



## Subject card

|   |  |  |                        |                                     |  |            |     |
|---|--|--|------------------------|-------------------------------------|--|------------|-----|
| Subject name and code                       | Graphics Systems, PG_00048265  |  |                        |                                     |  |            |     |
| Field of study                              | Informatics, Biomedical Engineering, Biomedical Engineering, Biomedical Engineering  |  |                        |                                     |  |            |     |
| Date of commencement of studies             | February 2022  | Academic year of realisation of subject                  |                        |                                     | 2022/2023  |            |     |
| Education level                             | second-cycle studies   | Subject group  |                        |                                     | Optional subject group<br>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                           | 2  | ECTS credits   |                        |                                     | 2.0  |            |     |
| Learning profile                            | general academic profile   | Assessment form  |                        |                                     | assessment   |            |     |
| Conducting unit                             | Department of Intelligent Interactive Systems -> Faculty of Electronics, Telecommunications and Informatics  |  |                        |                                     |  |            |     |
| Name and surname of lecturer (lecturers)    | Subject supervisor   |  | dr inż. Mariusz Szwoch |                                     |  |            |     |
|   | Teachers   |  | dr inż. Mariusz Szwoch |                                     |  |            |     |
| 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   |                        | 4.0                                 |  | 16.0       | 50  |
| Subject objectives                          | Teaching students: <ul style="list-style-type: none"><li>• fixed and programmable graphics rendering pipeline</li><li>• high- and low-level graphic libraries for open and closed platforms</li><li>• Khronos consortium open graphics rendering standards</li><li>• the latest cross-platform graphics rendering solutions, including Vulkan and SPIR-V</li></ul> |  |                        |                                     |  |            |     |

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| Learning outcomes  | Course outcome  | Subject outcome   | Method of verification  |
|  | [K7_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, making assessment and critical analysis of the prepared software as well as a synthesis and creative interpretation of information presented with it  | Student uses graphics libraries. Student creates graphic applications using OpenGL and Direct3D libraries.  | [SU1] Assessment of task fulfilment<br>[SU4] Assessment of ability to use methods and tools |
|  | [K7_W01] Knows and understands, to an increased extent, mathematics to the extent necessary to formulate and solve complex issues related to the field of study.  | Student describes the structure and the way of use of graphic libraries OpenGL and Direct3D in graphics rendering. Shows the stages of rendering of 3D scenes. Points the differences between fixed and programmable rendering pipeline. Differentiates functions of particular shaders.  | [SW1] Assessment of factual knowledge   |
|  | [K7_U07] can apply advanced methods of process and function support, specific to the field of study   | Student uses graphics libraries. Student creates graphic applications using OpenGL and Direct3D libraries.  | [SU4] Assessment of ability to use methods and tools  |
|  | [K7_U42] can solve engineering and research problems including design, assessment and maintenance of information systems and applications, using experimental methods and management techniques   | Student uses graphics libraries and knows the methods of managing multimedia database. Student creates graphic applications using OpenGL and Direct3D libraries.  | [SU1] Assessment of task fulfilment   |
| [K7_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 | Student describes the structure and the way of use of graphic libraries OpenGL and Direct3D in graphics rendering. Shows the stages of rendering of 3D scenes. Points the differences between fixed and programmable rendering pipeline. Differentiates functions of particular shaders.  | [SW1] Assessment of factual knowledge   |   |
| Subject contents   | 1. Introduction, 2D and 3D graphics in computer systems 2. Graphic library OpenGL - introduction, compatibility, installation, auxiliary libraries 3. OpenGL: primitives, transformations, projections, colours 4. OpenGL: 3D objects modelling, lighting, materials 5. OpenGL: textures, buffers, special effects 6. Fixed and programmable rendering pipelines and GPUs 7. Programmable vertex and fragment/pixel shaders 8. Shading languages basing on CPU and GPU, assembler 9. Shading languages Cg/HLSL 10. Shading language GLSL 11. Vulkan and DirectX12 graphics libraries 12. Multimedia library DirectX - introduction, compatibility, components, installation, SDK 13. DirectX architecture, .X format, graphics rendering pipeline, 3D scene rendering 14. DirectX 3D scene creation: views, primitives, objects, lighting, texturing 15. Graphics libraries for mobile devices: OpenGL ES |   |   |
| Prerequisites and co-requisites  |   |   |   |
| Assessment methods and criteria  | Subject passing criteria  | Passing threshold   | Percentage of the final grade   |
|  | Practical exercise  | 51.0%   | 50.0%   |
|  | Exam  | 51.0%   | 40.0%   |
|  | Activity/presence   | 51.0%   | 10.0%   |
| Recommended reading  | Basic literature  | <ol style="list-style-type: none"> <li>R.S. Wright jr, M.Sweet: OpenGL. Księga eksperta, Helion, Gliwice 1999</li> <li>Strona ARB/Khronos: <a href="http://www.opengl.org">http://www.opengl.org</a></li> <li>K. Dempski: DirectX. Rendering w czasie rzeczywistym, Helion, Gliwice</li> <li>2003. J.Sanchez,M.Canton: Direct3D.Biblia, Helion, Gliwice2000</li> <li>D.Wolff: OpenGL 4 Shading Language Cookbook - Third Edition, Packt Publishing 2018</li> <li>R.Madsen, S.Madsen: OpenGL Game Development By Example, Packt Publishing 2016</li> <li>P.Singh: OpenGL ES 3.0 Cookbook, Packt Publishing 2015</li> <li>P.Lapinski: Vulkan Cookbook, Packt Publishing 2017</li> </ol> |   |
|  | Supplementary literature  | No requirements   |   |
|  | eResources addresses  |   |   |

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| Example issues/<br>example questions/<br>tasks being completed |                |
| Work placement   | Not applicable |