



## Subject card

Subject name and code	Internet of Things platforms in medical applications, PG_00053360						
Field of study	Biomedical Engineering, Biomedical Engineering, Biomedical Engineering						
Date of commencement of studies	February 2025		Academic year of realisation of subject		2024/2025		
Education level	second-cycle studies		Subject group		Optional subject group Specialty subject group Subject group related to scientific research in the field of study		
Mode of study	Full-time studies		Mode of delivery		at the university		
Year of study	1		Language of instruction		Polish		
Semester of study	1		ECTS credits		3.0		
Learning profile	general academic profile		Assessment form		assessment		
Conducting unit	Department of Metrology and Optoelectronics -> Faculty of Electronics, Telecommunications and Informatics						
Name and surname of lecturer (lecturers)	Subject supervisor		dr hab. inż. Grzegorz Lentka				
	Teachers		dr hab. inż. Grzegorz Lentka  dr inż. Michał Rycewicz				
Lesson types and methods of instruction	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	15.0	0.0	15.0	0.0	0.0	30
	E-learning hours included: 0.0						
Learning activity and number of study hours	Learning activity	Participation in didactic classes included in study plan		Participation in consultation hours		Self-study	SUM
	Number of study hours	30		5.0		40.0	75
Subject objectives	Getting familiar with architectures of the hardware platforms used in Internet of Things (IoT) systems especially dedicated do medical applications, data processing units classification, communication interfaces, methods and components for data storage, wired and wireless communication methods for clouds, sensors and actuators service methods, software and hardware assisted information protection as well as examples of hardware platforms with different processing capability.						
Learning outcomes	Course outcome		Subject outcome		Method of verification		
	[K7_W04] knows and understands, to an increased extent, the principles, methods and techniques of programming and the principles of computer software development or programming devices or controllers using microprocessors or other elements or programmable devices specific to the field of study, and organization of work of systems using computers or such devices		Knows data processing units and selects suitable one depending on required processing power. Knows and can apply communication modules, data storage components as well as sensor and actuators devices.		[SW1] Assessment of factual knowledge		
	[K7_U03] can design, according to required specifications, and make a complex device, facility, system or carry out a process, specific to the field of study, using suitable methods, techniques, tools and materials, following engineering standards and norms, applying technologies specific to the field of study and experience gained in the professional engineering environment		Student configures and programs system consisting of sensors and processing units able to store the data in the cloud.		[SU1] Assessment of task fulfilment [SU4] Assessment of ability to use methods and tools		

Subject contents	<ul style="list-style-type: none"><li>• Introduction, basic terminology, definitions, IoT importance;</li><li>• Architecture of IoT devices and systems;</li><li>• Data processing units classification (microcontrollers, microprocessors, SoC, SBC);</li><li>• Communication interfaces used in IoT;</li><li>• Data processing and storage;</li><li>• Mobility (communication over Ethernet, LoRa, LoRaWAN, IoT gateway);</li><li>• Sensor servicing;</li><li>• Hardware constructions used for prototyping (SoC, SoM, SBC);</li><li>• The overview if popular hardware platforms:</li><li>• Small IoT modules based on microcontrollers;</li><li>• Esperssif modules dedicated for networking;</li><li>• Single Board Computers (SBC) as a IoT platform;</li><li>• Energy consumption reduction - special modes usage;</li><li>• Data security in IoT;</li><li>• Hardware modules aiding IoT security;</li></ul>		
Prerequisites and co-requisites	Basic knowledge of digital circuits, microprocessors and microcontrollers and the C programming language.		
Assessment methods and criteria	Subject passing criteria	Passing threshold	Percentage of the final grade
	Test during semester	50.0%	50.0%
	Lab exercises	50.0%	35.0%
	Activity/homeworks	0.0%	15.0%
Recommended reading	Basic literature	<ol style="list-style-type: none"><li>1. Aamir Riaz: Inter-communicating things - IoTs, Pacific Radio-communication Workshop 2019</li><li>2. Stuart R. Ball, Embedded Microprocessor Systems: Real World Design, Third Edition</li><li>3. Arnold S. Berger, Embedded Systems Design: An Introduction to Processes, Tools and Techniques</li><li>4. John Catsoulis, Designing Embedded Hardware</li><li>5. Ken Arnold, Embedded Controller Hardware Design</li><li>6. Texas Instruments: Design a Cloud Connected IoT Gateway with Security Protection</li><li>7. D. Avelino (AWS): Connecting Buildings to a Smart World with IoT, Cloud Computing and Digital Ceiling</li><li>8. A. Karkare: Internet of Things: An Overview</li><li>9. Philips Semiconductors: AN10216-01 I2C MANUAL, 2003</li><li>10. NXP: UM10204: I2C-bus specification and user manual, 2014</li><li>11. Analog Devices: Introduction to SPI Interface, Analogue Dialog 2018</li></ol>	
	Supplementary literature	<ol style="list-style-type: none"><li>1. Ed Sutter, Embedded Systems Firmware Demystified</li><li>2. Michael Barr, Programming Embedded Systems in C and C ++</li><li>3. Stuart R. Ball; Debugging Embedded Microprocessor Systems,</li></ol>	
	eResources addresses	Adresy na platformie eNauczanie:	
Example issues/ example questions/ tasks being completed	<ol style="list-style-type: none"><li>1. Using small microcontrollers for sensors servicing on the example of Arduino.</li><li>2. Small microcontrollers communication limits.</li><li>3. Espressif family communication modules used as IoT nodes.</li><li>4. Single Board Computers configuration (eg. Raspberry PI).</li><li>5. Prototyping platforms - using SoM and carier-board.</li></ol>		
Work placement	Not applicable		

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