(Faculty stamp) **COURSE DESCRIPTION**

1. Course title: EMBEDDED SYSTEMS	**2. Course code:** ES
3. Validity of course description: 2017/2018	
4. Level of studies: BA, BSc programme / ~~MA,MSc programme~~	
5. Mode of studies: intramural studies / ~~extramural studies~~	
6. Field of study: CEIE - Interdisciplinary Studies: Automatic Control and Robotics, Electronics and Telecommunications, Computer Science (RAU)	
7. Profile of studies: comprehensive / ~~practical~~	
8. Programme: all	
9. Semester: 6	
10. Faculty teaching the course: Faculty of Automatic Control, Electronics and Computer Science	
11. Course instructor: Ph.D. Eng. Krzysztof Tokarz	
12. Course classification: common courses	
13. Course status: compulsory /~~elective~~	
14. Language of instruction: English	
15. Pre-requisite qualifications: Microprocessor Systems, Theory of logic circuits.	
16. Course objectives: Main goal of the course is to present elements of microprocessor and embedded systems like: microprocessors, memories, buses, peripheral devices. PC computer elements are also presented. The process of embedded system development is presented with attention on proper choice of hardware elements, operating system, programming methods. Methods of hardware-software design with co-design is presented. Specification and documentation preparation according to standards is also presented as important part of system development process.	

17. Description of learning outcomes:

Nr	Learning outcomes description	Method of assessment	Teaching methods	Learning outcomes reference code
1	Student has knowledge of basics of the microprocessor technique needed to understand and solve simple tasks related to hardware and software in embedded systems design.	Lab report	Lecture, laboratory	K1A_W10
2	Student has the knowledge of architectures and development of embedded and real time systems.	Lab report	Lecture, laboratory	K1A_W14
3	Student has the knowledge of the techniques and methods of embedded systems design and time of life of such systems.	Lab report	Lecture, laboratory	K1A_W17, K1A_W18

4	Student can develop and program the embedded systems on API level and using assembly language	Lab report	Lecture, laboratory	K1A_U12, K1A_U17
5	Student can make tests of hardware and software in embedded systems	Lab report	Lecture, laboratory	K1A_U24
6	Student can make design of embedded system based on the specification. He can prepare specification for system.	Lab report	Lecture, laboratory	K1A_U3, K1A_U21
7	Student can cooperate in the group playing different roles.	Lab report	Laboratory	K1A_K3

18. Teaching modes and hours:
Lecture / BA /MA Seminar / Class / Project / Laboratory:
30 / 0 / 0 / 0 / 0 / 30

19. Syllabus description:

Lecture: Introduction to microprocessor and embedded systems. Definition, classification and development methods of embedded systems. Elements of embedded system: microprocessor, microcontroller, memories, peripheral devices. Parallel and serial input and output devices, analog to digital and digital to analog converters, serial synchronous and asynchronous communication. Elements of microcontroller: processor unit, RAM, Flash, EEPROM memories, timers, watchdog, brownout detector, communication devices, ports. Connecting external devices to microprocessor and microcontroller. Interrupt controllers, DMA controllers. Programmable logic devices, IP cores. Examples of modern microcontrollers. Operating systems for embedded systems, RTOS, cooperative and preemptive multitasking. Writing applications without operating system, superloop, interrupt driven software, finite state machine, examples of implementation. Requirements for embedded system, IEEE standards for embedded system specification and documentation. Stages of system development: requirements analyze, general design, subsystem design, subsystem implementation, integration, testing, documentation, development errors. Methods of hardware-software partitioning, co-design, selection of hardware elements. Hardware drivers.

Laboratory: Debugging in embedded systems. Simulators. 8051 microcontrollers. Serial synchronous data transmission. TWI, SPI. AVR microcontrollers, writting programs in assembler and C. Interrupt controllers. Interrupt priorities. Digital signal processors. Example of cooperative real-time operating system. ARM-based computer system – Raspberry PI.

20. Examination: no

21. Primary sources:

1. Embedded systems : architecture, programming and design / Raj Kamal. - Boston [etc.]: McGraw Hill Higher Education, cop. 2008.

2. Handbook of real-time and embedded systems / ed. by Insup Lee, Joseph Y-T. Leung, Sang H. Son. - Boca Raton ; London ; New York : Chapman & Hall/CRC, cop. 2008.

3. Networking and internetworking with microcontrollers / by Fred Eady. - Burlington, Ma ; Oxford : Newnes, cop. 2004.

22. Secondary sources:

1. Synthesis of arithmetic circuits : FPGA, ASIC and embedded systems / Jean-Pierre Deschamps, Géry Jean Antoine Bioul, Gustavo D. Sutter. - Hoboken, NJ : John Wiley & Sons, cop. 2006.

2. Specification and design of embedded systems / Daniel D. Gajski [et al.]. - Englewood Cliffs : PTR Prentice Hall, 1994.

23. Total workload required to achieve learning outcomes:

Lp.	Teaching mode	Contact hours / Student workload hours
1	Lecture	30/30
2	Classes	/
3	Laboratory	30/55
4	Project	/
5	Seminar	/
6	Others	5/-
	Total number of hours	65/85

24. Total hours: 120

25. Number of ECTS credits: 5

26. Number of ECTS credits allocated for contact hours: 2

27. Number of ECTS credits allocated for in-practice hours (laboratory classes, projects): 3

26. Comments:

Approved:

…….
(date, Instructor's signature)

……
(date , the Director of the Unit signature)