



## Subject card

Subject name and code	Industrial Computers and Embedded Systems, PG_00048151						
Field of study	Electronics and Telecommunications						
Date of commencement of studies	October 2022	Academic year of realisation of subject			2025/2026		
Education level	first-cycle studies	Subject group			Optional 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	4	Language of instruction			Polish		
Semester of study	7	ECTS credits			5.0		
Learning profile	general academic profile	Assessment form			exam		
Conducting unit	Department of Signals and Systems -> Faculty of Electronics, Telecommunications and Informatics						
Name and surname of lecturer (lecturers)	Subject supervisor	dr hab. inż. Iwona Kočańska					
	Teachers	dr hab. inż. Iwona Kočańska					
Lesson types and methods of instruction	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	30.0	0.0	30.0	0.0	0.0	60
	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	60		5.0		60.0	125
Subject objectives	<i>The objective of this course is to expose students with standards, architecture and design methodology of industrial computers, embedded systems and complex digital signal processing systems, and with programming techniques to effectively use the hardware resources of such systems.</i>						

Learning outcomes	Course outcome	Subject outcome	Method of verification
	<p>[K6_W04] knows and understands, to an advanced extent, the principles, methods and techniques of programming and the principles of computer software development or programming devices or controllers using microprocessors or programmable elements or systems specific to the field of study, and organisation of systems using computers or such devices</p>	<p>Student discusses specific requirements for industrial processors and computers used in dedicated real-time systems and the resulting technical solutions. He presents architecture, functionality and performances of industrial computers of PC/104 standard and its extensions, DIMM-PC standard, VMEbus standard, and CompactPCI standard. He lists advantages and disadvantages, and compares standards of industrial computers. He presents general characteristics, architecture, and hardware implementations of real-time multiprocessor systems. He observes and analyzes operation of VMEbus, industrial system with single chip microcontroller. Student knows the basics of embedded systems architecture and capabilities of typical solutions available on the market. Student knows techniques for designing and programming multi-threaded embedded systems and the methodology of software development for embedded systems (HW / SW co-design).</p>	<p>[SW1] Assessment of factual knowledge</p>
	<p>[K6_U06] can analyse the operation of components, circuits and systems related to the field of study, measure their parameters and examine technical specifications</p>	<p>Student is able to analyse proper operation of the embedded system.</p>	<p>[SU1] Assessment of task fulfilment</p>
	<p>[K6_U04] can apply knowledge of programming methods and techniques as well as select and apply appropriate programming methods and tools in computer software development or programming devices or controllers using microprocessors or programmable elements or systems specific to the field of study</p>	<p>Student observes and measures signals in real-time processing systems based on floating-and fixed-point digital signal processors.</p>	<p>[SU1] Assessment of task fulfilment</p>

Subject contents	<ol style="list-style-type: none"> <li>1. Introduction</li> <li>2. Industrial computers of PC/104 standard and its extensions. General characteristic and destination of PC/104 computers</li> <li>3. Mechanical specification of PC/104 computers</li> <li>4. Extension of PC/104 computers to PC/104 Plus standard</li> <li>5. Extension of PC/104 computers to formats EBX and EPIC</li> <li>6. Advantages and disadvantages of systems based on PC/104 standard</li> <li>7. Industrial computers of VMEbus standard. General characteristic of the VMEbus</li> <li>8. Architecture of VMEbus computers</li> <li>9. Interface of computers with VMEbus</li> <li>10. Operations realized on VMEbus</li> <li>11. Mechanical specification of VMEbus computers</li> <li>12. Selected application of VME standard computers</li> <li>13. Industrial computers of CompactPCI standard. General characteristics of the bus</li> <li>14. Techniques of configuration and transmission</li> <li>15. Architecture of CompactPCI computers</li> <li>16. Mechanical specification</li> <li>17. Typical applications</li> <li>18. Processor complex systems of digital signal processing. General characteristics.</li> <li>19. Architecture.</li> <li>20. Methods of hardware implementation of systems based on single-core processors</li> <li>21. Methods of hardware implementation of systems based on multi-core processors</li> <li>22. Multiprocessor systems</li> <li>23. Single Board Computers (SBC). SBC architecture</li> <li>24. SBC communication interfaces</li> <li>25. Comparison of different SBC's</li> <li>26. Embedded operating systems. POSIX standard</li> <li>27. OS for embedded systems</li> <li>28. Kernel and its surroundings in embedded systems</li> <li>29. Process manager. Memory management. Managing the namespace.</li> <li>30. Threads and processes. Methods for thread synchronization. Interprocess communication</li> <li>31. File systems</li> <li>32. Developing software for embedded systems. C++ programming in OS Linux</li> <li>33. Working in integrated Eclipse CDT</li> <li>34. Software cross-compilation for embedded systems</li> <li>35. OpenCV library</li> <li>36. Python programming</li> <li>37. Network programming for embedded systems</li> <li>38. Cloud computing. Communication with the cloud.</li> <li>39. Techniques for efficient use of hardware resources. Methods for code optimization</li> <li>40. Hardware and software techniques power consumption minimalization</li> </ol>		
Prerequisites and co-requisites			
Assessment methods and criteria	Subject passing criteria	Passing threshold	Percentage of the final grade
	Practical exercise	50.0%	50.0%
	Midterm colloquium	50.0%	50.0%
Recommended reading	Basic literature	<ol style="list-style-type: none"> <li>1. Kozielski S., Szczerbiński A. Komputery równoległe, architektura, elementy programowania. WNT Warszawa 1994</li> <li>2. Heath S. Vmebus: a practical companion. Butterworth-Heibemann 1994</li> </ol>	
	Supplementary literature	No requirements	
	eResources addresses	Adresy na platformie eNauczenie:	
Example issues/ example questions/ tasks being completed			
Work placement	Not applicable		

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