COURSE DESCRIPTION CARD - SYLLABUS

Course name
Embedded Systems Design for Internet of Things [S2Inf1-IP>PSW]

Course

Field of study
Computing

Year/Semester
1/1

Area of study (specialization)
Internet of Things

Profile of study
general academic

Level of study
second-cycle

Course offered in
Polish

Form of study
full-time

Requirements
compulsory

Number of hours

Lecture
15

Laboratory classes
20

Other
0

Tutorials
0

Projects/seminars
20

Number of credit points

5,00

Coordinators

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Lecturers

Prerequisites

A student starting this course should have basic knowledge of physics, electronics, digital and analog techniques, and metrology. He should have the ability to solve basic problems in the field of electrical engineering and electronics, programming in C, creating application operation algorithms and the ability to obtain information from the indicated sources. He should also be ready to cooperate as part of the team. In addition, in terms of social competences, the student must present attitudes such as honesty, responsibility, perseverance, cognitive curiosity, creativity, personal culture, respect for other people.

Course objective

1. Providing students with the initial knowledge of the Internet of Things. 2. To provide students with basic knowledge of designing embedded systems in the aspect of the Internet of Things. 3. Providing students with complementary knowledge in the field of designing printed circuits and the use of CAD tools, organization and programming of microcontrollers, selected digital circuits and sensors. 4. Developing the ability to solve simple problems related to the design, construction, operation, programming of digital systems. 5. Shaping students" teamwork skills as part of the tasks carried out in the laboratory.

Course-related learning outcomes

Knowledge:
1. has advanced knowledge in the field of microcontrollers, embedded systems and the internet of things, including design, construction, startup methods, and programming tools and environments used for their implementation - [k2st_w1]
2. has advanced detailed knowledge related to selected issues in the field of computer science, such as: programming microcontrollers in c language, handling sensors and output circuits, creating internet applications related to the operation of modules equipped with microcontrollers and sensors - [k2st_w3]
3. has basic knowledge of the life cycle of embedded systems and iot systems; has knowledge of trends and the most important new achievements in the development of microelectronics, nanotechnology, in particular microcontrollers, sensors, embedded systems, iot modules - [k2st_w5]

Skills:
1. can use literature information, databases and other sources in polish and in a foreign language; in the field of designing embedded systems and the internet of things, - [k2st_u1]
2. can use to formulate and solve engineering tasks and simple research problems in the field of embedded systems and the internet of things, analytical, simulation, experimental and diagnostic methods - [k2st_u4]
3. can - when formulating and solving engineering tasks - integrate knowledge from various areas of computer science (also knowledge from other scientific disciplines) and apply a systemic approach, also taking into account non-technical aspects, which is important in internet of things systems, relating to various fields, e.g. health care, sport or smart measurements, - [k2st_u5]
4. can assess the usefulness and the possibility of using new achievements (methods and tools) and new it products in the design of embedded systems and the internet of things, - [k2st_u6] 5. can assess the usefulness of methods and tools for solving an engineering task involving the implementation of an internet of things project, including the limitations of these tools - [k2st_u9]
6. can - using conceptual methods - solve complex design tasks in the field of the internet of things, including non-standard tasks and tasks with a research component - [k2st_u10]
7. can - in accordance with the given specification, taking into account non-technical aspects - design a complex embedded system integrated with the internet, implement this project - at least in part - using appropriate methods, techniques and tools, including adapting the existing or developing new tools for this purpose -[k2st_u11]
8. can cooperate in a team as part of designing embedded systems for the internet of things - [k2st_u15]
things - [k2st_k1]
2. understands the importance of using the latest knowledge in the field of computer science to solve problems related to the creation, launch and operation of modern internet of things systems - [k2st_k2]

Social competences:
1. understands the need for continuous training, understands that in computer science knowledge and

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Learning outcomes presented above are verified as follows:
Initial assessment:
a) in the field of lectures: - on the basis of answers to questions about the material discussed in previous lectures,
b) in the field of laboratories / projects: - based on the assessment of the current progress in the implementation of tasks,
Summative assessment:
a) in the field of lectures, verification of the assumed learning outcomes is carried out by: - assessment of the knowledge and skills shown in the exam of a problem nature, consisting of problem tasks selected from the list of issues previously made available to students (5 questions from 20 problem issues); - discussion of the results and, in individual cases, additional control questions,
b) in the field of laboratories / projects, verification of the assumed learning outcomes is carried out by:
- assessment of skills related to the implementation of laboratory exercises / projects;- continuous assessment during each class (oral answers); - evaluation of reports prepared on selected issues carried out in the laboratory; this assessment also includes teamwork; -assessment and defense by the student of the report on the implementation of the project.

Programme content

IoT communications, intelligent processing
information acquired from sensors, IoT applications. Embedded systems. Design of embedded systems for IoT. Features. Product lifecycle. Applications. Introduction to printed circuit board design. CAD/EDA type tool software (e.g. Eagle, KiCad) for electronics engineers. Editing of schematics. Editing of printed circuits. Creation of design documentation.
Technologies for making prints, design errors. JTAG diagnostic bus.
Architecture of microcontrollers. Peripheral circuits of microcontrollers.
Selected issues of design and commissioning of embedded systems. Selected interfaces
communication interfaces of microcontrollers (necessary for the implementation of the tasks of the subject): RS 232, I2C, SPI, 1-Wire.
Principles of connecting microcontrollers with simple input-output elements and software operation. Power supply circuits. Battery power sources. The problem of saving energy consumption in IoT.

Course topics

The lecture program covers the following topics:
Introduction to the Internet of Things (IoT): communication between
devices, architecture of distributed systems in particular IoT, intelligent processing of information acquired from sensors, IoT applications. Design of embedded systems and IoT: Embedded systems. Features. Product lifecycle. Applications. Introduction to printed circuit board design. CAD/EDA type tool software (e.g. KiCad) for electronics engineers. Editing of schematics. Editing of printed circuits. Creation of design documentation.
Technologies for making prints, design errors. Assembly and commissioning of modules. Bus JTAG diagnostic bus. Introduction to microcontrollers (to the extent necessary). Architecture microcontrollers. Selected families of microcontrollers and runtime modules. Microcontrollers with embedded Internet. Peripheral circuits of microcontrollers, timing circuits, ADCs and DACs. Analog channel. Interrupt system, organization, handling of external events, handling of circuits functional circuits of the microcontroller, operation of synchronous timer events, implementation of timers
virtual. Selected issues of design and commissioning of embedded systems. Selected interfaces
communication interfaces of microcontrollers (necessary for the implementation of the tasks of the subject): RS 232, IIC, SPI, 1-Wire.
Principles of connecting microcontrollers with simple input-output elements and software operation. Power supply circuits. Battery power sources. Programming microcontrollers in C language. Programming of microcontrollers for real-time systems - program algorithms for the case of simple sequential programs, complex programs with selection-type and parallel branching, combining multiple real-time applications.
The labs are carried out by teams of 2 students. The laboratory program includes the following topics:
Introduction to PCB design in KiCad. Preparation of a schematic diagram.
Single-sided, double-sided printing design. Creation of documentation. Introduction to Running applications on selected development modules with microcontrollers, e.g. Arduino, Wemos, NodeMCUESP8266, Raspberry Pi, . Microcontroller configuration. C language implementation of simple programs with simple timing loop; using timer; without interrupts and with interrupt handling. Programs using AC processing and CA processing. Operation of selected sensors. Programming of microcontrollers for real-time systems according to the principles presented in lectures for different classes of microcontrollers (8-, 16-, 32-bit) and different programming tools.
Development of simple applications for selected TCP/IP protocols in conjunction with a microprocessor module equipped with a
Microprocessor module equipped with sensors.
Student projects implemented on a selected base module.

Teaching methods

1. Lecture: multimedia presentation, presentation illustrated with examples given on the board,
2. Laboratory exercises: presentation of the issues of laboratory exercises, implementation of the issues presented
in the laboratory exercise program,
3. Projects: checking the progress, discussion and ongoing consultations in the field of implemented projects.

Bibliography

Basic
1. Eagle pierwsze kroki, Wieczorek H., BTC, Warszawa, 2007
2. Projektowanie systemów mikroprocesorowych, Hadam P., BTC, Warszawa, 2004
3. Spraw, by rzeczy przemówiły. Programowanie urządzeń elektronicznych z wykorzystaniem Arduino, Igoe T., Helion, 2013
4. Arduino dla zaawansowanych, Anderson R., Cervo D., Helion, 2014
5. Presentations for lectures
Additional
1. Embedded programming, Chew M.T., Gupta G.S., Silicon laboratories, 2005
2. Embedded microcontroller interfacing, Gupta G.S., Mukhopadhyay S.C., Springer 2010
3. Microcontrollers in practice, Mitescu M., Susnea I. , Springer , Berlin, 2005
4. Mikrokontrolery STM32 w praktyce, Paprocki K., BTC, Warszawa, 2009
5. Arduino w akcji, Evans M., Noble J., Hochenbaum J., Helion, 2014
6. Designing embedded systems and Internet of Things (IoT), Xiao P., Wiley, 2018
7. Internet sources, eg. www.silabs.com, www.atmel.com, www.ti.com, www.st.com

Breakdown of average student's workload

	Hours	ECTS
Total workload	125	5,00
Classes requiring direct contact with the teacher	55	2,50
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	70	2,50