

FACULTY OF ELECTRICAL  
ENGINEERING**SUBJECT CARD**

Name in Polish: **Podstawy inżynierii materiałowej**  
 Name in English: **Fundamentals of Materials Engineering**  
 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: **ARR041201**  
 Group of courses: **NO**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU):	30		15		
Number of hours of total student workload (CNPS):	60		30		
Form of crediting:	crediting with grade		crediting with grade		
For group of courses mark (X) final course:					
Number of ECTS points:	2		1		
including number of ECTS points for practical (P) classes :			1		
including number of ECTS points for direct teacher-student contact (BK) classes:	1.40		0.70		

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

1. Student has adequate knowledge from the range of physics and chemistry, relating to the structure and properties of matter from the range of the elementary and grammar school.
2. Student properly and effectively applies laws and rules of physics to the qualitative and quantitative analysis of physical phenomenon with engineering character.

**SUBJECT OBJECTIVES**

- C1. Understanding the phenomenon in physics and chemistry related with electrical, thermal and mechanical stresses  
 C2. Recognition of properties, structure and production technology of materials used in electrotechnical constructions  
 C3. Obtaining the knowledge about parameters characterizing the conducting, semi-conducting, dielectric and magnetic materials  
 C4. Explication necessary knowledge to understand proprieties of electrotechnical materials  
 C5. The practice of the skills of applying basic measuring techniques to the investigations of electrotechnical materials properties  
 C6. Pointing the awareness of the responsibility for the own work

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

- PEK\_W01 Student has the knowledge electrotechnical materials, their structure, basic properties and uses in electrical engineering  
 PEK\_W02 Student has a general understanding of advanced (smart) materials, nanotechnology and development of materials science

*relating to skills:*

- PEK\_U01 Student is able to apply the laws and rules of physics to analysis of the physical phenomenon and to plan and execute the measurements in safe way, and then to elaborate the results of the measurements  
 PEK\_U02 Student is able to measure properties of electrotechnical materials

*relating to social competences:*

- PEK\_K01 Student has awareness of the responsibility for the own and team work and is ready to submit to work principles to obtain common aim

PROGRAMME CONTENT		
Form of classes - lecture		Number of hours:
Lec 1	Introduction, presentation of the program, requirements and form of crediting of the subject. Historical outline, division and general characteristics of the materials	2
Lec 2	Crystal and amorphous materials. The defects of crystal structures and their influence on the materials properties	2
Lec 3	Liquid crystals, properties and applications, directions of the development	2
Lec 4	Electrical conductivity of metals. Line materials. New superconducting materials	2
Lec 5	Contact materials. Resistive materials. Thermistors and varistors	2
Lec 6	Applications of thermoelectric phenomena: temperature measurements, cooling	2
Lec 7	Semiconducting materials and their applications	2
Lec 8	Test (lecture 1-7). The structure of dielectrics. Electrical conductivity, polarization, dielectric loss, electric strength.	2
Lec 9	Sensors - properties, applications	2
Lec 10	Structure of the polymers. Thermoplastic and thermosetting isolating materials. Properties modifying	2
Lec 11	Piezoelectric and pyroelectric polymer materials. Properties and applications	2
Lec 12	Conductive polymers, electromagnetic shields, smart windows, flexible displays, artificial muscles, batteries	2
Lec 13	Electro- and magnetorheological materials. Properties, applications	2
Lec 14	Materials in optoelectronics	2
Lec 15	The basis of magnetism. Characteristic properties of magnetic materials. Test lecture (8-14)	2
Total hours:		<b>30</b>

Form of classes - laboratory		Number of hours:
Lab 1	The topics of the three-hour laboratories: 1. Investigation of dielectrics resistivity. 2. Investigation of electric permittivity. 3. Investigation of dielectric loss factor. 4. Investigation of magnetic properties of electrical steels samples. 5. Investigation of thermoelectric phenomena. 6. Investigation of Hall effect. Each student must attend four from the three-hour exercises to choose from the above mentioned.	12
Lab 2	Correction and supplementing class. Laboratory assessment	3
Total hours:		<b>15</b>

TEACHING TOOLS USED
<p>N1. Traditional lecture using multimedia presentation</p> <p>N2. Student's own work</p> <p>N3. Consultation</p> <p>N4. Checking the student's knowledge in the form of short tests and questions</p> <p>N5. Measuring using laboratory equipment</p> <p>N6. Analysis of test results</p> <p>N7. Development of measurement results in a report</p>

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT		
Evaluation <i>F - forming (during semester)</i> <i>P - concluding (at semester end)</i>	Educational effect number	Way of evaluating educational effect achievement
F1(W)	PEK_W01 PEK_W02 PEK_K01	Written test (lecture 1-7)
F2(W)	PEK_W01 PEK_W02 PEK_K01	Written test (lecture 8-14)
P(W)	$P=0,5F1+0,5F2$	
F1(L)	PEK_U01 PEK_U02 PEK_K01	Checking and evaluation laboratory preparation
F2(L)	PEK_U01 PEK_U02 PEK_K01	Crediting of reports from research
P(L)	$P=0,5F1+0,5F2$	

## PRIMARY AND SECONDARY LITERATURE

### PRIMARY LITERATURE:

- [1] Podstawy inżynierii materiałowej. Laboratorium. Oficyna Wyd. Politechniki Wrocławskiej 2005.  
 [2] Celiński Z., Materiałoznawstwo elektrotechniczne, Oficyna Wyd. Politechniki Warszawskiej, Warszawa, 2005.  
 [3] Blicharski M., Wstęp do inżynierii materiałowej, Wyd. AGH, Kraków, 2003.

### SECONDARY LITERATURE:

- [1] Kolbiński K., Słowikowski J., Materiałoznawstwo elektrotechniczne, WNT, 1988.

## SUBJECT SUPERVISOR

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### MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT **ARR041201 - Fundamentals of Materials Engineering** AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY **Control Engineering and Robotics**

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_W08	C.1 C.2 C.3	Lec1 Lec2 Lec3 Lec4 Lec5 Lec6 Lec7 Lec8 Lec9 Lec10 Lec14 Lec15	N.1 N.2 N.3
PEK_W02	K1AiR_W08	C.1 C.2 C.3	Lec11 Lec12 Lec13	N.1 N.2 N.3
PEK_U01	K1AiR_U04 K1AiR_U05	C.4 C.5	Lab2 Lab3 Lab4 Lab5 Lab6 Lab7 Lab8	N.2 N.3 N.4 N.5 N.6 N.7
PEK_U02	K1AiR_U06	C.4 C.5	Lab2 Lab3 Lab4 Lab5 Lab6 Lab7 Lab8	N.2 N.3 N.4 N.5
PEK_K01	K1AiR_K03	C.6	Lec1 Lec2 Lec3 Lec4 Lec5 Lec6 Lec7 Lec8 Lec9 Lec10 Lec11 Lec12 Lec13 Lec14 Lec15 Lab1 Lab2 Lab3 Lab4 Lab5 Lab6 Lab7 Lab8	N.1 N.2 N.3 N.4 N.5 N.6 N.7