Syllabus

Course Description

Course Title	Linear Algebra
Course Code	42195
Course Title Additional	
Scientific-Disciplinary Sector	MATH-03/A
Language	English
Degree Course	Bachelor in Industrial and Mechanical Engineering
Other Degree Courses (Loaned)	
Lecturers	Prof. Giovanni Modanese, Giovanni.Modanese@unibz.it https://www.unibz.it/en/faculties/engineering/academic-staff/person/494
Teaching Assistant	
Semester	First semester
Course Year/s	1
CP	6
Teaching Hours	47
Lab Hours	13
Individual Study Hours	90
Planned Office Hours	18
Contents Summary	- Vector spaces - Geometry of space - Matrices - Linear systems - Determinant and rank - Linear transformations
Course Topics	Vector spaces: operations in , and their properties. Vector space axioms. Linear combination. Basis. Spaces R2, R3, Rn. Standard basis. Scalar product and norm in Rn.

	Geometry of space. Vector product, mixed product: geometrical definition, computation in components, properties. Cartesian equation of a plan in space. Cartesian and parametric equation of a straight line in space. Non-intersecting lines. Distance plane-to-point. Distance between planes, distance between non-intersecting lines. Matrices. Definitions and operations. Vector space structure. Basis in Mm,n(R). Product. Inverse matrix, transpose matrix and their properties. Linear systems. Matrix form, homogeneous case. Dimension of the solution space, Gauss triangulation method. Linear dependence and independence of vectors. Determinant and rank. Recursive definition, Laplace rule, properties. Computation of inverse matrices. Rank of a matrix: definition through determinants and linearly independent vectors. Linear transformations. Matrix representation. Nucleus, image. Orthogonal matrices. Homothetic and affine transformations. Definition and computation of eigenvalues and eigenvectors of a linear transformation.
Keywords	Vectors spaces, Geometry of space, Matrices, Linear systems, Determinants and rank, Linear transformations
Recommended Prerequisites	Precalculus.
Propaedeutic Courses	
Teaching Format	Frontal lectures and exercises.
Mandatory Attendance	Recommended.
Specific Educational Objectives and Learning Outcomes	The course belongs to the area of core fundamental sciences, specifically to the sector of mathematics, informatics and statistics. It is a mandatory course. It aims at providing students with general scientific contents and method characteristic of (1) Linear algebra of vectors and matrices. (2) Analytical geometry of tridimensional space, with vector methods. The knowledge of these topics is a prerequisite for several other courses, especially Physics, Mathematical Analysis II, Electrotechnics. 1) Knowledge and understanding of concepts, symbolism and

	techniques of linear algebra, analytical geometry of space, complex algebra. 2) Applying knowledge and understanding in solving exercises and problems which require a formalization, tools and methods learned in the course (for example, by solving linear systems, determining the rank and inverse of a matrix, decide whether some vectors are linearly independent, finding the Cartesian and parametric equations of straight lines and planes in space, solving an algebraic equation in the complex field). 3) Making judgments in tackling with the right approach and convenient tools problems and questions suitable to be formulated mathematically. 4) Communication skills in reporting on the calculations in a clear and effective way. This is also essential for the student to be able to check his/her own results and overcome deadlocks in the resolution procedure. 5) Learning skills through the acquisition and assimilation of a symbolism, methods and tools which are necessary to understand the content of a consistent part of the courses in this academic curriculum.
Specific Educational Objectives and Learning Outcomes (additional info.)	
Assessment	Written exam, consisting in 8-10 exercises containing various specific questions. - Summative assessment: 100% written exam: 3 hours; ILOs assessed: 1 - 5. With reference to Learning Outcomes 1-5, the assessment is based on the following points: 1) The student must understand the questions and place them exactly in the context of the theory explained in the course. 2) The student must solve the exercises and arrive at the correct result, thus applying the knowledge and understanding of the course issues. 3) The student must describe the calculations which lead to the final result, thus proving the ability of making judgments, this being evidenced by the choice of suitable solving methods. 4) The clarity and completeness of the description allows and evaluation of communication skills.

	5) Altogether, the way in which the written examination is worked out allows to assess the learning skills of the student; in particular, it allows to see whether the student masters all the program, or some sections are missing.
Evaluation Criteria	The evaluation is expressed through a unique mark. For the exam to be passed, the mark has to be greater or equal to 18/30. Relevant for assessment are: the identification of a suitable solution method, the knowledge of formulae and/or tools to apply and/or use, the logic and clarity of the arguing, the ability to correctly complete exercises, the number of exercises solved.
Required Readings	Geza Schay, A concise introduction to linear algebra, Birkhauser, 2012; e-ISBN 978-0-8176-8325-2 (free personal copy can be downloaded from the Library).
Supplementary Readings	Günter M. Gramlich, „Lineare Algebra: Eine Einführung“, Carl Hanser Verlag. M. Abate, “Geometria”, McGraw-Hill. M. Abate, “Algebra lineare”, McGraw-Hill.
Further Information	
Sustainable Development Goals (SDGs)	Quality education