General Information

Name of Course:	**LARGE-SCALE LINEAR SYSTEMS OF EQUATIONS**
Course Code:	IVM326ANMI
Semester:	**Computer Science Engineering Msc 1st**
Credit Units:	4
Allotment of Hours per Week:	2 Lecture Lessons /Week, 2 Practical Lessons /Week
Evaluation:	2 midterm tests (with grade) and a homework
Prerequisites:	**None**

Instructors: **Dr Mihály KLINCSIK, professor**
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Introduction, Learning Outcomes:

The aim of the course is to introduce the direct and iterative solvers of large scale system of linear equations for students. Furthermore the most modern solution techniques are also discussed, for example: multigrid, domain decomposition. Basic concepts of linear algebra, matrices, discretization of partial differential equations, sparse matrices, iterative solvers, Jacobi, Gauss-Siedel, relaxation methods, Convergence, projection, Krylov method, Arnoldi method, GMRES, Conjugate gradient method, preconditioning, parallel implementations, parallel preconditioning, multigrid methods, Schur complement, domain decomposition.
The students can solve successfully one homework using Maple Computer algebra system and 2 written midterm tests.

Prerequisites
To understand and apply concepts of large-scale linear systems of equations need to know basic linear algebra concepts.

General Course Description and Main Content:

Subject "Large-scale linear systems of equations" includes the following topics

- Summary of basic linear algebra concepts: vector and matrix norms, determinant, eigenvalues.
- Spares matrices, graph representation of matrices
- Compression of storage of sparse matrices
- Discretization of differential equations
- Basic iterative methods: Jacobi, Gauss-Seidel and relaxation.
- Convergence considerations. Krylov method, Arnoldi method.
- Steepest descent and gradient method.
- Conjugate gradient method
- Preconditioning of conjugate gradient
- Multigrid-methods, parallel executions

Methodology:

The course gives an introduction to important mathematical techniques of exercise solving problems from large-systems of linear equations and understands the basic theory with and without using Maple computer algebra software. Equal emphasis is given to learning new mathematics concepts and to learning how to construct and write down correct linear algebraic arguments.
A graphing calculator with matrix capabilities is highly desirable. Students will use MAPLE program at class and homework which is available on campus computers.

Schedule:

week	Topics	Homework, Quizes
1.	Summary of basic linear algebra concepts: vectors and matrices, norms, determinant, eigenvalues.	
2.	Spares matrices, graph representation of matrices	
3.	Discretization of differential equations	
4.	Basic iterative methods: Jacobi, Gauss-Seidel	
5.	Relaxation methods	
6.	Convergence considerations	
7.	Projection methods: Krylov and Arnoldi methods.	.
8.	**1. Midterm written test**	**1. Midterm test**
9.	**Spring holiday**	
10.	Steepest descent method and Gradient method	
11	Conjugate gradient method	**Homework & Quizes**
12.	Preconditioning	
13.	Multigrid-methods	
14.	Schur-complement, domain decomposition. Parallel computations.	
15.	**2. Midterm written test**	**2. Midterm written test**

Attendance:

Attending is required all classes, and will impact the grade (max. 5%).. Unexcused absences will adversely affect the grade, and in case of absence from more than 30% of the total number of lesson will be grounds for failing the class. To be in class at the beginning time and stay until the scheduled end of the lesson is required, tardiness of more than 20 minutes will be counted as an absence. In the case of an illness or family emergency, the student must present a valid excuse, such as a doctor's note.

Evaluation + Grading

1. Midterm test with weighting factor 40%
2. Midterm test with weighting factor 40%
Homework with weighting factor 20%

1. Satisfactory work: Achieving more than 40% of the total points in the homework and together with 2 written test2 then the grading scale table will be applied to obtain the final result.
2. Unsatisfactory work: When the total points of the written tests are less than 40% then a new test need to write from the whole topics of the semester in the exam period. A minimum of 40% is required to pass on this exam.

Grading Scale table:

Numeric Grade:	excellent (5)	good (4)	satisfactory (3)	pass (2)	fail (1)
Evaluation in percentages:	[85%,100%]	[70%,85%)	[55%,70%)	[40%,55%)	[0%,40%)

PTE Grading Policy:
Information on PTE's grading policy can be found at the following location:

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.

Readings and Text books:

[1] Y. Saad, Iterative methods for sparse linear systems, SIAM, 2nd ed.(2003)
[2] W. Auzinger, Iterative Solution of Large Linear Systems, Wien, 2011.
[3] C. Vuik and D.J.P. Lahaye, Scientific Computing, Delft University of Technology, Netherlands (2017)

Materials are found on platform of Neptun https://neptun.pte.hu/ login as student.