

FACULTY OF ELECTRICAL
ENGINEERING**SUBJECT CARD**

Name in Polish: **Kompatybilność elektromagnetyczna**
 Name in English: **Electromagnetic Compatibility**
 Main field of study (if applicable): **Control Engineering and Robotics**
 Specialization (if applicable): **Automation and Control in Electrical Power Systems**
 Level and form of studies: **2nd level, full-time**
 Kind of subject: **optional**
 Subject code: **ARR041101**
 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:	examination		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. Basic knowledge of electrical engineering

SUBJECT OBJECTIVES

- C1. Gaining the knowledge base about electromagnetic interference
 C2. The acquisition of ability to measure the properties suppression and surge protection devices

SUBJECT EDUCATIONAL EFFECTS*relating to knowledge:*

- PEK_W01 The student has knowledge about sources of interference in low-voltage installations
 PEK_W02 The student knows protection methods against interference in installations and low-voltage devices

relating to skills:

- PEK_U01 The student can designate the characteristics of dynamic and static overvoltage protection elements
 PEK_U02 The student can perform the measurements of noise levels in different drive systems

relating to social competences:

- PEK_K01 The student can think and act in a creative and enterprising manner

PROGRAMME CONTENT		
Form of classes - lecture		Number of hours:
Lec 1	Introduction, basic problems and EMC requirements. External sources of the electromagnetic interference.	2
Lec 2	Lightning strikes	2
Lec 3	Elements and surge protection systems.	2
Lec 4	Lightning and overvoltage protection of the installations and devices in buildings.	2
Lec 5	Electrostatic discharge: the phenomenon, parameters, threats, remedies.	2
Lec 6	The issue of shielding the electromagnetic field.	2
Lec 7	Shielding efficiency, measuring methods and systems.	2
Lec 8	Polymer end textile shielding materials.	2
Lec 9	Nanocomposites shielding materials.	2
Lec 10	Magnetic field shielding. Absorbing materials.	2
Lec 11	Graphene and CNT based shielding materials. Aerospace shielding materials.	2
Lec 12	Power converters as a sources of the electromagnetic interference.	2
Lec 13	Filtering and compensation systems in converters drive systems.	2
Lec 14	The influence of the transformers and the connection groups on the propagation of harmonics generated by the inverter.	2
Lec 15	Issues of the harmonic filter selection in the systems powered by converter transformers	2
Total hours:		30

Form of classes - laboratory		Number of hours:
Lab 1	Preface, knowing with the rules of laboratory work, health and safety training	2
Lab 2	The study of static characteristics of surge protection elements.	2
Lab 3	The study of dynamic characteristics of surge protection elements.	2
Lab 4	Research of the surge arresters for medium voltage lines.	2
Lab 5	The survey conducted noise level in the propulsion system of controlled rectifiers of different types.	2
Lab 6	The survey conducted noise level in the propulsion system of frequency converters.	2
Lab 7	Studying the effects of passive filters and active on the level of generated conducted interference in adjustable frequency drives.	2
Lab 8	Credit lab	1
Total hours:		15

TEACHING TOOLS USED
N1. Traditional lecture using multimedia presentation
N2. Student's own work
N3. Measurement Laboratory conducted in the traditional manner in student groups exercises
N4. Reports of the laboratory exercises

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_K01	Exam
P(W)	P=F1	
F1(L)	PEK_U01 PEK_U02 PEK_K01	Checking and evaluation of the preparation to laboratory exercises
F2(L)	PEK_U01 PEK_U02 PEK_K01	Evaluation of the reports from performed researches
P(L)	P = 0,5 F1 + 0,5 F2	

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

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| <p>[1] Charoy A., Zakłócenia w urządzeniach elektronicznych, t. 1-4, WNT, Warszawa 1999.</p> <p>[2] Sowa A., Kompleksowa ochrona odgromowa i przepięciowa, Biblioteka COSiW SEP, Warszawa, 2005.</p> <p>[3] Frąckowiak L., Energoelektronika, Cz. 2, Wyd. Politechniki Poznańskiej, Poznań, 2000</p> |
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SECONDARY LITERATURE:

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| <p>[1] Więckowski T., Badania kompatybilności elektromagnetycznej urządzeń elektrycznych i elektronicznych, Oficyna Wydawnicza PWr, Wrocław, 2001.</p> <p>[2] Praca zbiorowa pod red. D.J. Bena, Impulsowe narażenia elektromagnetyczne, Wyd. Politechniki Wrocławskiej, Wrocław, 1994.</p> <p>[3] Haase P., Overvoltage protection of low voltage systems, IEE, London, 2000.</p> <p>[4] Prasad Kodali V., Engineering Electromagnetic Compatibility, IEEE Press, New York, 1996.</p> |
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SUBJECT SUPERVISOR

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
ARR041101 - Electromagnetic Compatibility
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY **Control Engineering and Robotics**
AND SPECIALIZATION **Automation and Control in Electrical Power Systems**

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	S2ASE_W12	C.1 C.2	Lec1 Lec2 Lec3 Lec4 Lec5 Lec6 Lec7 Lec8 Lec9 Lec10 Lec11 Lec12 Lec13 Lec14 Lec15	N.1 N.2
PEK_W02	S2ASE_W12	C.1 C.2	Lec1 Lec2 Lec3 Lec4 Lec5 Lec6 Lec7 Lec8 Lec9 Lec10 Lec11 Lec12 Lec13 Lec14 Lec15	N.1 N.2
PEK_U01	S2ASE_U11	C.1 C.2	Lab1 Lab2 Lab3 Lab4 Lab5 Lab6 Lab7	N.2 N.3 N.4
PEK_U02	S2ASE_U11	C.1 C.2	Lab1 Lab2 Lab3 Lab4 Lab5 Lab6 Lab7	N.2 N.3 N.4
PEK_K01	K2AiR_K06	C.1 C.2	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