl">grzegorz.kosobudzki@pwr.edu.pl</a>
---

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT <b>ARR043305 - Industrial Measurement</b> AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY <b>Control Engineering and Robotics</b>				
Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1AIR_W22	C.1 C.3 C.4	Lec1 Lec2 Lec3 Lec5 Lec6 Lec7 Lec8 Lec9 Lec10 Lec11 Lec12 Lec13 Lec14 Lec15	N.1
PEK_W02	K1AIR_W22	C.1 C.3 C.4	Lec1 Lec2 Lec3 Lec4 Lec5 Lec6 Lec7 Lec8 Lec9 Lec10 Lec11 Lec12 Lec13 Lec14 Lec15	N.1
PEK_W03	K1AIR_W22	C.1 C.3 C.4	Lec1 Lec2 Lec3 Lec4 Lec5 Lec6 Lec7 Lec8 Lec9 Lec10 Lec11 Lec12 Lec13 Lec14 Lec15	N.1
PEK_U01	K1AIR_U20	C.2 C.4 C.5	Lab1 Lab2 Lab3 Lab4 Lab5 Lab6 Lab7 Lab8 Lab9 Lab10 Lab11 Lab12 Lab13 Lab14	N.2
PEK_U02	K1AIR_U20	C.2 C.4 C.5	Lab1 Lab2 Lab3 Lab4 Lab5 Lab6 Lab7 Lab8 Lab9 Lab10 Lab11 Lab12 Lab13 Lab14	N.2
PEK_U03	K1AIR_U20	C.2 C.4 C.5	Lab1 Lab2 Lab3 Lab4 Lab5 Lab6 Lab8 Lab9 Lab10 Lab11 Lab12 Lab13 Lab14	N.2
PEK_K01	K1AIR_K02	C.5	Lec1 Lec2 Lec3 Lec4 Lec5 Lec6 Lec7 Lec8 Lec9 Lec10 Lec11 Lec12 Lec13 Lec14 Lec15 Lab1 Lab2 Lab3 Lab4 Lab5 Lab6 Lab7 Lab8 Lab9 Lab10 Lab11 Lab12 Lab13 Lab14 Lab15	N.1 N.2