COURSE DESCRIPTION CARD - SYLLABUS

Course name
Sensors and Wireless Sensor Networks [N2Inf1-AMiWdIP>SEN]

Course

Field of study
Computing

Year/Semester
1/1

Area of study (specialization)
Mobile and Embedded Applications for the Internet of Things

Profile of study
general academic

Level of study
second-cycle

Course offered in
polish

Form of study
part-time

Requirements
compulsory

Number of hours

Lecture
16

Laboratory classes
16

Other (e.g. online)
0

Tutorials
0

Projects/seminars
0

Number of credit points

4,00

Coordinators

mgr inż. Joanna Szewczyk
joanna.szewczyk@put.poznan.pl

Lecturers

mgr inż. Joanna Szewczyk
joanna.szewczyk@put.poznan.pl

Prerequisites

A student starting the subject Sensors and Wireless Sensor Networks should have basic knowledge of computer networks and digital and analog technology. He or she should have the ability to solve basic problems in electrical and electronic engineering, program in C language, create algorithms for the operation of applications, and have the ability to obtain information from indicated sources. He should also be ready to cooperate as part of a team.

Course objective

1. To provide students with basic knowledge in the field of selected wireless transmission protocols and sensors. 2. Providing students with complementary knowledge in the field of construction, operation, sensor applications as well as the organization of protocols, technical implementation of radio transmission, hardware and software solutions for network modules (nodes), transmission security, applications. 3. Developing the ability to solve simple problems related to the use of sensors as well as the construction, operation, programming, and starting low-power radio networks. 4. Shaping students" teamwork skills as part of the tasks carried out in the laboratory.

Course-related learning outcomes

Knowledge:
1. has ordered, theoretically founded general knowledge in the field of sensor networks (WSN and LPWAN - IoT applications) and the construction and operation of sensors. - [K2st_W2]
2. has an ordered, theoretically founded knowledge of the organization of sensor network protocols and programming of network nodes with sensors. - [K2st_W3]
3. has knowledge about trends and the most important new achievements in the development of microelectronics, nanotechnology, in particular microcontrollers, sensors, embedded systems and low-power radio networks. - [K2st_W4]
4. has advanced and detailed knowledge of the processes taking place in the life cycle of such systems as radio sensor networks in terms of concept, software and hardware solutions - [K2st_W5]
5. knows the basic methods of solving engineering tasks in the field of design and implementation of sensor network nodes; knows and understands the principles of connecting electronic components and systems with microcontrollers, in particular sensors. - [K2st_W6]

Skills:
1. can use literature information, databases and other sources in Polish and a foreign language in the field of sensor networks and sensors, - [K2st_U1]
2. can use analytical, simulation and experimental methods to formulate and solve engineering tasks and simple research problems - [K2st_U4]
3. can - when formulating and solving engineering tasks concerning sensor networks and sensors - integrate knowledge from various areas of computer science (and, if necessary, also knowledge from other scientific disciplines) and apply a system approach, also taking into account non-technical aspects - [K2st_U5]
4. can assess the usefulness and the possibility of using new achievements (methods and tools) and new IT products in the field of sensor networks and sensors - [K2st_U6]
5. can cooperate in a team and implement subsequent stages of design, programming and commissioning of sensor networks, can prepare project documentation - [K2st_U15]
6. can determine the directions of further learning and implement the self-learning process in the field of sensor networks and sensors, - [K2st_U16]

Social competences:
1. understands that in IT knowledge and skills very quickly become obsolete, this also applies to sensors and wireless sensor networks. - [K2st_K1]
2. understands the importance of using the latest knowledge in the field of computer science in solving research and practical problems in the field of low-power radio networks and sensors, - [K2st_K2]

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

The knowledge acquired in the lecture is verified by a written (and/or oral) test consisting of several larger or a dozen short questions mostly descriptive; the questions are of varying degrees of difficulty, with different number of points assigned to them. Passing threshold: 50%.
The issues on the basis of which questions are developed will be placed in the eCourses system.

The skills acquired in laboratory classes are verified on the basis of a report representing
The report is developed according to the scheme given by the lecturer.

Programme content

The lecture program covers the following topics:
Wireless Sensor and Activator Networks (BSS; WSN -Wireless Sensor Network).
Low power wireless networks for the Internet of Things, operating in licensed and unlicensed radio bands. Frequency bands used in WSNs.
Introduction to modern sensor circuit solutions - construction, operation, interfaces, application principles.
Simple executive systems (displays, motors, servos) - construction, operation, control.
Security issues in sensor networks: packet integrity, confidentiality - AES encryption. Simple WSN protocols for measurement and control purposes and complex standardized protocols - IEEE802.15.4/ ZigBee and other protocols based on IEEE802.15.4.
Selected WSN routing protocols e.g. DSR, AODV. Short-range transmission - RFID, Bluetooth.
Applications of wireless sensor networks.

Low-energy routing in WSNs.
Introduction to selected microcontrollers and C programming, to the extent
To the extent necessary for the laboratory exercises.

Laboratory exercises are carried out by teams of 2 students.
The laboratory program includes the following topics:
Introduction to selected hardware and programming environment. Organization of the wireless transmission protocol. Security of packets. Configuration of the radio circuit. The simplest transmission (transmit - receive). Operation of selected sensors. Project - Implementation of the set wireless transmission protocol.

Teaching methods

1. Lecture: multimedia presentation, presentation illustrated with examples given on the board,
2. Laboratory exercises: practical implementation of hardware and software for selected issues in the field of lectures,
3. Consultations in the field of laboratory exercises.

Bibliography

Podstawowa
1. Sensor Networks, Glisic, Savo G, Advanced Wireless Networks: Technology and Business Models, 2016.
2. E. N.Szynkiewicz, M. Marks, P. Arabas, A.Sikora. Bezorzewodowe sieci czujników w Internecie Rzeczy.Wydawnictwo Naukowe PWN. 2023
3. Artykuły w czasopismach i internecie podawane/wskazywane przez prowadzącego.
4. Prezentacje do wykładów

Uzupełniająca
1. Dokumentacje techniczne mikrontrolerów.
2. C. Bell. Beginning Sensor Networks with XBee, Raspberry Pi, and Arduino: Sensing the World with Python and MicroPython 2nd ed. Edition. Apress. 2020
3. Tinyml: Machine Learning with Tensorflow Lite on Arduino and Ultra-Low-Power Microcontrollers. O'Reilly Media. 2020

Breakdown of average student's workload

	Hours	ECTS
Total workload	100	4,00
Classes requiring direct contact with the teacher	34	1,50
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	66	2,50