

## Subject card

|                                             |                                                                                                                                                                                                                                                                                       |                                                          |                                         |                                     |                        |            |     |
|---------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------|-----------------------------------------|-------------------------------------|------------------------|------------|-----|
| Subject name and code                       | Computer graphics for mathematicians, PG_00161250                                                                                                                                                                                                                                     |                                                          |                                         |                                     |                        |            |     |
| Field of study                              | Mathematics                                                                                                                                                                                                                                                                           |                                                          |                                         |                                     |                        |            |     |
| Date of commencement of studies             | October 2024                                                                                                                                                                                                                                                                          |                                                          | Academic year of realisation of subject |                                     | 2024/2025              |            |     |
| Education level                             | postgraduate studies                                                                                                                                                                                                                                                                  |                                                          | Subject group                           |                                     | Optional subject group |            |     |
| 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                            |                                     | 6.0                    |            |     |
| Learning profile                            | academic                                                                                                                                                                                                                                                                              |                                                          | Assessment form                         |                                     |                        |            |     |
| Conducting unit                             | Zaklad Geometrii -> Instytut Matematyki -> Faculty of Mathematics, Physics and Informatics -> Rektor                                                                                                                                                                                  |                                                          |                                         |                                     |                        |            |     |
| Name and surname of lecturer (lecturers)    | Subject supervisor                                                                                                                                                                                                                                                                    |                                                          | dr Michał Jabłonowski                   |                                     |                        |            |     |
|                                             | Teachers                                                                                                                                                                                                                                                                              |                                                          |                                         |                                     |                        |            |     |
| Lesson types                                | Lesson type                                                                                                                                                                                                                                                                           | Lecture                                                  | Tutorial                                | Laboratory                          | Project                | Seminar    | SUM |
|                                             | Number of study hours                                                                                                                                                                                                                                                                 | 30.0                                                     | 30.0                                    | 0.0                                 | 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                                                       |                                         | 10.0                                |                        | 80.0       | 150 |
| Subject objectives                          | The aim is to present the knowledge and basic mathematical and IT tools used in computer graphics and needed to understand it; during laboratory exercises, the aim is to familiarize yourself with the Blender program, which will be used to complete a short math-related project. |                                                          |                                         |                                     |                        |            |     |

| Learning outcomes | Course outcome                                                                                                                                                                                                                                                                               | Subject outcome                                                                                                                                                  | Method of verification                                                                                      |
|-------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------|
|                   | [MATMU2_W01] knows and understands in-depth the theory of selected areas of mathematics                                                                                                                                                                                                      | Not applicable.                                                                                                                                                  | [SW1] oral statement/<br>conversation/discussion                                                            |
|                   | [MATMU2_U07] is able to define his/her interests and develop them; in particular, is able to establish contact with specialists in his/her field, e.g. understand their lectures intended for young mathematicians                                                                           | Not applicable.                                                                                                                                                  | [SU8] observation of student's independent or team work                                                     |
|                   | [MATMU2_U03] can understand mathematical texts of various types from selected fields of mathematics                                                                                                                                                                                          | Not applicable.                                                                                                                                                  | [SU8] observation of student's independent or team work                                                     |
|                   | [MATMU2_K06] is ready to formulate opinions on basic mathematical issues                                                                                                                                                                                                                     | Not applicable.                                                                                                                                                  | [SK8] observation of student's independent or team work                                                     |
|                   | [MATMU2_U01] can construct mathematical reasoning: prove theorems and refute hypotheses through construction and selection of counterexamples                                                                                                                                                | Not applicable.                                                                                                                                                  | [SU8] observation of student's independent or team work                                                     |
|                   | [MATMU2_K01] is willing to acknowledge the limitations of his or her own knowledge and is willing to pursue further education                                                                                                                                                                | The student is able to independently search for information in the literature/<br>Internet.                                                                      | [SK8] observation of student's independent or team work                                                     |
|                   | [MATMU2_U05] can perform proofs in a selected field and, if necessary, also use tools from other areas of mathematics                                                                                                                                                                        | Not applicable.                                                                                                                                                  | [SU8] observation of student's independent or team work                                                     |
|                   | [MATMU2_U06] is able to apply methods and examples from a selected field of mathematics in related fields                                                                                                                                                                                    | The student is able to prepare an animated, dynamic 3D scene showing or using a selected mathematical issue. Then it can be saved as a movie in a given quality. | [SU2] presentation/project/paper/<br>report<br>[SU6] demonstration of practical skills                      |
|                   | [MATMU2_K02] is ready to precisely formulate questions to deepen his/her understanding of a given topic or find missing elements of reasoning                                                                                                                                                | The student is ready to precisely formulate questions to deepen understanding of a given topic.                                                                  | [SK1] oral statement/conversation/<br>discussion                                                            |
|                   | [MATMU2_W03] knows and understands in-depth a selected field of theoretical or applied mathematics and is able to understand the formulations of issues in this field that are still at the research stage and knows the connections of issues in this field with other areas of mathematics | The student has extended and deepened knowledge of mathematics regarding formulating and solving tasks/problems related to computer graphics.                    | [SW4] test/exam - oral or written                                                                           |
|                   | [MATMU2_K05] is ready to independently search for information in literature, also in foreign languages                                                                                                                                                                                       | The student is able to independently search for information in the literature/<br>Internet.                                                                      | [SK2] presentation/project/paper/<br>report                                                                 |
|                   | [MATMU2_U04] is able, at an advanced level and including modern mathematics, to apply and present, orally and in writing, methods of at least one selected branch of mathematics                                                                                                             | Not applicable.                                                                                                                                                  | [SU8] observation of student's independent or team work                                                     |
|                   | [MATMU2_W02] knows and understands well the role and importance of the construction of mathematical reasoning                                                                                                                                                                                | Not applicable.                                                                                                                                                  | [SW1] oral statement/<br>conversation/discussion                                                            |
|                   | [MATMU2_K04] is ready to understand and appreciate the importance of intellectual honesty in one's own and other people's actions; ethical conduct                                                                                                                                           | The student is ready to understand and appreciate the importance of intellectual honesty in his own and other people's actions; ethical conduct.                 | [SK1] oral statement/conversation/<br>discussion<br>[SK8] observation of student's independent or team work |

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|---------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------|
| Subject contents                | 1. Modeling and modifying solids and surfaces, polygonal meshes.<br>2. Projections, view and camera movement.<br>3. Lighting models, shading methods.<br>4. Transformation matrices: scaling, shifts, rotations, reflections.<br>5. Material properties, texturing.<br>6. Applications of algebra in 3D graphics, including quaternions.<br>7. Interpolation curves, motion curves.<br>8. Animation using keyframes.<br>9. Rendering, ray tracing, sampling.<br><br>Elements of physics simulation. |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                               |
| Prerequisites and co-requisites | Linear algebra course.                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                               |
| Assessment methods and criteria | Subject passing criteria                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Passing threshold                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Percentage of the final grade |
|                                 | observation of the student's attitude                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 100.0%                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 0.0%                          |
|                                 | project and its quality                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 51.0%                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 70.0%                         |
|                                 | exam                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 51.0%                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 30.0%                         |
| Recommended reading             | Basic literature                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | <b>A.1.</b> <ul style="list-style-type: none"><li>S. Marschner and P. Shirley, Fundamentals of Computer Graphics, CRC Press 2022.</li><li>J. Blain, The complete guide to Blender Graphics. Computer Modeling &amp; Animation , CRC Press 2021.</li></ul> <b>A.2.</b> <ul style="list-style-type: none"><li>P. Chlipalski, Blender : architektura i projektowanie, Helion 2018.</li><li>F. Dunn and I. Parberry, 3D Math Primer for Graphics and Game Development, 2011.</li></ul> |                               |
|                                 | Supplementary literature                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | <ul style="list-style-type: none"><li>S. Gortler, Foundations of 3D Computer Graphics, The MIT Press 2012.</li><li>B. Simonds, Blender : praktyczny przewodnik po modelowaniu, rzeźbieniu i renderowaniu, Helion 2014.</li><li>A. Brito, Blender 3. The beginners guide, 2022.</li></ul>                                                                                                                                                                                           |                               |
|                                 | eResources addresses                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Adresy na platformie eNauczanie:                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                               |
|                                 | Example issues/<br>example questions/<br>tasks being completed                                                                                                                                                                                                                                                                                                                                                                                                                                      | n/a                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                               |
| Work placement                  | Not applicable                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                               |

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