FACULTY OF ELECTRICAL ENGINEERING

SUBJECT CARD

Name in Polish:	**Techniki mikroprocesorowe w elektroenergetyce**
Name in English:	**Microprocessor techniques in electrical power engineering**
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:	**ELR042104**
Group of courses:	**NO**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge C language: rules of programming, variable types, basic instructions. Basic knowledge of A/D and D/A conversion.
2. Basic practical skills in C programming: creating, edition and compilation the programme.

SUBJECT OBJECTIVES

C1. Knowledge of structure, operation and programming rules microprocessor family.
C2. Knowledge of microprocessor peripheral circuits: digital and analogue inputs/outputs, timers/counters, alphanumerical displays.
C3. Practical ability of programming in C language peripheral circuits listed in C2. Especially practical implementation.
C4. Practical implementation of selected real time algorithms of power systems protections like: measuring data collection, amplitude measurement, undervoltage and overcurrent protection, digital filters of criterial data.
C5. Ability of practical team working: algorithms creation and programming.

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:

PEK_W01	Student has knowledge of architecture, working and peripheral circuits of microprocessors controllers.
PEK_W02	Student has knowledge of algorithms development and microprocessor controllers and their peripheral circuits programming (in C language), especially for power system protection.

relating to skills:

PEK_U01	Student has the ability to use and programming (in C language) peripheral circuits of microprocessors controllers.
PEK_U02	Student can independently, based on an existing microprocessor, execute a simple task, or part of a complex task from basic power system protection.

relating to social competences:

PEK_K01	Student can competently cooperate in the group that develops a complex project.

PROGRAMME CONTENT		
Form of classes - lecture		**Number of hours:**
Lec 1	Introduction. Establishing rules for credit. The construction of a typical microprocessor. Differences in the structure and use: microprocessor - microcontroller, microprocessor controller - a PLC microcontroller. Programming languages: assembler, high-level languages (e.g. C), graphic languages - the advantages and disadvantages. Basics of C language programming for microprocessors. The overall structure of the programme in C.	2
Lec 2	ARM family microcontrollers - general characteristics. Description core processor architecture, the address space, types of memory, the memory controller MAM, addressing modes.	2
Lec 3	Microcontroller power supply. Power saving modes. Universal I/O ports: management, reading, setting. Timers and counters. Real-time clock.	2
Lec 4	The interrupts system. VIC interrupt controller.	2
Lec 5	A/D and D/A converters.	2
Lec 6	Measurement data registration. The maximum recording rate, methods of data collection.	2
Lec 7	Algorithms for measuring amplitude and frequency. The algorithm undervoltage and overcurrent protection.	2
Lec 8	Digital filter algorithms selected size criterion.	1
	Total hours:	**15**

Form of classes - laboratory		**Number of hours:**
Lab 1	Presentation of the Rules of Procedure Health and Safety Laboratory. Establish rules for passing. General knowledge of the laboratory stand. Discussion of the software environment. The rules for creating new projects. Documentation own programs. Discussion of the structure of the program. Declaration of variables. Creating first simple program. Compilation of the program. Getting to know the simulator. Loading a program into the microprocessor controller.	2
Lab 2	The digital outputs handling: port operations, light and acoustic signalling, alphanumeric displays.	2
Lab 3	The digital inputs handling: port operations, keyboard, sensors.	2
Lab 4	Counting circuits: event counters, timers, real-time clock RTC.	2
Lab 5	Emergency and accidental event handling: interrupts.	2
Lab 6	Management of analogue signals: A/D and D/A converters.	2
Lab 7	Measurement data real-time registration.	2
Lab 8	The implementation of signal amplitude measurement algorithm.	2
Lab 9	The implementation of signal frequency measurement algorithm.	2
Lab 10	The implementation of the undervoltage and overcurrent protection algorithm.	2
Lab 11	The implementation of the digital filter algorithms for selected size criterion.	2
Lab 12	The implementation of the selected project in the field of power engineering.	2
Lab 13	The implementation of the selected project in the field of power engineering. (continued)	2
Lab 14	The implementation of the selected project in the field of power engineering. (continued)	2
Lab 15	The implementation of the selected project in the field of power engineering. (continued)	2
	Total hours:	**30**

TEACHING TOOLS USED
N1. Informative lecture.
N2. Microprocessor development kit.
N3. Programming environment for editing, compiling and running programs for microprocessor controllers.
N4. The presentation of the passing project.

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT		
Evaluation *F – forming (during semester)* *P – concluding (at semester end)*	**Educational effect number**	**Way of evaluating educational effect achievement**
F1(W)	PEK_W01 PEK_W02	attendance on classes
F2(W)	PEK_W01 PEK_W02	assessment of the correctness of the algorithms used in the implementation of the final project
P(W)	P = 0,1F1 + 0,9F2	
F1(L)	PEK_U01 PEK_U02	activity
F2(L)	PEK_U01 PEK_U02	check the quality of the final task
P(L)	P = 0,3F1 + 0,7F2	

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Bryndza L. „LPC2000 Mikrokontrolery z rdzeniem ARM7”, BTC, Warszawa 2007.
[2] Stawski E. „Mikrokontrolery LPC2000 w przykładach”, BTC, Warszawa 2009.
[3] „Mikrokontrolery z rdzeniami ARM”, Elektronika Praktyczna, wydanie specjalne 1/2006, AVT, Warszawa 2006.
[4] „LPC2131/2132/2138 Data Sheet”, Philips*
[5] „LPC2131/2132/2138 User Manual”, Philips*
[6] Opis zestawu uruchomieniowego ZL6ARM firmy BTC, Warszawa, 2007*

* literature available from teacher

SECONDARY LITERATURE:

[1] Bryndza L. „Mikrokontrolery z rdzeniem ARM9 w przykładach”, BTC, Warszawa 2009
[2] Kernighan B.W., Ritchie D.M., “Język ANSI C”, WNT, Warszawa 2007
[3] Majewski J., Kardach K., „Programowanie mikrokontrolerów z serii 8x51 w języku C”, Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2002

SUBJECT SUPERVISOR

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
ELR042104 - Microprocessor techniques in electrical power engineering
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY **Electrical Engineering**

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	K1ETK_W26 K1ETK_EEN_W09	C.1 C.2	Lec1 Lec2 Lec3 Lec4 Lec5	N.1
PEK_W02	K1ETK_W26 K1ETK_EEN_W09	C.1 C.2	Lec6 Lec7 Lec8	N.1
PEK_U01	K1ETK_U23 K1ETK_EEN_U06	C.3	Lab1 Lab2 Lab3 Lab4 Lab5 Lab6	N.2 N.3
PEK_U02	K1ETK_U23 K1ETK_EEN_U06	C.4	Lab7 Lab8 Lab9 Lab10 Lab11 Lab12 Lab13 Lab14 Lab15	N.2 N.3
PEK_K01	K1ETK_K05 K1ETK_K09	C.5	Lab12 Lab13 Lab14 Lab15	N.4