

FACULTY OF ELECTRICAL
ENGINEERING**SUBJECT CARD**

Name in Polish: **Materiały elektromagnetyczne**
 Name in English: **Electromagnetic materials**
 Main field of study (if applicable): **Electrical Engineering**
 Specialization (if applicable): **Industrial Electrical Engineering**
 Level and form of studies: **2nd level, part-time**
 Kind of subject: **obligatory**
 Subject code: **ELR051269**
 Group of courses: **NO**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU):	22				
Number of hours of total student workload (CNPS):	60				
Form of crediting:	crediting with grade				
For group of courses mark (X) final course:					
Number of ECTS points:	2				
including number of ECTS points for practical (P) classes :					
including number of ECTS points for direct teacher-student contact (BK) classes:	1.40				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student has knowledge on fundamentals of materials engineering
2. Student has a general knowledge of physics

SUBJECT OBJECTIVES

- C1. Understanding the physical nature of the phenomena describing properties of solid materials important from the point of view of their applications in electrical engineering
 C2. Understanding the properties of selected groups of materials (conductive materials including ionic, semiconductor materials, dielectric materials, including non-linear materials, magnetic materials, including non-linear materials) and their possible applications
 C3. Knowledge of developments in the field of materials engineering
 C4. Consolidation of traditional academic values

SUBJECT LEARNING OUTCOMES*relating to knowledge:*

- PEU_W01 Student knows the physical nature of the phenomena determining the electromagnetic properties of materials
 PEU_W02 Student has an advanced knowledge in material science enabling proper selection of materials for the particular construction

*relating to skills:**relating to social competences:*

- PEU_K01 Student understands the need for self-education, including improving the skills of concentration and focus on important things, and develop the ability to independently apply their knowledge and skills

PROGRAMME CONTENT		
Form of classes - lecture		Number of hours:
Lec 1	Introduction, program, credit requirements. Electrical conductivity, bands model.	2
Lec 2	Metals and alloys	2
Lec 3	Crystal semiconductors	2
Lec 4	Amorphous semiconductors	2
Lec 5	Conductive and semi-conductive polymeric materials	2
Lec 6	Materials with ionic conduction and solid electrolytes	2
Lec 7	Dielectric-dielectric composites	2
Lec 8	Dielectric-conductor composites	2
Lec 9	Dielectrics with relaxation polarization and non linear effects	2
Lec 10	Magnetic materials and non-linear effects	2
Lec 11	Special materials. Test	2
Total hours:		22

TEACHING TOOLS USED
N1. Traditional lecture using multimedia presentation N2. Short written tests N3. Consultation N4. Student's own work

EVALUATION OF SUBJECT LEARNING OUTCOMES 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)	PEU_W01 PEU_W02 PEU_K01	Short written tests
F2(w)	PEU_W01 PEU_W02 PEU_K01	Final test
P(w)	$P=0,4F1+0,6F2$	

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE: [1] Bogusz W., Krok F., Elektolity stałe, WNT, Warszawa 1995. [2] Chełkowski A., Fizyka dielektryków, PWN, Warszawa, 1993. [3] Szalimowa K.W., Fizyka półprzewodników, PWN, Warszawa, 1974. [4] Jacak L., Radosz A., Materia i materiały, Wyd. P. Wr., Wrocław 1996.
SECONDARY LITERATURE: [1] Hilczer B., Małecki J., Elektrety i piezopolimery, PWN, Warszawa 1992. [2] Kittel C., Wstęp do fizyki ciała stałego, PWN, Warszawa, 1976. [3] Hippel A., Fizyka dielektryków, PWN, Warszawa, 1963. [4] Kittel C., Introduction to Solid State Physics.J. Wiley & Sons Inc., N.Y. 1966. [5] Setter N., Piezoelectric Materials in Devices. EPFL, Lusanne, 2002 [6] Ferry D. K., Bird J. P., Electronic Materials and Devices, Academic Press, San Diego, 2001. [7] Zuo-Guang Ye, Handbook of advanced dielectric, piezoelectric and ferroelectric materials, Woodhead Publ. Ltd., Cambridge, England, 2008. [8] Sessler G. M., Electrets, Laplacian Press,m Morgan Hill, California, 1998. [9] Neelakanta P. S., Handbook of Electromagnetic Materials, CRC Press Inc. Boca Raton

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