

Obuda University John von Neumann Faculty of Informatics			Institute of Applied Mathematics		
Name and code: Applied Mathematics NMXAM1EMNE				Credits: 5	
Computer Engineering MSc			2021/22 year I. semester		
Subject lecturers: Ágnes Záborszky					
Prerequisites (with code):		none			
Weekly hours:	Lecture: 3	Seminar: 1	Lab. hours: 0	Consultation: 0	
Way of assessment:	Written exam				
Course description:					
Goal: Acquisition of basic mathematical material of MSc level.					
Course description: Elements of number theory, fields, systems of linear equations, matrices and their decompositions, determinants, linear spaces.					

Lecture schedule	
<i>Education week</i>	<i>Topic</i>
1.	Review of differential calculus
2.	Prime numbers, fundamental theorem of number theory, Euler's totient function ϕ , prime tests, cryptography. Properties of congruence, linear congruences.
3.	Properties of fields, various fields of characteristic 0 and their generation. Finite fields. Calculations in finite fields.
4.	Determinants (over arbitrary fields), Laplace expansion formula, determinants of special kind, effect of row operations on determinants. Skew expansion. Notion of a matrix, matrix operations.
5.	Properties of matrix operations, special matrices. Notion of the inverse of a matrix, existence condition, method of its computation. Systems of linear equations, row and column model.
6.	Cramer rule, equivalent systems of equations, notion of the coefficient matrix and the extended matrix, elementary operations, Gaussian elimination, (reduced) row echelon form. Relation with the elementary matrices, LU decomposition.
7.	Condition of solvability, number of solutions. Homogeneous systems of linear equations, and their solutions. Relation of homogeneous and nonhomogeneous systems. Midterm test 1.
8.	Solutions as vectors. Space of n-dimensional column vectors. Notion of a vector space. Linear combinations, linear independence. Official holiday
9.	Rank of a vector system, subspace, basis, dimension. Linear transformations and their matrices. Matrices of reflections and projections. Linear transformations and matrix operations.
10.	Notion of kernel and image. Determination of a basis of kernel and image. Fundamental theorem of linear algebra. Eigenvalues and eigenvectors. Characteristic polynomial.
11.	Number of eigenvalues, algebraic and geometric multiplicity. Diagonalisability. Symmetric matrices, spectral theorem.
12.	Orthogonality, orthonormal bases. Gram-Schmidt orthogonalisation.
13.	Review of the material, Midterm test 2.
14.	Singular value decomposition. Test retake.

Midterm requirements

Students are required to write two mid-term tests of 50 points. One of the tests can be retaken at the test retake.

Test retake is

- **compulsory** for those who missed one of the tests, otherwise they will be **banned** from further exams;
- **optional** for those who have written both tests but would like to achieve better grade. In this case the test with the lower score can be retaken, and its result will replace the original score (no matter if it is lower).

Students receive the end-term signature (and thus have the right to take the exam), if they have written the two tests, their overall score is at least 50, and their absence from classes does not exceed the allowed 30%.

Attendance at classes is compulsory. If absence exceeds the 30% of the total number of lessons, the student is banned from exams, teacher's signature is rejected and the student is not allowed to write the signature retake exam described below. In this case the student gets a "banned" entry in their credit book.

Mid-term papers

Education week

7	1 st test
13	2 nd test
14	test retake

Signature retake exam

In case the student has written both mid-term papers, but their result is under 50%, and their absence at classes does not exceed the 30% of the total number of lessons, they have one opportunity to write a paper covering the whole course material in the exam-period. Students can register for the signature retake through the Neptun system after paying the appropriate registration fee. The test contains simple questions and students need to achieve at least 50% of the scores for the end-term signature

Examination

The examination is written. The test contains theoretical questions and calculation exercises of the overall course material (altogether 70 points max). If the student does not reach at least 50% of the maximum score, the result is fail (1). Otherwise, 30% of their mid-term test result will be added to the exam score, thus a total 100 points can be achieved. In case the student fulfilled the signature requirements at the signature retake exam, their mid-term score is 15, regardless of the actual score. The final exam grade can be determined by the chart below:

Score	Exam grade
86–100	excellent (5)
74–85	good (4)
62–73	satisfactory (3)
50–61	pass (2)
0–49	fail (1)

Literature

<http://elearning.uni-obuda.hu/>