I055	**Embedded Systems**	L	S	E	ECTS
		2	1	2	7

Course objectives. Course objectives are to familiarize students with enough knowledge such that they are able to design and create their own Internet of Things (IoT) device based on microcontroller or single-board computer.

Course prerequisites. Introduction to Computer Science.

Syllabus.

1. Introduction to Embedded Systems. ES and CPS (Cyber-physical systems): use and examples, common features.
2. Main features of embedded systems: real-time clock, interrupts.
3. Interface to the environment: sensors, AD/DA converters, LED, TFT
4. Electronics: resistors, voltage, current, Ohm's Law, …
5. Hardware types: ARM, PIC, AVR, Linux everywhere: Raspberry Pi, virtual hardware
6. Arduino platform and C programming. Interfacing with the Arduino.
7. Raspberry Pi platform and Python programming. Interfacing with the Raspberry Pi.
8. Communication: serial, network (wifi, Bluetooth, Ethernet, nfc)
9. Reliability and fault tolerance

EXPECTED LEARNING OUTCOMES

No.	**LEARNING OUTCOMES**
1.	To demonstrate knowledge and understanding which can serve as the foundation for developing and application of original ideas.
2.	To apply knowledge, understanding and skills in a broad variety of problems in the field of embedded systems.
3.	To integrate new knowledge to successfully solve programming problems in the IoT.
4.	To be able to present conclusions and findings to experts and laymen based on knowledge and experience.
5.	To apply the acquired skills onto further education in this field.

COUPLING OF THE EXPECTED LEARNING OUTCOMES, TEACHING PROCESS ORGANIZATION AND THE EVALUATION OF THE TEACHING OUTCOMES

TEACHING PROCESS ORGANIZATION	**ECTS**	**EXPECTED LEARNING OUTCOMES ****	**STUDENT ACTIVITY ***	**EVALUATION METHOD**	**SCORE**	
					min	**max**
Lecture attendance	1	1-5	Class attendance, discussion, solving the	Lists with signatures, observing the	0	4

			problems individually and in a team	activity during the lectures		
Homework	1	1-4	Solving the problems individually	Grading	12	20
Repeated exams	2	1-4	Preparation for the written exam	Grading	19	38
Final exam	2	1-4	Revising	Oral exam	19	38
TOTAL	7				50	100

Teaching methods and student assessment. Lectures will be illustrated with many practical examples. Students will directly work (program) with Arduino and Raspberry Pi platforms. Attending lectures, exercises and seminars is obligatory. Exercises will be held in specialized computer-based laboratories where students will learn how to program Arduino in C, and Raspberry Pi in Python. The final exam will be held after the completion of lectures and exercises and it will contain practical task (capstone project) each student will have to complete individually or in groups of four students at most.

Can the course be taught in English: Yes

Basic literature:

1. Edward A. Lee and Sanjit A. Seshia, Introduction to Embedded Systems, A Cyber-Physical Systems Approach, http://LeeSeshia.org, ISBN 978-0-557-70857-4, 2011.

Recommended literature:

1. Peter Marwedel, Embedded System Design, ISBN 978-94-007-0257-8, Springer, 2nd ed. 2011
2. Online matherials: http://www.embedded.com/
3. David Russell, Introduction to Embedded Systems: Using ANSI C and the Arduino Development Environment, Synthesis Lectures on Digital Circuits and Systems, 2010.
4. S. Monk, Programming the Raspberry Pi: Getting Started with Python, McGraw-Hill, 2013.

Muhammad Ali Mazidi, Sarmad Naimi, Sepehr Naimi, AVR Microcontroller and Embedded Systems: Using Assembly and C, Pearson Custom Electronics Technology, Prentice Hall; 1 edition, 2010.