# General Informations:

**Curriculum:** Architecture Bsc

**Name of Course: Mathematics 1**

**Course Code:** EPE075AN

**Semester:** 2023/24/1

**Number of Credits:** 4

**Allotment of Hours per Week:** 2/2/0

**Evaluation:** examination grade

**Prerequisites: -**

Course director: Ildikó Perjési-Hámori dr., associate professor

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Instructors: Péter Szabó, assistant lecturer

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## General Course Description

This lecture- and practical-based course aims to give architect students a solid mathematical backgroung in the theory of geometric transformations, enabling them to interpret and understand architectural sciences. During the course, students learn to apply matrix computations in parallel to the visualization of transformations. They further deepen their basic theoretical knowledge in the field of architecture through solving practical exercises.

## Learning Outcomes

The lectures give some elements of important mathematical techniques that are used in an architect’s practice. Upon completion of this course, the student should be able to: interpret, and put into practice

1. Constructing the golden ratio
2. Using vectorial products and matrix multiplication
3. Using inhomogeneous and homogeneous coordinates
4. Plot objects with infinitely far points in a projective coordinate system
5. Describe transformations in the projective plane in matrix form

## Subject content

Lecture:

* Golden ratio
* Vectors and vector operations
* Linear independence, basis, coordinates
* Operations with matrices, determinant
* Euclidean, affine and projective geometry of the plane; group of similarity, affine and projective transformations
* Construction of the projective plane, ideal elements
* Introducing homogeneous coordinates
* Matrix of linear transformations and their application
* Analytic description of congruency, similarity, affine and projective transformations of the plane
* Analytic description of congruency, similarity, affine and projective transformations of the 3D space

Practice: the weekly practice classes closely follow the topics of the lecture with corresponding exercises.

**Examination and evaluation system**

*In all cases. Annex 5 of the Statutes of the University of Pécs, the* ***Code of Studies and Examinations (CSE)******of the University of Pécs*** *shall prevail*

[*https://international.pte.hu/sites/international.pte.hu/files/doc/TVSZ%202022\_06\_23\_ENG.pdf*](https://international.pte.hu/sites/international.pte.hu/files/doc/TVSZ%202022_06_23_ENG.pdf)

**Attendance**

In accordance with the Code of Studies and Examinations of the University of Pécs, Article 45 (2) and Annex 9. (Article 3) a student may be refused a grade or qualification in the given full-time course if the number of class absences exceeds 30% of the contact hours stipulated in the course description.

Method for monitoring attendance: attendance sheet

**Assessment**

2 mid-term tests in the study period, written exam in the exam-period. One-time retake for both tests. Proposed final grade.

**Mid-term assessments, performance evaluation and their weighting as a pre-requisite for taking the final exam**

|  |  |  |
| --- | --- | --- |
| **Type** | **Assessment** | **Ratio in the mid-term performance** |
| *Test 1* | *max 45 points* | *50%* |
| *Test 2* | *max 45 points* | *50%* |

**Requirements for the end-of-semester signature**

Grading will follow the course structure with the following details:

The two midterm tests account for 50-50% in the evaluation of the mid-term performance. At least 40% midterm performance is required for the end-of-semester signature. Only students with signature can get a final grade.

***Re-takes for the end-of-semester signature*** *(PTE CSE 50§(2))*Each test can be repeated/improved once in the first two weeks of the examination period.The score of the retake will overwrite the score of the corresponding test.

***Exam and proposed final grade***

Only students with signature (i.e., at least 40% mid-term performance) can get a final grade. Students with signature get a proposed final grade based on their mid-term performance (see the calculation of the grade below). Students, who accept their proposed grade in Neptun ES do not have to take the exam!

Students, who do not accept the proposed grade can get a final grade by registering for an exam in Neptun ES.

**Type of examination** (written, oral): written

The exam is successful if the result is minimum 40%.

**Calculation of the final grade (PTE CSE 47§ (3))**

The mid-term performance accounts for 50%, the performance at the exam accounts for 50% in the calculation of the final grade.

**Calculation of the final grade based on aggregate performance in percentage**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Grade: | 5 | 4 | 3 | 2 | 1 |
|  | A, excellent | B, good | C, satisfactory | D, pass | F, fail |
| Performance in % | 85%-100% | 70%-84% | 55%-69% | 40%-54% | 0-39% |

## Readings and Reference Materials

**Required:**

[1.] Enikő Dinnyés and Ferenc Kárpáti: Mathematics for Architects I – Basis of Visualization. Digital lecture notes. PTE MIK Mérnöki Matematika Tanszék, Pécs

**Recommended:**

[2.] Golden Ratio – Slides (available in Microsoft Teams)

## Methodology

The course is structured in a way that helps the students to internalise the basics of geometric planning and to become familiar with the abstract mathematical framework (three-way divion of geometries by Klein) that can be used later in concrete planning and modeling tasks. We put great emphasis to improving individual problem-solving and spacial visualization skills. At first, each topic is presented from a theoretical viewpoint and then unfolded through a wide variety of geometric applications. The presentations give an introduction to important mathematical techniques of exercise solving and the basic theory of geometric transformations. Equal emphasis is given to learning new mathematics and to learning how to construct and write down correct mathematical arguments.

1. In lectures: the theoretical background of the topic is presented to the students and illustrated with examples

2. In practices: the students individually solve different exercises corresponding to the applications of the theory, then, the solutions are discussed together and further explained by the lecturer

3. On-demand consultations in person or in groups

## Students with Special Needs

Students with a disability and needs to request special accommodations, please, notify the Deans Office. Proper documentation of disability will be required. All attempts to provide an equal learning environment for all will be made.

*Detailed requirements and schedule of the Course*

## Schedule

Study period: 13 weeks (4 September - 2 December 2023)

Test 1: 11 October 2023 (6th week, during practice class)

Test 2: 22 November 2023 (12th week, during practice class)

Retake of Tests: in the 1st week of the exam period (4-8 December 2023)

Exams: in the exam period that starts on (4-22 December 2023, 8-18 January 2024)

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| Lecture  |
| week | **Topic** | **Compulsory reading; page number****(from … to …)** | **Required tasks (assignments, tests, etc.)** | **Completion date, due date** |
| 1. | Golden ratio, vector operations | [1] 2-4, [2] 1-31 | - | 06.09.2023 |
| 2. | Linear independence, basis, coordinates | [1] 4-5 | - | 13.09.2023 |
| 3. | Scalar-, vectorial- and mixed product of vectors  | [1] 5-6 | - | 20.09.2023 |
| 4. | Matrices and matrix operations  | [1] 7-10 | - | 27.09.2023 |
| 5. | Determinant and its geometric applications | [1] 10-11 | - | 04.10.2023 |
| 6. | Geometric systems, Euclidean, affine and projective geometry of the plane, Pappus’s theorem | [1] 12-20 | - | 11.10.2023 |
| 7. | Construction of the projective plane, ideal (infinitely far) points | [1] 22-24 | - | 18.10.2023 |
| 8. | No lecture (National holiday) |  | - | 25.10.2023 |
| 9. | Linear transformations of the plane and their analytic description using inhomogeneous coordinates | [1] 21-22, 26-27 | - | 01.11.2023 |
| 10. | Homogeneous coordinates in the plane, homogeneous matrix of a shape | [1] 23-27 | - | 08.11.2023 |
| 11. | Identity, central similarity, simple shear, translation, rotation, reflection and their matrices in the plane, analytic description of affine and projective transformations in the plane | [1] 27-40 | - | 15.11.2023 |
| 12. | End-of-term test | - | End-of-term test | 22.11.2023 |
| 13. | Inhomogeneous coordinates, congruency and similarity transformations and their matrices in the 3D space; analytic description of the affine and projective transformations of the 3D space | [1] 41-50 | - | 29.11.2023 |

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| Practice |
| week | **Topic** | **Compulsory reading; page number****(from … to …)** | **Required tasks (assignments, tests, etc.)** | **Completion date, due date** |
| 1. | Golden ratio, vector operations,  | [1] 2-4, [2] 1-31 | - | 06.09.2023 |
| 2. | Linear independence, basis, coordinates | [1] 4-5 | - | 13.09.2023 |
| 3. | Scalar-, vectorial- and mixed product of vectors  | [1] 5-6 | - | 20.09.2023 |
| 4. | Matrices and matrix operations  | [1] 7-10 | - | 27.09.2023 |
| 5. | Determinant and its geometric applications | [1] 10-11 | - | 04.10.2023 |
| 6. | Midterm test | - | Midterm test | 11.10.2023 |
| 7. | Geometric systems, Euclidean, affine and projective geometry of the plane, Pappus’s theorem | [1] 12-20 | - | 18.10.2023 |
| 8. | No lecture (National holiday) | [1] 22-24 | - | 25.10.2023 |
| 9. | Construction of the projective plane, ideal (infinitely far) points |  | - | 01.11.2023 |
| 10. | Linear transformations of the plane and their analytic description using inhomogeneous coordinates | [1] 21-22, 26-27 | - | 08.11.2023 |
| 11. | Homogeneous coordinates in the plane, homogeneous matrix of a shape | [1] 23-27 | - | 15.11.2023 |
| 12. | Identity, central similarity, simple shear, translation, rotation, reflection and their matrices in the plane, analytic description of affine and projective transformations in the plane | [1] 27-40 | - | 22.11.2023 |
| 13. | Inhomogeneous coordinates, congruency and similarity transformations and their matrices in the 3D space; analytic description of the affine and projective transformations of the 3D space | [1] 41-50 | - | 29.11.2023 |

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 course director

Pécs, 31.08.2023