Syllabus

Term:	2021/22/1	**Subject name:**	Mathematics for Civil Engineering	**Subject code:**	MSM083ANEP

Unit (Unit code) (MIK-MS)

Lecturer responsible for the course: PILGERMÁJER Ákos
Requirement: Exam
Classes per week : 2/1/0/0
Classes per term: 14/7/0/0

Purpose of education:

After the necessary and intuitive theoretical introduction some typical examples are discussed and solved by paper and pencil followed by more difficult or simply just much bigger ones where certain software must be used for numerical computations. Some of those numerically efficient methods are discussed. At the end of each topic students should have the appropriate mathematical knowledge to identify, compare and choose the appropriate from the known methods and then correctly apply, interpret them.

Contents:

Planned weekly schedule

1. Define the concept of a linear space, (linear) subspace, span, linear (in)dependency of vectors, basis, dimension. Examples of frequently used linear spaces.

2. Define orthogonality, normalization, orthonormal basis, orthogonal projection in general linear spaces. Orthogonal complement, direct sum. Describe and compute Gram-Schmidt orthogonalization method.

3. Identify special matrix classes (diagonal, diagonally dominant, band, triangular, symmetric, hermitian, orthogonal, normal), rearrange matrices into appropriate forms. Compute determinants.

4. Define and identify important mathematical structures used in many fields of numerical methods, like inner product (Hilbert), normed (Banach), metric spaces. Give typical examples of them and show the connection among them.

5. Solve linear systems by Gauss-Jordan method, explain the structure of solutions. Investigate sensibility of linear systems. Solve LS by iterative methods (Jacobi, Gauss-Siedel), comparison by usability, convergence.

6. Compute eigenvalues, eigenvectors of matrices. Diagonalize them. Practicing for the first assessment.

Contents:

7. First mid term test in time of laboratory classes.

8. Autumn break.

9. Solve non-linear equations by fix point iteration, Newton-Raphson method. Elements of approximation (interpolation) theory, function sequences, ~ series. Taylor-, Fourier-series and their application: Lagrange, Hermite, spline, Fourier interpolations. Approximation by least squares method, highlight its minimum property.

10. Numerical differentiation, integration. Apply Picard-iteration, Taylor series expansion to first order ordinary differential equations (ODEs).

11. Apply Euler's, Heun's, Runge-Kutta's methods to first order ordinary differential equations (ODEs).

12. Solve second order ODEs with Euler's method and using finite differences.

13. Classify partial differential equations, solve them by separation on appropriate meshes, give analytic solutions in special examples and numerical solutions by means of central differences.

14. Practicing for the second assessment.

15. Lecture: summary of the course, preparation for the final exam. Second mid term test in time of laboratory classes.

System of examing and valuation:

Attendance

As we face COVID-19 pandemic, in this semester attendance is regulated in a slightly differernt way. The Student has to attend all classes online or in person, which can be examined by the instructor in any randomly chosen time during the sessions. 70% of the (online) classes must be visited.

~~Attending is required all classes, and will impact the grade (max. 10%). Unexcused absences will adversely affect the grade, and in case of absence from more than 30% of the total number of lessons (five or more~~

System of examing and valuation:

~~absences) implies that you fail the course with no further excuse. To be in class at the beginning and stay until the scheduled end of the lesson is required, tardiness of more than 15 minutes will be counted as an absence.~~

Evaluation + Grading

Each student earns the **course signature** if and only if the weighted average in percent of its **midterm tests** (separately must be at least 40%) and the **homeworks** in sum reaches 50%. This summary percentage is called the **midterm result**:

midterm result % = 0.7*(midterm tests %)+0.3*(homeworks %)

Only those who have course signature can take **exams** (at most three in the exam period) for which one must register in advance in Neptun.

If each midterm tests are better than 72% at first and the student earned the course signature, then I offer the final mark as the midterm result. Call this **offered grade**.

If one cannot earn an offered grade or does not accept it, but has course signature, then takes an exam (successful if is at least 50%).

The **final mark** - in case of exams - will be calculated as the arithmetic average of the exam result and the midterm result as stated in grading scale table below.

Grading Scale:

Numeric Grade:	5	4	3	2	1
Result (%):	[85;100]	[72;85)	[60;72)	[50;60)	[0;50)

System of examing and valuation:

Description of the awarded grades

Mark 5: Outstanding work. Execution of work is thoroughly complete and demonstrates a superior level of achievement overall with a clear attention to details. The student is able to synthesize the course material with new concepts and ideas in a thoughtful manner, and is able to communicate and articulate those ideas in an exemplary fashion.

Mark 4: High quality work. Student work demonstrates a high level of craft, consistency, and thoroughness throughout its work. The student demonstrates a level of thoughtfulness in addressing concepts and ideas, and participates in group discussions. Work may demonstrate excellence but less consistently than above at grade '5'.

Mark 3: Satisfactory work. Student work addresses all of the assignment objectives with few minor or major problems.

Mark 2: Less than satisfactory work. Overall work is substandard, incomplete in significant ways, and lacks craft and attention to detail.

Mark 1: Unsatisfactory work. Work exhibits several major and minor problems with basic conceptual premise, lacking both intention and resolution. Overall the assignments are severely lacking, and is weak in clarity, craft and completeness.

Bibliography:

- Elementary Linear Algebra, application version – 11th edition, Howard Anton, Chris Rorres, Wiley, 2014

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Bibliography:

- Young, T., Mohlenkamp, M. J. (2018): Introduction to Numerical Methods and Matlab Programming for Engineers. Ohio: Department of Mathematics, Ohio University, http://www.ohiouniversityfaculty.com/youngt/IntNumMeth/book.pdf

- TEXTBOOK: NUMERICAL METHODS WITH APPLICATIONS, Autar K Kaw, Egwu E Kalu, Duc Nguyen link. Access the website here for much more learning material

- Corresponding virtual space in Moodle or M$ Teams